VISION OF DEPARTMENT OF ELECTRONICS ENGINEERING:

The Department of Electronics Engineering is committed to produce globally competitive and socially sensitized graduates in Electronics & Communication Engineering. We seek to instill the spirit of creativity and leadership skills enabling the students to make a global impact towards the availability of technology to mankind from all walks of life.

MISSION OF DEPARTMENT OF ELECTRONICS ENGINEERING

- To impart high quality technical education to students from socially and economically diverse backgrounds
- Give solid foundation on Mathematical skills and allied fields of Electronics & Communication
- To produce students with technical competence to design sophisticated systems in Electronics & Communication
- To make high quality research contribution in the field of Electronics, Communication, Networking, VLSI & Signal Processing
- To collaborate with industries in Electronics & Communication in the indigenous product development
- To inculcate qualities of leadership and entrepreneurship in students
- To facilitate adequate exposure to the faculty enabling them to be synchronized with the Cutting edge technology
1. **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**
   I. Acquire core competence and excel in communication and networking based industries.
   II. Serve in research establishments and contribute towards the development of sophisticated signal processing systems.
   III. Provide consultancy and offer networking solutions for establishments.
   IV. Work towards doctoral and post-doctoral degrees in the area of communication, signal processing and networking.
   V. Become entrepreneurs and contribute towards indigenous product development which could compete in global market.

2. **PROGRAMME OUTCOMES (POs):**

<table>
<thead>
<tr>
<th>PO#</th>
<th>GRADUATE ATTRIBUTE</th>
<th>PROGRAMME OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Research aptitude</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
</tr>
<tr>
<td>2.</td>
<td>Technical documentation</td>
<td>An ability to write and present a substantial technical report/document</td>
</tr>
<tr>
<td>3.</td>
<td>Technical competence</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
</tr>
<tr>
<td>4.</td>
<td>Engineering Design</td>
<td>Ability to design and conduct experiments, perform analysis, signal processing and networking systems by applying the knowledge of computing, mathematics, science and electronic engineering.</td>
</tr>
<tr>
<td>5.</td>
<td>Conduct investigations of complex problems</td>
<td>Interpret the problems of communication and investigate solutions and work towards improved solutions.</td>
</tr>
<tr>
<td>6.</td>
<td>Life-long Learning</td>
<td>Continuously update knowledge with modern tools and technical developments and ensure professional development.</td>
</tr>
</tbody>
</table>

7. **PROGRAMME SPECIFIC OUTCOMES (PSOs):**
   By the completion of Communication and Networking programme, students will have the following programme specific outcomes.
   
   I. Foundation of communication and signal processing systems: Ability to understand the basics principles of communication, signal processing and understand their implementation issues.
   
   II. Foundation of networking systems: Ability to understand the various technologies behind the recent communication standards and work towards improved solutions.
   
   III. Foundations of Mathematical concepts: Ability to apply mathematical knowledge to solve complex signal processing algorithms and networking issues.
   
   IV. Applications of Communication and networking and Research ability: Ability to use knowledge in various Domains to identify research gaps and provide innovative solutions.
8. PEO/PO Mapping:

<table>
<thead>
<tr>
<th>PEOs</th>
<th>PROGRAMME OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>I.</td>
<td></td>
</tr>
<tr>
<td>II.</td>
<td>✓</td>
</tr>
<tr>
<td>III.</td>
<td>✓</td>
</tr>
<tr>
<td>IV.</td>
<td>✓</td>
</tr>
<tr>
<td>V.</td>
<td>✓</td>
</tr>
</tbody>
</table>

L- Low, M-Medium, H-High

<table>
<thead>
<tr>
<th>SEM</th>
<th>SUBJECTS</th>
<th>PROGRAM OUTCOMES (PO)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>I</td>
<td>Applied Mathematics for Network Engineers</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Digital Communication Techniques</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Advanced Optical Communication</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>High Performance Computer Networks</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>RF Engineering</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Research Methodology and IPR</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Audit Course- I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication and signal processing Lab</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>RF System Design Laboratory</td>
<td>H</td>
</tr>
<tr>
<td>II</td>
<td>Adaptive Signal Processing Techniques</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Network Security</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Wireless Mobile communication</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Program Elective I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program Elective -II</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Audit Course- II</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Networking Laboratory</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Wireless Technology Laboratory</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Mini Project with Seminar</td>
<td>H</td>
</tr>
<tr>
<td>III</td>
<td>Program Elective III</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program Elective IV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program Elective V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open Elective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissertation - I</td>
<td>H</td>
</tr>
<tr>
<td>IV</td>
<td>Dissertation - II</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Title</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>Electromagnetic Interference and Electromagnetic Compatibility</td>
<td>H</td>
</tr>
<tr>
<td>2</td>
<td>Analysis and Design of CMOS Analog Integrated Circuits</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td>Electromagnetic for Communications</td>
<td>H</td>
</tr>
<tr>
<td>4</td>
<td>Information Theory and Coding</td>
<td>H</td>
</tr>
<tr>
<td>5</td>
<td>Parallel Processing</td>
<td>H</td>
</tr>
<tr>
<td>6</td>
<td>RF Integrated Circuits Design</td>
<td>H</td>
</tr>
<tr>
<td>7</td>
<td>Speech Recognition and Synthesis</td>
<td>H</td>
</tr>
<tr>
<td>8</td>
<td>VLSI Design Automation</td>
<td>H</td>
</tr>
<tr>
<td>9</td>
<td>IoT Fundamentals</td>
<td>H</td>
</tr>
<tr>
<td>10</td>
<td>Detection and Estimation Theory</td>
<td>H</td>
</tr>
<tr>
<td>11</td>
<td>Pattern Recognition and machine learning</td>
<td>H</td>
</tr>
<tr>
<td>12</td>
<td>Computational Electromagnetics</td>
<td>H</td>
</tr>
<tr>
<td>13</td>
<td>Digital Audio and Video Broadcasting Technology</td>
<td>H</td>
</tr>
<tr>
<td>14</td>
<td>Fundamentals of Cloud Computing</td>
<td>H</td>
</tr>
<tr>
<td>15</td>
<td>Game theory for Wireless Communication and Networking</td>
<td>H</td>
</tr>
<tr>
<td>16</td>
<td>Microwave Photonics</td>
<td>H</td>
</tr>
<tr>
<td>17</td>
<td>Optical Networks</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Reconfigurable Architectures And Applications</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>18.</td>
<td>Satellite Communication</td>
<td>H</td>
</tr>
<tr>
<td>19.</td>
<td>Space time wireless Communication</td>
<td>H</td>
</tr>
<tr>
<td>20.</td>
<td>Spread Spectrum Techniques and Applications</td>
<td>H</td>
</tr>
<tr>
<td>22.</td>
<td>Microwaves and Radar</td>
<td>H</td>
</tr>
<tr>
<td>23.</td>
<td>Real Time Embedded System</td>
<td>H</td>
</tr>
<tr>
<td>24.</td>
<td>VLSI Signal Processing Techniques</td>
<td>H</td>
</tr>
<tr>
<td>25.</td>
<td>Advanced Operating Systems</td>
<td>H</td>
</tr>
<tr>
<td>26.</td>
<td>VLSI Design Techniques</td>
<td>H</td>
</tr>
<tr>
<td>27.</td>
<td>ASIC Design</td>
<td>H</td>
</tr>
<tr>
<td>28.</td>
<td>Image Analysis and Computer Vision</td>
<td>H</td>
</tr>
<tr>
<td>29.</td>
<td>Computational Intelligence</td>
<td>H</td>
</tr>
<tr>
<td>30.</td>
<td>Cognitive Radio Networks</td>
<td>H</td>
</tr>
</tbody>
</table>
### Semester I

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA5155</td>
<td>Applied Mathematics for Network Engineers</td>
<td>PCC</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>NE5101</td>
<td>Digital Communication Techniques</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>NE5102</td>
<td>Advanced Optical Communication</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>NE5103</td>
<td>High Performance Computer Networks</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>NE5151</td>
<td>RF Engineering</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>RM5151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Audit Course- I</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>NE5111</td>
<td>Communication and Signal Processing Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>NE5161</td>
<td>RF System Design Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

**TOTAL** 19 1 8 26 22

*Audit course is optional*
# SEMESTER II

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>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>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>NE5251</td>
<td>Adaptive Signal Processing Techniques</td>
<td>PC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>NE5201</td>
<td>Network Security</td>
<td>PC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>NE5202</td>
<td>Wireless Mobile communication</td>
<td>PC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Program Elective I</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Program Elective -II</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Audit Course- II*</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>NE5211</td>
<td>Networking Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>WT5261</td>
<td>Wireless Technology Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>NE5212</td>
<td>Mini Project with Seminar</td>
<td>EEC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>17 0 12</td>
<td>29</td>
<td>21</td>
</tr>
</tbody>
</table>

*Audit course is optional

# SEMESTER III

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>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>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td>Program Elective III</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Program Elective IV</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Program Elective V</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</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>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>NE5311</td>
<td>Dissertation-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 12</td>
<td>24</td>
<td>18</td>
</tr>
</tbody>
</table>

# SEMESTER IV

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>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>1.</td>
<td>NE5411</td>
<td>Dissertation- 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 NUMBER OF CREDITS = 73
# FOUNDATIONAL COURSE (FC)

<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>MA5155</td>
<td>Applied Mathematics for Network Engineers</td>
<td>FCC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

# PROGRAM CORE COURSE (PCC)

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>NE5101</td>
<td>Digital Communication Techniques</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>NE5102</td>
<td>Advanced Optical Communication</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>NE5103</td>
<td>High Performance Computer Networks</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>NE5251</td>
<td>Adaptive Signal Processing Techniques</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>NE5201</td>
<td>Network Security</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>NE5202</td>
<td>Wireless Mobile Communication</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>NE5111</td>
<td>Communication and Signal Processing Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>NE5161</td>
<td>RF System Design Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>NE5211</td>
<td>Networking Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>WT5261</td>
<td>Wireless Technology Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

# EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<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>NE5311</td>
<td>Dissertation - I</td>
<td>EEC</td>
<td>0 0 12</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>NE5411</td>
<td>Dissertation - II</td>
<td>EEC</td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>3.</td>
<td>NE5212</td>
<td>Mini Project with Seminar</td>
<td>EEC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>
### RESEARCH METHODOLOGY AND IPR COURSES (RMC)

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>CODE NO.</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>RM5151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2 0 0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

### OPEN ELECTIVE COURSES (OEC)

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>CODE NO.</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>OE5091</td>
<td>Business Data Analytics</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OE5092</td>
<td>Industrial Safety</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OE5093</td>
<td>Operations Research</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OE5094</td>
<td>Cost Management of Engineering Projects</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OE5095</td>
<td>Composite Materials</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OE5096</td>
<td>Waste to Energy</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AX5091</td>
<td>English for Research Paper Writing</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX5092</td>
<td>Disaster Management</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX5093</td>
<td>Sanskrit for Technical Knowledge</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX5094</td>
<td>Value Education</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>AX5095</td>
<td>Constitution of India</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>AX5096</td>
<td>Pedagogy Studies</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>AX5097</td>
<td>Stress Management by Yoga</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>AX5098</td>
<td>Personality Development Through Life Enlightenment Skills</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>AX5099</td>
<td>Unnat Bharat Abhiyan</td>
<td>2 0 0</td>
<td>0</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS:** 0
<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>NE5072</td>
<td>Electromagnetic Interference and Electromagnetic Compatibility</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>NE5001</td>
<td>Analysis and Design of CMOS Analog Integrated Circuits</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>NE5002</td>
<td>Electromagnetic for Communications</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>NE5075</td>
<td>Information Theory and Coding</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>NE5003</td>
<td>Parallel Processing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>NE5004</td>
<td>RF Integrated Circuits Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>NE5005</td>
<td>Speech Recognition and Synthesis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>NE5006</td>
<td>VLSI Design Automation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>NE5076</td>
<td>IoT Fundamentals</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>NE5007</td>
<td>Detection and Estimation Theory</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>NE5078</td>
<td>Pattern Recognition and machine learning</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>NE5009</td>
<td>Computational Electromagnetics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>NE5010</td>
<td>Digital Audio and Video Broadcasting Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>NE5011</td>
<td>Fundamentals of Cloud Computing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>NE5073</td>
<td>Game theory for Wireless Communication and Networking</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>NE5012</td>
<td>Microwave Photonics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>NE5013</td>
<td>Optical Networks</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>NE5079</td>
<td>Reconfigurable Architectures And Applications</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</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>19.</td>
<td>NE5014</td>
<td>Satellite Communication</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>NE5015</td>
<td>Space time wireless Communication</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>NE5016</td>
<td>Spread Spectrum Techniques and Applications</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>WT5151</td>
<td>Wireless Sensor Network Design</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>NE5077</td>
<td>Microwaves and Radar</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>VE5151</td>
<td>Real Time Embedded System</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td>VE5071</td>
<td>VLSI Signal Processing Techniques</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>CP5251</td>
<td>Advanced Operating Systems</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>NE5080</td>
<td>VLSI Design Techniques</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>VL5151</td>
<td>ASIC Design</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>NE5074</td>
<td>Image Analysis and Computer Vision</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>NE5071</td>
<td>Computational Intelligence</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>CU5071</td>
<td>Cognitive Radio Networks</td>
<td>PEC</td>
<td>3 0 0 3 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MA5155  APPLIED MATHEMATICS FOR NETWORK ENGINEERS  L T P C
                                                                 3 1 0 4

OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
- To develop the ability to use the concepts of Special Functions for solving problems related to Networks.
- To analyze the Graph algorithms and understand their applications in Networks.
- To impart knowledge on Numerical Methods that will come in handy to solve numerically the problems that arise in engineering. This will also serve as a precursor for future research.
- To acquire skills in analyzing Queuing Models.

UNIT I  LINEAR ALGEBRA  12

UNIT II  SPECIAL FUNCTIONS  12
Bessel's equation – Bessel function – Recurrence relations - Generating function and orthogonal property for Bessel functions of first kind – Fourier-Bessel expansion.

UNIT III  GRAPH ALGORITHMS  12

UNIT IV  ALGEBRAIC EQUATIONS  12

UNIT V  RANDOM PROCESSES  12
Classification – Auto correlation - Cross correlation - Stationary random process – Markov process — Markov chain - Poisson process – Gaussian process

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, students will be able to
- Work with vector spaces and linear transformations and their applications.
- Use the ideas of Special Functions in solving special types of problems.
- Apply Graph Theory algorithms in networks.
- Use various methods of solving systems of Algebraic Equations and eigenvalue problems.
- Apply the ideas of random processes.

REFERENCES:

NE5101 DIGITAL COMMUNICATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:
- To have a comprehensive knowledge of the various signalling schemes.
- To have an in depth knowledge of synchronization and equalization.
- To have a comprehensive knowledge of the transmission techniques
- To understand the various channel coding techniques
- To be able to understand the various speech/ video and text compression schemes.

UNIT I SIGNALING SCHEMES

UNIT II SYNCHRONIZATION & EQUALIZATION
Carrier Synchronization- Bit, Frame synchronization. Channel Models- ISI-Eye Diagram-Receiver Front End-ML Sequence estimation-Linear Equalization-Decision Feedback Equalization.

UNIT III ERROR CONTROL TECHNIQUES
Channel coding-bandwidth expansion-Error correction vs detection- coding gain-Matrix Parity Check Codes-Linear Block Codes – Error Detection & Correction capability- Cyclic Codes – CRC-Hamming codes – Convolutional codes – Viterbi Decoding algorithm-Turbo Codes-LDPC

UNIT IV COMPRESSION TECHNIQUES

UNIT V TRANSMISSION TECHNIQUES
Subscriber Loop Transmission - xDSL, Trunk Transmission Line Coding / Framing / Multiplexing - Signaling- Timing Synchronization —ARQ Protocols.

TOTAL: 45 PERIODS

OUTCOMES:
- To be able to design the various errors control coding schemes and carry out their implementations.
- To design a receiver to meet out the required power and BER requirements
- To be able to design compression techniques as applicable to the specific application
- To be able to design digital transmission systems
- To be able to design equalization algorithms.
REFERENCES:

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

NE5102 ADVANCED OPTICAL COMMUNICATION L T P C 3 0 0 3

OBJECTIVES:
- Understand the concepts of optical communications and various systems
- Know the recent developments in optical components and their applications
- Understand the nonlinearities and dispersion issues in optical transmission.
- Understand the dispersion issues and compensation schemes in optical transmission.
- Be able to identify the merits and demerits of different modulation and detection schemes

UNIT I REVIEW OF OPTICAL COMMUNICATIONS SYSTEMS 9
Optical fibers, dispersion, link budget, Time Division Multiplexing, Sub Carrier Multiplexing and code division multiplexing. Systems: Passive optical Network, Hybrid fiber coax architectures, Radio over fiber technologies, free space optics

UNIT II MODERN OPTICAL COMPONENTS 9
VCSEL, QW lasers, Multi section DFB lasers, Tunable lasers, Electro absorption modulator, Integrated transmitters and receivers, optical switches and routers, WDM components, Optical schemes for microwave generation, PCF and PCF components

UNIT III NON LINEAR FIBER OPTICS AND APPLICATIONS 9
Non linear optics – basics, Brilluion, Raman effects, Four wave mixing, optical phase conjugation. Optical Amplifiers-SOA, EDFA, DRFA. Fiber lasers, Solitons, Communication using solitons, WDM solitons

UNIT IV DISPERSION COMPENSATION SCHEMES 9
Pre, post and mixed compensation schemes, Optical filters for compensation, Delay line filters, Dispersion slope compensation, Dispersion and Non linearity, Dispersion maps, multichannel compensation schemes.

UNIT V ADVANCED MODULATION AND DETECTION TECHNIQUES 9
Limitations of direct modulation, ASK, PSK, FSK modulations in coherent systems, Analog schemes: QPSK, QAM, DQPSK, Carrier suppressed schemes. External modulators, single and Dual drive MZM, performance. Non coherent and coherent detection.

TOTAL: 45 PERIODS
OUTCOMES:
- A thorough knowledge of different optical communication systems
- A thorough knowledge of optical components and its performances
- Details of impairments in optical fiber links and schemes to mitigate them
- A thorough knowledge about the design and implementation of integrated optics
- To be able to compare the performance of various modulation and detection schemes

REFERENCES:
5. Frederic Zolla and 7 more, Foundations of photonic crystal fibers, 2nd edition, Imperial college press.

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

NE5103       HIGH PERFORMANCE COMPUTER NETWORKS       L T P C
3 0 0 3

OBJECTIVES:
- To understand the high speed computer network architectures.
- To understand the concepts of multimedia networking.
- To study the recent network concepts with reference to MPLS and VPN.
- To study about the mathematical models related to network performance analysis.
- To understand the current network management concepts.

UNIT I       SWITCHING NETWORKS

UNIT II       MULTIMEDIA NETWORKING APPLICATIONS
Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, RSVP-differentiated services.

UNIT III      ADVANCED NETWORKS CONCEPTS
UNIT IV PACKET QUEUES AND DELAY ANALYSIS 9
Little's theorem, Birth and Death process, Queueing discipline- Control & stability -. Markovian
FIFO Queueing system, Non-Markovian - Pollaczek-Khinchin Formula and M/G/1, M/D/1,
self- similar models and Batch-arrival model, Networks of Queues – Burke's theorem and
Jackson Theorem.

UNIT V NETWORK MANAGEMENT & SNMP 9
Network Architecture, SNMP Basics, SNMP Naming and OIDs, MIBs, SNMPv1 Data Types, ASN.1
Syntax and SNMP, SNMP Tables, SNMP Operations, MIB Browsing, MIB-2, SNMP and ASN.1
Encoding

TOTAL: 45 PERIODS

OUTCOMES:
- To be able to design and implement network protocols in HPCN.
- To be able to design and implement protocols in multimedia networks.
- To be able to compare the various methods of providing connection-oriented
  services over an advanced network with reference to MPLS, VPN.
- To be able to analyze performance of network related issues using mathematical models.
- To be able to explore the concepts of network management.

REFERENCES:
5. Fred Halsall and Lingana Gouda Kulkarni, “Computer Networking and the Internet”,

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

NE5151 RF ENGINEERING L T P C 3 0 0 3

OBJECTIVES
- To model high frequency circuit using scattering matrixes
- To acquire knowledge on the RF filter design
- To design microwave amplifier
- To get familiar with design of RF oscillator
- To learn about the high frequency antennas

UNIT I NETWORKS AND MATRICES 9
Scattering and chain scattering matrices, Generalized scattering matrix, Analysis of two port
networks, Interconnection of networks. Positive real concepts, scattering matrix, representation of
microwave components (directional couple, circulators, hybrids and isolators).
UNIT II  HIGH FREQUENCY CIRCUIT DESIGN  9

UNIT III  MICROWAVE AMPLIFIER DESIGN  9
Types of amplifiers, Power gain equations. Introduction to narrow band amplifiers basic concepts, Maximum gain design, Low noise design. High power design, Negative resistance, reflection amplifiers – various kinds – stability considerations, Microwave transistor amplifier design – input and output matching networks – constant noise figure circuits.

UNIT IV  MICROWAVE TRANSISTOR OSCILLATOR DESIGN  9
One port and two port negative resistance oscillators. Oscillator configurations, Oscillator design using large signal measurements, Introduction to Microwave CAD packages, Microwave integrated circuits, MIC design for lumped elements.

UNIT V  RF AND MICROWAVE ANTENNAS  9
Radiation from surface current and line current distribution, Basic Antenna parameters, Feeding structure-Patch Antenna, Ring Antenna, Micro strip dipole, Micro strip arrays, Traveling wave Antenna, Antenna System for Mobile Radio-Antenna Measurements and Instrumentation. Propagation characteristics of RF and Microwave signals, Introduction to EBG structures.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the student should be able to
- Apply scattering parameters in RF circuit and systems
- Develop filters for high frequency applications
- Design amplifiers for RF transceivers
- Understand the RF oscillator design techniques
- Develop antennas for high frequency applications.

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICAL WRITING / PRESENTATION 6
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

TOTAL: 30 PERIODS

OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVE:
- To develop skills for implementing various modulations, coding and quantization schemes on a SDR platform.
- To understand the merits and demerits of different modulation schemes
- To understand the requirements of synchronization and acquire the ability to implement different techniques of synchronization
- To design equalization filters so as to mitigate the ill-effects of channel
- To understand the channel behaviour through suitable estimation techniques.

LIST OF EXPERIMENTS:
1. Pulse Shaping, Timing & Frequency Synchronization
2. BPSK Modulation and Demodulation
3. Differential BPSK
4. QPSK Modulation and Demodulation
5. 16-QAM
6. LMS based Channel Equalization
7. Decision Feedback Equalizer
8. OFDM -Synchronization & Channel estimation
9. Mini Project

TOTAL: 60 PERIODS

OUTCOMES:
- To be able to design and implement synchronization schemes for communication system.
- To be able to design and implement equalization schemes.
- To be able to design and implement various digital modulation schemes.
- To be able to design and implement OFDM systems.
- To be able to use SDR platform for design of communication systems.

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

NE5161  RF SYSTEM DESIGN LABORATORY  L T P C  0 0 4 2

OBJECTIVES:
- To enable the student to design and develop RF components and systems
- To enable the student to learn RF measurements
- To design and develop RF filters
- To design and develop antennas for RF applications
- To design and characterize the RF systems

LIST OF EXPERIMENTS
1. Measurement of transmission line parameters using network analyzer
   (a) Inductor  (b) Capacitor
2. Measurement of transmission line parameters using network analyzer
(a) Reflection coefficient  (b) VSWR

3. Design of Microstrip transmission line
   (a) λ/2 line  (b) λ/4 line  (c) λ/8 line

4. Design and characterization of RF filters

5. Design of impedance matching network

6. Measurement of RF signals and their spectrum

7. Design and characterization of antennas

8. Design and characterization of LNA

9. Design and characterization of Mixer

10. Design and characterization of VCO

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course the student should be able to

- Measure the RF network parameters
- Design and develop RF filters
- Design and develop antennas for RF applications
- Construct new circuit and systems for high frequency applications
- Test RF components and systems.

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

NE5251          ADAPTIVE SIGNAL PROCESSING TECHNIQUES

OBJECTIVES:

- To understand the basic principles of discrete random signal processing
- To understand the principles of spectral estimation
- To learn about the weiner and adaptive filters
- To understand the different signal detection and estimation methods
- To acquire skills to design synchronization methods for proper functioning of the system

UNIT I          DISCRETE RANDOM SIGNAL PROCESSING


UNIT II          SPECTRAL ESTIMATION


UNIT III          WEINER AND ADAPTIVE FILTERS

UNIT IV  
DETECTION AND ESTIMATION  
Bayes detection techniques, MAP, ML— detection of M-ary signals, Neyman-Pearson, minimax decision criteria. kalman filter- Discrete kalman filter, The Extended kalman filter, Application.

UNIT V  
SYNCHRONIZATION  
Signal parameter estimation, carrier phase estimation, symbol timing estimator, joint estimation of carrier phase and symbol timing.

OUTCOMES:  
On successful completion of this course, students will be able to  
- Analyze the basic principles of discrete random signal processing  
- Analyze the principles of spectral estimation  
- Analyze the weiner and adaptive filters  
- Analyze the different signal detection and estimation methods  
- Design the synchronization methods for proper functioning of the system

REFERENCES:  

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>CO2</th>
<th>PO2</th>
<th>CO3</th>
<th>PO3</th>
<th>CO4</th>
<th>PO4</th>
<th>CO5</th>
<th>PO5</th>
<th>CO6</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

NE5201  
NETWORK SECURITY  
L T P C  
3 0 0 3

OBJECTIVES:  
- To learn the fundamentals of cryptography and its application to network security.  
- To understand the mathematics behind cryptography.  
- To learn about the principles and protocols that enables its application to wired and wireless networks.  
- To develop an understanding of security policies such as authentication, integrity and confidentiality as well as protocols to implement such policies.  
- To study about network security threats, security services, and counter measures.

UNIT I  
INTRODUCTION TO CRYPTOGRAPHY  
UNIT II SYMMETRIC AND ASYMMETRIC CIPHERS

UNIT III SECURITY TECHNIQUES

UNIT IV SECURITY AT LAYERS

UNIT V SYSTEM SECURITY
Intruders- Intrusion Detection, Malicious software - Types, viruses, countermeasures, worms. Firewalls - Need for firewalls, characteristics, types.

TOTAL: 45 PERIODS

OUTCOMES:
- To design cryptographic algorithms and carry out their implementation.
- To carry out cryptanalysis on cipher.
- To be able to design and implement security protocols.
- To carry out system security for various threat environments.
- To understand the importance of firewall security for network.

REFERENCES:

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

NE5202 WIRELESS MOBILE COMMUNICATION

OBJECTIVES:
- To understand the basic concepts in cellular communication
- To understand the characteristics of wireless channels.
- To know the Impact of digital modulation techniques in fading
- To get exposed to diversity techniques in wireless communication.
- To acquire knowledge in multicarrier systems
UNIT I CELLULAR CONCEPTS

UNIT II 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 Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT III PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS

UNIT IV DIVERSITY TECHNIQUES

UNIT V MULTICARRIER MODULATION
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.

TOTAL: 45 PERIODS

OUTCOMES:
- To be able to design solutions for cellular communication
- To be able to compute the capacity of wireless channels
- To be able to analyze the performance of the digital modulation techniques in fading channels.
- To apply various diversity techniques in wireless communication.
- To design multicarrier systems in wireless communication

REFERENCES:
NE5211           NETWORKING LABORATORY                  L T P C  0 0 4 2
          (Experiments using NS2/ QUALNET /NS3/ OMNET/ equivalent)  

OBJECTIVES:
• To understand the functioning of various protocols in Wired and Wireless Environment.
• To perform real time experimentation using the existing infrastructure.
• To impart programming skill using NS2/QUALNET.
• Gain knowledge to construct LAN, WLAN, and VLAN in a real-time environment.
• To understand the security algorithms for network.

LIST OF EXPERIMENTS:
1. AODV/DSR routing
2. Security algorithms in wired network
3. MAC protocols Wired and wireless
4. Configuration of LAN
5. Configuration of VLAN- Tunneling
6. Configuration of WLAN
7. MINI PROJECT

TOTAL: 60 PERIODS

OUTCOMES
• Ability to design MAC and routing protocols in Wired and Wireless Environment using
  NS2/QUALNET.
• To acquire the technical competence to meet out the industry expectation on the state – of the
  art wired / wireless technologies.
• To acquire the ability to design WLAN/ LAN systems meeting out real time requirements.
• To be able to design and configure a network.
• To be able to design VLAN for secured communication.

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

WT5261           WIRELESS TECHNOLOGY LABORATORY           L T P C  0 0 4 2

OBJECTIVES:
• To understand the functioning of various protocols in Wired Environment.
• To understand the functioning of various protocols in Wireless Environment.
• To perform real time experimentation using the existing infrastructure.
• To get exposed to open source networking tools.
• To gain knowledge in constructing LAN, WLAN, and VLAN

LIST OF EXPERIMENTS
1. Wired and Wireless network scenario creation.
2. Study of Routing Protocols
3. Analysis of Network Security Algorithms
4. Study of ZigBee Energy Model and MAC protocols
5. Queuing mechanism.
7. Call establishment in cellular network
8. Handover in cellular network
9. Throughput performance for various terrain models, transmission modes, loading conditions, Traffic profiles in LTE network.

**TOTAL: 60 PERIODS**

**OUTCOMES:**
- Ability to design MAC and routing protocols in Wired Environment
- Ability to design MAC and routing protocols in Wireless Environment
- Acquire the technical competence to meet out the industry expectation in the wired technologies
- Ability to meet out requirements of industries related to wireless technologies
- Acquire the ability to design WLAN/ LAN systems meeting out real time requirements.

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

**NE5072**  
**ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY**  
**TOTAL: 60 PERIODS**

**OBJECTIVES:**
- To develop an understanding of basics of Electromagnetic interference in Electronic systems
- To acquire knowledge on the EMI coupling mechanisms
- To impart concepts of EMI control schemes
- To get acquainted with design PCB incorporating EMC principles
- To know about the current EMC standards and measurement techniques

**UNIT I**  
**EMI/EMC CONCEPTS**
EMI/EMC Concepts, EMI-EMC definitions and Units of parameters, Sources and victim of EMI Conducted and Radiated EMI Emission, Susceptibility, Transient EMI, ESD, Radiation Hazards.

**UNIT II**  
**EMI COUPLING PRINCIPLES**
EMI Coupling Principles - Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling, cross talk; Field to cable coupling; Power mains and Power supply coupling. Simulation of Electromagnetic interference.

**UNIT III**  
**EMI CONTROL TECHNIQUES**
EMI Control Techniques: Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.
UNIT IV  EMC DESIGN OF PCBs
EMC Design Of PCBs: Component selection and mounting; PCB trace impedance; Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations; EM simulation of PCB’s

UNIT V  EMI MEASUREMENT AND STANDARDS
EMI Measurements: Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx/Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Receiver and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards: MIL461E/462.

OUTCOMES:
On completion of the course the student should be able to:
- Understand EMI and susceptibility
- Identify EMI coupling mechanisms
- Use appropriate EMI control schemes in electronic systems
- Design PCBs with EMC
- Conduct EMI measurements according to standards.

REFERENCES:

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

NE5001  ANALYSIS AND DESIGN OF CMOS ANALOG INTEGRATED CIRCUITS  L T P C
3 0 0 3

OBJECTIVES:
- To understand the behaviour of MOS Transistor.
- To learn the concepts of amplifiers, current mirrors and reference generator circuits.
- To understand data converters.
- To study the feedback and frequency compensation techniques.
- To acquire information about the different types of comparators

UNIT I  MODELS FOR IC ACTIVE DEVICES
Introduction- Large signal behavior of MOS transistor- small signal behavior of the MOS transistor – Short channel effect in MOS transistor – Weak inversion in MOS transistor – Large signal and small signal analysis of single stage MOS amplifiers (CS, CG and CD) - SPICE simulation for MOS circuits.
UNIT II  CMOS OPERATIONAL TRANSCODUCTANCE AMPLIFIER
Introduction – Difference between Op-Amp and OTA- Differential OTA – slew rate, PSRR, CMRR and Dynamic range of the OTA- Design of Telescopic Cascode and Folded Cascode OTAs. Design of two-stage amplifier- Miller compensation method for two-stage OTA- Noise in feedback OTAs- SPICE frequency simulation for CMOS OTA.

UNIT III  CURRENT MIRROR AND REFERENCES

UNIT IV  ANALOG COMPARATORS AND OUTPUT STAGES

UNIT V  ANALOG DESIGN WITH MOS TECHNOLOGY
Design of 8-bit flash type ADC- Design of 10-bit successive approximation (SAR) & pipelined ADC- A Systematic Design approach of DAC- SPICE simulations for the above designs – Introduction to concepts of power integrity, substrate noise, and reliability.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students will have the ability

- To design various OTAs.
- To design different kinds of data converters.
- To carry out SPICE simulation of various analog circuits.
- To design and analyze the performance of current mirrors.
- To apply the concepts of CMOS circuits for real time application.

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To revise of basics of Electromagnetic theory and understand its importance in communication systems.
- To acquire knowledge on the EMI mechanisms
- To impart concepts of Electromagnetic compatibility schemes
- To understand the importance of EM wave propagation in communication
- To know about the basics of light wave and Radar systems

UNIT I  FUNDAMENTALS OF ELECTROMAGNETIC THEORY  9
Electric and magnetic fields; Maxwell’s equations in integral and Differential forms; Boundary conditions; Poynting’s vector and energy storage; Static fields and circuit elements; Quasi-static fields and frequency behaviour of circuit elements.

UNIT II  ELECTROMAGNETIC INTERFERENCE  9
Electromagnetic Environment, Practical concerns, Frequency spectrum conservation, Sources of EMI: Lightning, ESD, EMP, EMI from apparatus and circuits. Modeling of Interferences, Test sites and measurements, Simulation of EMI.

UNIT III  ELECTROMAGNETIC COMPATIBILITY  9
Capacitive and inductive couplings; Crosstalk on transmission lines; Common impedance coupling; Methods of solution of EMC problems; EMI filters, Grounding and Shielding; Cables and connectors, EMC standards.

UNIT IV  ELECTROMAGNETIC WAVE PROPAGATION  9
EM Waves and Radiation. Overview of propagation effects; Ground wave, Sky wave, Tropospheric, Ionospheric propagation effects; Propagation models for satellite and Mobile links. EM Simulation of propagation models.

UNIT V  ELECTROMAGNETICS FOR LIGHTWAVE & RADAR SYSTEMS  9
Reflection, refraction, Interference and diffraction of plane waves; Dielectric slab waveguide; Pulse broadening in a dispersive medium. RADAR, LIDAR range equations, Radar cross section (RCS). Introduction to electromagnetic field computation and simulation.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the student should be able to:
- Understand the importance of EM theory for communication
- Identify EMI in circuits and systems
- Use appropriate EM compatibility schemes in electronic systems
- Model wireless channels for communications
- Apply knowledge light wave and RADAR system design.

REFERENCES:
NE5075 INFORMATION THEORY AND CODING L T P C
3 0 0 3

OBJECTIVES:

- To understand the concepts of Information theory and Coding.
- To analyze the various techniques to improve the capacity of the channel.
- To understand the fundamental limits prescribed by the information theory.
- To get exposed to the gaussian channel
- To learn the various coding schemes in detail.

UNIT I QUANTITATIVE STUDY OF INFORMATION 9
Entropy, Relative Entropy, Mutual information, Chain rule, Relationship Bounds on entropy, Fisher information, Cramer Rao inequality, Entropy rates of a Stochastic process.

UNIT II CAPACITY OF NOISELESS CHANNEL 9
Fundamental theorem for a noiseless channel, Data compression, Kraft inequality, Shannon-Fano codes, Huffman codes, Asymptotic equi partition, Rate distortion theory.

UNIT III CHANNEL CAPACITY 9
Properties of channel capacity, jointly typical sequences, Channel Coding Theorem, converse to channel coding theorem, Joint source channel coding theorem.

UNIT IV DIFFERENTIAL ENTROPY AND GAUSSIAN CHANNEL 9
AEP for continuous random variables, relationship between continuous and discrete entropy, properties of differential entropy, Gaussian channel definitions, converse to coding theorem for Gaussian channel, channels with colored noise, Gaussian channels with feedback.

UNIT V CHANNEL CODING TECHNIQUES 9
Galois Fields, Fundamental Theorem of Galois Theory (FTGT), Reed-Solomon Codes, Turbo Codes, LDPC Codes, TCM.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be in a position to quantify information.

- To be able to implement various coding schemes.
- To be able to design efficient channel.
- To be able to apply coding techniques to information sources like video, audio and so on.
- To able to implement the information theory and coding technique for effective communication
REFERENCES:

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

NE5003 PARALLEL PROCESSING L T P C

OBJECTIVES:
- To understand the various architectures for parallel processing
- To learn the concepts of Pipelining and Multithreading
- To Learn the Levels in Main Memory and Virtual Memory Hierarchy Schemes
- To understand the Address Translation Mechanisms available in Virtual Memory Technology
- To learn the concepts of Parallel Programming Languages and Constructs

UNIT I THEORY OF PARALLELISM
Parallel computer models- the state of computing, Multiprocessors and multi computers and multivectors and SIMD computers, PRAM models

UNIT II PARALLEL PROCESSING APPLICATIONS
Conditions of parallelism, Program partitioning and scheduling, Program flow mechanisms, system interconnect architectures. Principles of scalable performance, performance metrics and measures.

UNIT III HARDWARE TECHNOLOGIES
Processor and memory hierarchy- advanced processor technology, superscalar and vector processors, memory hierarchy technology, virtual memory technology, bus cache and shared memory, backplane bus systems, cache memory organizations, shared memory Organizations.

UNIT IV PARALLEL PROGRAMMING
Parallel Programming models- Shared Memory Multiprocessors- Constructs for specifying Parallelism- Sharing data- Parallel Programming Languages and Constructs- Opn MP- Introduction.

UNIT V PARALLEL ALGORITHMS

TOTAL: 45 PERIODS
OUTCOMES:
On successful completion of this course, students will be able to
• Apply the problem solving techniques in parallel computing
• To solve problems related to memory management
• To design efficient memory hierarchical scheme with cost evaluations
• To translate the information from virtual memory to main memory
• To write programs in the parallel processing environment

REFERENCES:

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

NE5004 RF INTEGRATED CIRCUITS DESIGN

OBJECTIVES:
• To introduce the Integrated circuit design for Amplifiers at radio frequency.
• To get exposed to microwave oscillator design.
• To impart the concepts of RF IC
• To analyze and focus on circuits for radio frontends for mobile phone handsets.
• To understand noise amplifiers, mixers, power amplifiers, frequency synthesizers (phase locked loops) and modern radio architectures.

UNIT I BASIC RF IC COMPONENTS
Resistors, Capacitor, Inductor and Transformers at high frequency, Skin effect, Interconnect options. S-parameters with Smith chart, Impedance matching networks, Transmission lines, finite length effects, MOSFET characteristics, Noise: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR.

UNIT II RECEIVERS ARCHITECTURE AND LOW NOISE AMPLIFIERS
Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two step up conversion Transmitter, CMOS amplifiers, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs, OC Time constants in bandwidth estimation and enhancement.
UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS

UNIT IV PLL AND FREQUENCY SYNTHESIZERS
Linearised PLL Model, Noise properties, Phase detectors, Loop filters and Charge pumps, PLL Design examples. Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

UNIT V MIXERS AND OSCILLATORS
Mixer characteristics, Non-linear based mixers, Multiplier based mixers, Single balanced and double balanced mixers, sub sampling mixers, Oscillators describing Functions, Resonators, Phase noise, Chip Design Examples: GPS Receiver, WLAN receiver.

TOTAL: 45 PERIODS

OUTCOMES:
- Design amplifier by using RF IC
- Develop RF oscillator for high frequency applications
- Apply RF technology in the high frequency IC design
- Understand the RF point to point system design
- Apply IC design techniques in the transmission line equipment

REFERENCES:

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

NE5005 SPEECH RECOGNITION AND SYNTHESIS

OBJECTIVES:
- To understand the various speech models
- To understand the basic characteristics of speech
- To know the details of algorithms, techniques and limitations of state of the art speech systems.
- To investigate various speech synthesis mechanism
- To analyze the various speech recognition techniques

LT P C
3 0 0 3
UNIT I  BASIC CONCEPTS  9

UNIT II SPEECH ANALYSIS  9
Features, Feature Extraction and Pattern Comparison Techniques; Spectral distortion measures- mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Liftering, Likelihood Distortions, Spectral Distortion using a Warped frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, multiple Time – Alignment Paths.

UNIT III SPEECH MODELLING  9

UNIT IV SPEECH RECOGNITION  9
Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary Continuous Speech Recognition system – acoustics and language models, Sub-word units- models for phonemes, syllables, triphones, Language models, n-grams, context dependent sub-word units.

UNIT V SPEECH SYNTHESIS  9
Text-to-speech synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody, Applications.

TOTAL: 45 PERIODS

OUTCOMES:
- To be able to carry out transform domain/ time domain implementation of speech algorithm
- To be able to analyse speech signal for various applications
- To design speech recognition systems
- To design speech synthesis systems
- To be able to implement various speech models

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To learn the basics of logical design automation
- To give clear idea about VLSI Physical Design Cycle
- Study of different architectures of FPGA from different families.
- To learn the algorithmic concepts and complexity in physical design automation.
- To understand the faults in system and causes for occurrence of faults.

UNIT I  INTRODUCTION AND LOGICAL DESIGN AUTOMATION

UNIT II  PHYSICAL DESIGN AUTOMATION

UNIT III  PARTITIONING, FLOORPLANNING, PLACEMENT, ROUTING AND AUTOMATION OF FPGAs AND MCMs

UNIT IV  MODELLING, SIMULATION AND VERIFICATION
Modelling – Register transfer level (RTL) – Structural – Gate level, switch level and high level 34odeling – High-level modeling of VLSI Systems – System Verilog and SystemC concepts- Simulation & Verification – Event driven and continuous analog simulation methods – Analog and mixed signal simulation and verification – SPICE – Introduction to assertion-Based-Verification (ABV) and Formal Verification (FV).

UNIT V  TESTING & VERIFICATION
Design for Testability, Boundary scan test, Fault simulation – ATPG – Application of ASICs – Analog and Mixed signal (AMS) test and DFT – Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, students will be able to
- Analyze the basics of logical design automation
- Analyze the basics of VLSI physical design cycle
- Analyze the different architectures of FPGA families.
- Design and analyze the algorithms in physical design automation
- Analyze and verify the faults in a VLSI system.
REFERENCES:

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

NE5076 IoT FUNDAMENTALS LT P C 3 0 0 3

OBJECTIVES:
- To assess the vision and introduction of IoT.
- To Implement Data and Knowledge Management and use of Devices in IoT Technology.
- To Understand State of the Art - IoT Architecture.
- To build a small low-cost embedded system using Single Board Computers
- To learn the various case study of IoT systems.

UNIT I INTRODUCTION AND APPLICATIONS

UNIT II IoT DESIGN & SYSTEM MANAGEMENT

UNIT III IoT PROTOCOLS & SYSTEM

UNIT IV IoT CLOUD & DATA ANALYTICS

UNIT V IoT SECURITY
IoT attacks - Phase attacks, Attacks as per architecture, Attacks based on components. Security Protocols - Time-Based Secure Key Generation and Renewal - Security access algorithms for unidirectional data transmissions, Security access algorithms for bidirectional data transmissions.

TOTAL:45 PERIODS
OUTCOMES:
Upon the completion of the course the student will be able to
- Interpret the vision of IoT from a global context.
- Compare and Contrast the use of Devices, Gateways and Data Management in IoT.
- Design a portable IoT using any Single Board Computer and relevant protocols
- Analyze applications of IoT in real time scenario
- Deploy an IoT application and connect to the cloud.

REFERENCES:

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</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>
</tr>
<tr>
<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>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
UNIT III  FUNDAMENTALS OF ESTIMATION THEORY  
Formulation of the General Parameter Estimation Problem, Relationship between Detection and 
Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes Estimation, 
Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters.

UNIT IV  WIENER AND KALMAN FILTERS  
Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener 
Filter, Generalization of Discrete and Continuous Filter Representations, Linear Least-Squares 
Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance, 
LeastSquares, Kalman Algorithm - Computational Considerations, Signal Estimation, Continuous 
Kalman Filter, Extended Kalman Filter.

UNIT V  APPLICATIONS  
Detector Structures in Non-Gaussian Noise, Examples of Noise Models, Receiver Structures, and 
Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel 
Models, Receiver Structures with Known Channel Parameters, Receiver Structures without 
Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver 
Structures and Performance with No Channel Knowledge.

OUTCOMES:  
• To be able to apply stochastic process concepts in various application  
• To apply probability and stochastic process concepts in detection and estimation. 
• To design Wiener and Kalman filters to solve linear estimation problems.  
• To design optimal system in the process of Non-Gaussian noise  
• To design various synchronized schemes in the receiver.

REFERENCES:  
3. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and 
Fault Detection, Isolation, and Estimation (Systems & Control: Foundations & 
Applications)”,2006  
5. Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume II : Detection Theory, 
1998

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To understand the basics of data processing and dimensionality reduction techniques
- To understand different learning models for classification
- To understand the principles and applications of ANN architectures
- To study the different Deep convolutional networks
- To learn deep generative models

UNIT I  BASICS OF PROBABILITY AND RANDOM PROCESS  9
Probability Theory - Conditional and Joint Probability - Stationary and non-stationary process - Expectation - Auto correlation - Cross Correlation - Eigen values - Eigen vectors - Singular values - Singular vectors - Decision Theory - Information Theory

UNIT II  DIMENSIONALITY REDUCTION  9
Introduction - Features, feature vectors - Feature selection and ranking - Discriminant functions - Fisher's Discriminant analysis - Principal Component Analysis - Kernel PCA - Independent component analysis

UNIT III  LEARNING MODELS  9
Linear models for Classification and Regression - Classifiers based on Bayes Decision theory – Naïve Bayes - Nearest neighbor rules - Mixture models - Mixture of Gaussian - Hidden Markov Model

UNIT IV  ARTIFICIAL NEURAL NETWORKS  9
Supervised Learning - Unsupervised Learning- Reinforcement Learning – Feed Forward and Feedback architectures - Multilayer Perceptron - Backpropagation Algorithm- Radial Basis Function networks - Support vector Machines

UNIT V  DEEP LEARNING NETWORKS  9

OUTCOMES:
On successful completion of this course, students will be able to
- Employ different feature extraction and dimensionality reduction techniques
- Design different learning models
- Implement different neural network architectures
- Realize basic Deep neural network architectures
- Test and implement deep generative models for various data processing applications

REFERENCES:
NE5009  
COMPUTATIONAL ELECTROMAGNETICS  

OBJECTIVES:
- To understand the concepts and mathematical methods to analyze electromagnetic fields and wave phenomena.
- To learn analytical techniques to solve electromagnetic problems.
- To acquire knowledge on numerical methods for solving electromagnetic problems.
- To get acquainted with field computations.
- To understand computational techniques for high frequency systems.

UNIT I  INTRODUCTION  9

UNIT II  ANALYTICAL TECHNIQUES  9

UNIT III  NUMERICAL TECHNIQUES  9

UNIT IV  FIELD COMPUTATION FOR BASIC STRUCTURES  9

UNIT V  CASE STUDIES  9

OUTCOMES:
- To be able to understand EM problems.
- To be able to solve EM problems using analytical techniques.
- To identify numerical methods for EM problems.
- To be able to use field computation methods.
- To design and analyze antenna and other high frequency structures.

TOTAL: 45 PERIODS
REFERENCES:

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

NE5010 DIGITAL AUDIO AND VIDEO BROADCASTING TECHNOLOGY L T P C

OBJECTIVES:
- To understand the basics of audio broadcasting technology
- To understand the basics of video broadcasting technology.
- To learn the principle of audio and video coding methods.
- To understand the technology of digital TV transmission.
- To understand digital audio broadcasting.

UNIT I INTRODUCTION 9
Basic television, analog and digital TV, standards for analog and digital TV, scanning on original black and white picture, synchronization, horizontal and vertical synchronization, adding colour information, transmission methods, distortion and interference, measurements on analog video standards.

UNIT II VIDEO CODING 9
Video compression, MPEG-2 data stream, coding, modulation of moving pictures, DPCM of moving pictures, DCT and quantization, Huffman coding, structure of video elementary system, recent compression methods, MPEG-4 –H.263-advanced video coding. HDTV.

UNIT III AUDIO AND VIDEO COMPRESSION 9
Digital audio signal, MPEG and dolby digital, subband coding, transform coding for MPEG, multi channel sound, Comparison digital video signal, MPEG- 1, MPEG-- 2, VCD, DVD, MPEG 3, MPEG-4, MPEG- 7 and MPEG- 21, measurement of MPEG-2 transport system, picture quality analysis.

UNIT IV DIGITAL AUDIO BROADCASTING 9
Digital audio broadcasting (DAB),comparing DAB and DVB, physical layer of DAB, forward error correction of DAB, modulator and transmitter for DAB, single frequency networks, DAB data broadcasting.
UNIT V  DIGITAL TV SIGNAL TRANSMISSION

Digital TV signal transmission by satellite, DVB-S/S2, parameters, modulator, signal processing in satellite, receiver, satellite transmission link, DVB-S measurement of CNR, SNR and Eb/No, noise power, broadcast cable transmission, DVB-C, modulator and receiver, DVB-T and DVB-H standards.

TOTAL: 45 PERIODS

OUTCOMES:
- To be able to design and implement digital compression techniques.
- To be able to design video coding and audio compression
- To be able to design digital audio schemes
- To be able to design digital TV systems
- To identify issues and provide solutions for digital TV transmission.

REFERENCES:

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

NE5011  FUNDAMENTALS OF CLOUD COMPUTING  L T P C

OBJECTIVES
- To Introduce the fundamentals of Cloud Computing and virtualization.
- To familiarize various standards related to cloud computing.
- To be familiar with the lead players in cloud.
- To understand various cloud services in cloud computing.
- To install and use current cloud technologies

UNIT I  INTRODUCTION TO CLOUD


UNIT II  CLOUD BASED WEB SERVICES

Understanding Private and Public cloud environments – Communication as a Service (CaaS)-Infrastructure as a Service (IaaS) – On-demand, Amazon’s Elastic, Amazon EC2, Mosso–Monitoring as a Service (MaaS) –Platform as a Service (PaaS) – On-Premises model, new cloud model – Software as a Service (SaaS) –implementation issues, characteristics, SaaS model.

UNIT III  CLOUD COMPUTING FOR EVERYONE

Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists– Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation
UNIT IV USING CLOUD SERVICES

UNIT V FUTURE DIRECTIONS TO CLOUD

TOTAL : 45 PERIODS

OUTCOMES:
- To be able to build custom made clouds.
- To be able to develop remote access applications, alert generation using cloud.
- To be able to work with commercial cloud packages.
- To identify core issues of cloud computing such as security.
- To be able to install and use current cloud technologies

REFERENCES:

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

NE5073 GAME THEORY FOR WIRELESS COMMUNICATION AND NETWORKING

OBJECTIVES:
- To give an overview of a broad range of models that is studied in game theory
- To attain understanding on concepts related to non-cooperative games
- To understand a range of mathematical models of conflict and co-operation between two or more agents
- To attain understanding on concepts related to Bayesian games
- To discuss the application of game theory in wireless communication and networking

UNIT I INTRODUCTION
Introduction to theory of games- conflict, strategy, utility theory, games in extensive and normal forms, Examples.
UNIT II  NON CO-OPERATIVE GAMES  9

UNIT III  COOPERATIVE GAMES  9

UNIT IV  BAYESIAN GAMES  9
Overview of Bayesian Games, Bayesian Games in extensive form, Cournot duopoly model with incomplete information, Super-Modular games, Learning in games: Fictitious play, and Regret minimization, Vickrey-Clarke-Groves Auction, Optimal Auction.

UNIT V  APPLICATIONS TO NETWORKING  9

TOTAL: 45 PERIODS

OUTCOMES:
- To be able to understand new concept in game theory
- To be able to design non cooperative game theory based models
- To be able to design cooperative game theory based models
- To be able to design Bayesian game theory based models
- To be able to apply game theory to solve network related issues.

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To understand the role of optical fiber to transmit RF and microwave signal for wireless communication applications.
- To acquire knowledge on optical modulation techniques
- To identify different optoelectronic and all optical techniques for microwave signal generation and signal processing.
- To learn the applications of radio over fiber in the field of mobile communication networks
- To impart concepts on ROF for CATV and RADAR.

UNIT I  RADIO OVER FIBER (ROF) LINK
Introduction to microwave photonics, Radio over fiber, figure of merit and performance of microwave photonics, gain and frequency response, noise figure, distortion in RF links, directly modulated optical links, RF subcarrier link for local access networks.

UNIT II  MODULATION TECHNIQUES FOR MICROWAVE PHOTONICS
Laser diode fundamentals, rate equation analysis, small signal analysis, microwave loss, modulation effect on link performance, frequency modulation, intensity modulation, External modulation, LiNbO3 and polymer based electro optic modulator, broad band travelling wave modulator, Electro absorption modulator.

UNIT III  OPTO-ELECTRONIC OSCILLATOR AND MICROWAVE GENERATION
Basics of opto-electronic oscillators, signal generation for RF photonic systems, multi loop opto electronic oscillator, photonic link technique for microwave frequency conversion, benefits of frequency converting, optical local oscillator, microwave frequency conversion in photonic links.

UNIT IV  ROF FOR CELLULAR SYSTEMS
Analysis of analog fiber optic link, fiber optic remote antenna feeding links, comparison of fiber optic and co axial remote antenna feeding links, ROF for micro cellular system, fiber optic micro cell repeater, performance evaluation, WCDMA for 3G cellular systems, WCDMA based ROF system performance, ROF for micro cellular communication networks.

UNIT IV  ROF FOR RADAR AND CATV APPLICATIONS
ROF for mobile communications, antenna remoting applications, phased array antennas, wide band photonic phased array antenna, photonic beam steering, ROF for CATV applications, mobile CATV, ROF application for multiservice wireless communication systems, fixed and integrated multi service mobile communication.

TOTAL : 45 PERIODS

OUTCOMES:
- To be able to understand the properties of Radio over fiber link.
- To identify suitable optical modulation techniques for various applications.
- To be able to understand optical methods for microwave generations.
- To be able to design RoF based cellular systems.
- To be able apply ROF techniques for Radar and CATV applications.

REFERENCES:
OBJECTIVES:
- Understand the concepts of optical components and networks.
- To gain an understanding of various issues in designing a high speed, high date rate 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 photonics technology.

UNIT I OPTICAL SYSTEM COMPONENTS

UNIT II OPTICAL NETWORK ARCHITECTURES
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 WAVELENGTH ROUTING NETWORKS
The Optical layer, Node Designs, Optical layer cost tradeoff, Routing and Wavelength Assignment algorithms, Virtual Topology design, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS

UNIT V NETWORK DESIGN AND MANAGEMENT
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.

TOTAL: 45 PERIODS

OUTCOMES:
- To be able to apply design state-of-the-art optical networks.
- To be able to implement optical network protocols.
- To be able to design high speed networks using optical fibers.
- To be able to simulate access network.
- To be able to design the optical network infrastructure and network management methods.
REFERENCES:

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

NE5079 RECONFIGURABLE ARCHITECTURES AND APPLICATIONS L T P C 3 0 0 3

OBJECTIVES:
- The student shall develop an overview and deeper insight into the research and development that is underway to meet future needs of flexible processors
- To learn the concepts of implementation, synthesis and placement of modules in reconfigurable architectures
- To understand the communication techniques and system on programmable chip for reconfigurable architectures
- To learn the process of reconfiguration management
- To familiarize the applications of reconfigurable architectures

UNIT I INTRODUCTION

UNIT II IMPLEMENTATION, SYNTHESIS AND PLACEMENT

UNIT III COMMUNICATION AND SoPC

UNIT IV RECONFIGURATION MANAGEMENT
Reconfiguration – configuration architectures – managing the reconfiguration process – reducing configuration transfer time – configuration security.
UNIT V APPLICATIONS

FPGA based parallel pattern matching - Low power FPGA based architecture for microphone arrays in wireless sensor networks - Exploiting partial reconfiguration on a dynamic coarse grained reconfigurable architecture – Parallel pipelined OFDM baseband modulator with dynamic frequency scaling for 5G systems.

TOTAL: 45 Periods

OUTCOMES:
On successful completion of this course, students will be able to
- Analyze the different architecture principles relevant to reconfigurable computing systems
- Compare the tradeoffs that are necessary to meet the area, power and timing criteria of reconfigurable systems
- Analyze the algorithms related to placement and partitioning
- Analyze the communication techniques and system on programmable chip for reconfigurable architectures
- Analyze the principles of network and system on a programmable chip

REFERENCES:

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

NE5014 SATELLITE COMMUNICATION

OBJECTIVES:
- To provide exposure to orbital mechanics and launching techniques.
- To understand various satellite subsystems.
- To provide an in-depth knowledge in Earth station equipments and measurements.
- To know the basic parameters in satellite link design.
- To get exposed to practical applications of satellite.

UNIT I ELEMENTS OF SATELLITE COMMUNICATION

UNIT II SATELLITE SUBSYSTEM
UNIT III  EARTH STATION

UNIT IV  SPACE LINK

UNIT V  SATELLITE APPLICATIONS

TOTAL: 45 PERIODS

OUTCOMES:
- To design elements of satellite communication system.
- To be able to design satellite subsystems.
- To be able to implement earth station.
- To be able to calculate satellite link budget.
- To realize various satellite applications.

REFERENCES

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

NE5015  SPACE TIME WIRELESS COMMUNICATION

OBJECTIVES:
- To acquire the knowledge on Space time wireless technology using multiple antennas.
- To understand Space time wireless propagation and space time channel.
- To understand diversity and capacity performance of space time wireless communication.
- To exploit the channel knowledge at the transmitter.
- To realize space time multiuser communication and system design.

UNIT I  MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION 9
Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Physical scattering model, sampled signal model, ST multiuser and ST interference channels.
UNIT II CAPACITY OF MULTIPLE ANTENNA CHANNELS
Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of Ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels.

UNIT III SPATIAL DIVERSITY
Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity, Indirect transmit diversity, Diversity of a space-time- frequency selective fading channel.

UNIT IV MULTIPLE ANTENNA CODING AND RECEIVERS
Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Receivers(SISO, SIMO, MIMO), Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

UNIT V ST OFDM, SPREAD SPECTRUM AND MIMO MULTIUSER DETECTION
SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO-OFDM, SISO-SS modulation, MIMO-SS modulation, Signaling and receivers for MIMO-S, MIMO-MAC, MIMO-BC, Outage performance for MIMO-MU, MIMO-MU with OFDM.

TOTAL : 45 PERIODS

OUTCOMES:
- To be able to apply the knowledge of wireless technology using multiple antennas.
- To be able to analyze space time wireless propagation and space time channel.
- To be able to evaluate the performance of space time wireless communication.
- To be able to utilize the channel knowledge at the transmitter.
- To be able to understand space time multiuser communication.

REFERENCES

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:

- To introduce the concept of spread spectrum modulation.
- To understand the generation of PN sequence and their properties.
- To understand the performance of spread spectrum in jamming environment.
- To understand the way in which spread spectrum is applied to CDMA and GPS systems.
- To get exposed to the applications of spread spectrum.

UNIT I SPREADING CODES

- Finite-Field Arithmetic - Sequence Generator Fundamentals
- State - Machine Representation of Shift-Register Generators
- Generation & Properties of m-Sequences
- Gold Codes - Kasami Sequences (Small Set)
- Quaternary Sequences
- Complementary Code Keying - Walsh-Hadamard Sequences.

UNIT II SPREAD SPECTRUM SYSTEMS

- Direct Sequence Spread Spectrum (DSSS) - Processing Gain
- Frequency Hop Spread Spectrum (FHSS) - Coherent & Noncoherent Slow FHSS

UNIT III SYNCHRONIZATION IN SPREAD SPECTRUM

- Sources of synchronization Uncertainty, Carrier Synchronization - Code Synchronization & Acquisition
- Matched Filter Acquisition, Serial Search Acquisition, Sequential Acquisition, Code Tracking
- Delay Lock Tracking loop, Noncoherent Tracking loop.

UNIT IV SPREAD SPECTRUM IN CELLULAR COMMUNICATION

- Cellular Network and Power Control - DS-CDMA Cellular Networks, FH-CDMA Cellular Networks
- Performance in Jamming Environment – Low Probability of Intercept methods
- Optimum Intercept Receives for Spread - Spectrum Signals.

UNIT V APPLICATIONS OF SPREAD SPECTRUM METHODS

- Space Systems, Avionics Systems, Test Systems and equipment, Message Protection, GPS
- System-Principles-Differential GPS.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to arrive at detailed specifications of the spread spectrum systems.
- To be able to realize the generation of PN sequence.
- To be able to analyze synchronization issues in spread spectrum.
- To design systems based on spread spectrum to mitigate the jamming.
- To be able to design GPS system.

REFERENCES:

WT5151  WIRELESS SENSOR NETWORK DESIGN  L T P C  3 0 0 3

OBJECTIVES:
- To understand the fundamentals of wireless sensor network
- To gain knowledge on the MAC and Routing Protocols of WSN
- To get exposed to 6LOWPAN technology
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.
- To gain knowledge about operating system related to WSN and 6LOWPAN

UNIT I  INTRODUCTION  
Principle of Wireless Sensor Network - Introduction to wireless sensor networks - Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II  MAC AND ROUTING PROTOCOLS  
MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT III  6LOWPAN  

UNIT IV  APPLICATION  
Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

UNIT V  TOOLS  
TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming

TOTAL: 45 PERIODS
OUTCOMES:
- To be able to design solutions for WSNs applications
- To be able to develop efficient MAC and Routing Protocols
- To be able to design solutions for 6LOWPAN applications
- To be able to develop efficient layered Protocols in 6LOWPAN
- To be able to use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications

REFERENCES:

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

NE5077          MICROWAVES AND RADAR          L T P C 3 0 0 3

OBJECTIVES:
- To provide knowledge on the electronic devices and their implementation in generating RADAR signal
- To study the principles of operation and types of RADAR.
- To understand the theoretical principles underlying microwave sources for RADAR.
- To provide knowledge on signal processing involved in RADAR
- To learn about RADAR tracking.

UNIT I MICROWAVESOURCES 9
Passive waveguide components, Microstrip line structure and components, Simple theory and operating characteristics of Reflex klystrons, Two cavity Klystrons, Magnetrons, and TWTS - solid state source - TEDS, IMPATTS, TRAPATT, GaAs FETs and Tunnel diode.

UNIT II RADAR PRINCIPLES 9

UNIT III TYPES OF RADARS 9
UNIT IV  RADAR SIGNAL PROCESSING  

UNIT V  TRACKING RADAR  
Tracking with radar – Monopulse Tracking – conical scan and sequential lobing – limitations to tracking Accuracy- Kalman Tracker - Fundamentals of Airborne radar

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
   CO1: To understand the concepts of radar
   CO2: To derive a radar equations
   CO3: To design a radar system.
   CO4: To design and implement radar tracking algorithms.
   CO5: To review the types of microwave sources

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

VE5151  REALTIME EMBEDDED SYSTEM  
<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

OBJECTIVES:

- To have a detailed knowledge about the process involved in the design and development of real-time embedded system.
- To develop a programmable embedded platform from scratch on ARM Processor.
- To develop an integrated approach in low-power systems with hardware, software, sensors, actuators and controllers.
- To improve the knowledge base of students in Real time operating system, Systems modeling and Verification.
- To study about the different methods involved in software development, Emulation and Debugging.
UNIT - I  INTRODUCTION

UNIT II  ARM PROCESSOR

UNIT III  REAL TIME OPERATING SYSTEM

UNIT IV  EMBEDDED SYSTEM MODELING AND VERIFICATION

UNIT V  SOFTWARE DEVELOPMENT, EMULATION AND DEBUGGING TECHNIQUES
Compilation process - Native vs Cross-Compilers - Run-time libraries - Writing a library - Using Standard and alternative libraries - Porting Kernels - C extensions - Downloading - Debugging techniques - Emulation techniques

OUTCOMES:
To be able to design and program for real time embedded system application.
To be able to model and design on embedded platform.
To be able to design a system in different hardware and software platforms.
To be able to port an operating system in Embedded Systems.
Complete understanding of real-time embedded platform.

REFERENCES:

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:

- To understand the overview of DSP systems and the concepts of parallel and pipeline techniques
- To acquire knowledge on various retiming algorithms and architectures
- To acquire knowledge on fast convolution algorithms
- To understand the architecture of parallel and pipelined recursive filters
- To develop knowledge on the clocking styles of the digital circuits

UNIT - I  INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING FOR FIR FILTERS  9
Overview of DSP systems – FPGA Technology- DSP Technology Requirements- Data flow and Dependence graphs - Critical path, Loop bound, Iteration bound, Longest path matrix Algorithm, Pipelining and Parallel Processing of FIR filters.

UNIT - II  RETIMING, ALGORITHMIC STRENGTH REDUCTION  9

UNIT – III  FAST CONVOLUTION, PIPELINED AND PARALLEL RECURSIVE AND ADAPTIVE FILTERS  9
Fast convolution – Cook-Toom algorithms, Winograd algorithms, Pipelined and parallel recursive filters – Pipeline Interleaving in Digital Filters- Pipelining in I & II order Digital Filter – Parallel Processing for IIR Filter- Pipelined Adaptive Digital Filters.

UNIT – IV  BIT-LEVEL ARITHMETIC ARCHITECTURES  9
Parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers - Design of Lyon’s bit-serial multipliers using Horner’s rule, Bit-serial FIR filter design - CSD Arithmetic, CSD multiplication using Horner’s rule for precision improvement - Distributed Arithmetic - Offset binary coding.

UNIT – V  NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING  9
Sub-expression Elimination, Multiple Constant Multiplication, Sub-expression sharing - Synchronous pipelining and Clocking styles - Clock skew in edge-triggered single phase clocking and Two-phase clocking - Wave Pipelining - NPCPL - Asynchronous Pipelining.

OUTCOMES:

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

- Analyze the critical path of the DSP architectures
- Design efficient retiming architecture for FIR filter using data flow graphs
- Analyze various bit-level arithmetic architectures used in signal processing applications
- Design fast convolution algorithms to minimize computational complexity
- Analyze and implement proper clocking techniques on VLSI circuits

TOTAL: 45 PERIODS
REFERENCES:

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

CP5251 ADVANCED OPERATING SYSTEMS L T P C
9 3 0 0 3

OBJECTIVES:
- To understand the concepts of distributed systems.
- To get an insight into the various issues and solutions in distributed operating systems.
- To learn about real-time operating systems.
- To gain knowledge on the design concepts of mobile operating systems.
- To understand cloud operating systems.

UNIT I INTRODUCTION

UNIT II DISTRIBUTED OPERATING SYSTEMS

UNIT III DISTRIBUTED RESOURCE MANAGEMENT
UNIT IV  REAL TIME OPERATING SYSTEMS  9  

UNIT V  MOBILE AND CLOUD OPERATING SYSTEMS  9  

OUTCOMES:  
Upon completion of the course, the students will be able to
- Identify the features of distributed operating systems.
- Demonstrate the various protocols of distributed operating systems.
- Identify the different features of real time operating systems.
- Discuss the features of mobile operating systems.
- Discuss the features of cloud operating systems.

REFERENCES:

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

NE5080  VLSI DESIGN TECHNIQUES  L T P C  3 0 0 3

OBJECTIVES:
- To learn the fundamentals of VLSI design
- To understand the IC Manufacturing Process
- To familiarize with VLSI combinational logic circuits design
- To familiarize with VLSI sequential logic circuits design
- To learn the various arithmetic circuits and testing methodologies

UNIT - I  MOS TRANSISTOR PRINCIPLES  9  
UNIT - II  COMBINATIONAL LOGIC CIRCUITS  9

UNIT – III  SEQUENTIAL LOGIC CIRCUITS AND MEMORY ARRAY STRUCTURES  9
Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory core and peripheral circuitry, memory reliability and power dissipation. Case Studies: PLA, SRAM and NAND flash memories.

UNIT – IV  DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING  9

UNIT – V  IMPLEMENTATION STRATEGIES  9
Full custom and semicustom design – cell based design – array based implementation - Programmable ASIC logic cells - Actel ACT - Xilinx LCA - Altera FLEX and MAX.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course students will be
• Able to familiarize the basics of VLSI design.
• Able to design combinational logic circuits.
• Able to design sequential logic and memory circuits.
• Able to analyze the various design techniques involved in arithmetic building blocks.
• Able to analyze the implementation strategies in circuit design.

REFERENCES:

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:
- The course focuses on the semi-custom IC Design and introduces the principles of design logic cells, I/O cells and interconnect architecture, with equal importance given to FPGA and ASIC styles.
- The entire FPGA and ASIC design flow is dealt with from the circuit and layout design point of view.

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN
Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS
Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

UNIT III PROGRAMMABLE ASIC ARCHITECUTRE

UNIT IV LOGIC SYNTHESIS, PLACEMENT AND ROUTING

UNIT V SYSTEM-ON-CHIP DESIGN
SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, High performance filters using delta-sigma modulators.
Case Studies: Digital camera, SDRAM, High speed data standards.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to apply logical effort technique for predicting delay, delay minimization and FPGA architectures
- Ability to design logic cells and I/O cells
- Ability to analyze the various resources of recent FPGAs
- Ability to use algorithms for floorplanning and placement of cells and to apply routing algorithms for optimization of length and speed.
- Ability to analyze high performance algorithms available for ASICs

REFERENCES:
NE5074 IMAGE ANALYSIS AND COMPUTER VISION

OBJECTIVES:
- To understand the general process of image acquisition and enhancement
- To study the different image transform techniques
- To get exposed to algorithms related to image segmentation and restoration
- To learn basic concepts and methodologies in image compression
- To understand the basics of video processing for computer vision applications

UNIT I IMAGE ENHANCEMENT
Digital image fundamentals - Image sampling - Quantization - Spatial domain filtering - intensity transformations - Contrast stretching - Histogram equalization - Smoothing filters, Sharpening filters - Noise distributions - Mean filters - Order statistics filters

UNIT II IMAGE TRANSFORMS
1D DFT - 2D Transforms - DFT - DCT - Walsh - Hadamard - Slant - Haar - KLT - SVD - Wavelet transform

UNIT III IMAGE RESTORATION AND SEGMENTATION
Image restoration - degradation model - Unconstrained and Constrained restoration - Inverse filtering - Wiener filtering - Image segmentation - Thresholding - Edge detection, Edge linking - Region based methods

UNIT IV IMAGE COMPRESSION
Need for data compression - Huffman - Arithmetic coding - LZW technique - Vector Quantization - JPEG - MPEG

UNIT V VIDEO PROCESSING
Back ground Subtraction - Video analytics - Video object Segmentation - Object Detection - Face Recognition - Motion Estimation

TOTAL : 45 PERIODS

OUTCOMES:
- To be able to implement image enhancement algorithms
- To be able to apply image transform for different imaging modalities
- To be able to perform different segmentation and restoration processes
- To be able to implement different compression techniques
- To be able to develop algorithms for computer vision problems
REFERENCES:

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

NE5071    COMPUTATIONAL INTELLIGENCE   L T P C
          3 0 0 3

OBJECTIVES:
- To get exposed to neural network learning techniques and architectures
- To study fuzzy concepts and models
- To get exposed to hybrid neuro -fuzzy techniques
- To learn the basic concepts in Deep Learning networks
- To understand different optimization techniques and apply the same in different scenarios

UNIT I    NEURAL NETWORKS
Biological Neurons Networks - Artificial Neural Networks - Supervised -unsupervised learning - Reinforcement Learning - Activation functions - Perceptrons - Back Propagation networks - Radial Basis Function Networks - Adaptive Resonance architectures - Support Vector Machines

UNIT II    FUZZY LOGIC

UNIT III   NEURO-FUZZY MODELING

UNIT IV    DEEP LEARNING NETWORKS

UNIT V     EVOLUTIONARY ALGORITHMS
Heuristic search and optimization techniques - Random search - Introduction to Genetic Algorithms - Social Algorithms
OUTCOMES:
- To be able to design systems based on neural network architectures
- To be able to perform basic operations in fuzzy
- To be able to implement fuzzy models and work on fuzzy tool box
- To be able to design and implement deep learning architectures
- To be able to design optimization based algorithm for a given application

TOTAL: 45 PERIODS

REFERENCES:

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

CU5071 COGNITIVE RADIO NETWORKS

COURSE 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 SOFTWARE DEFINED RADIO AND ITS ARCHITECTURE
Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT II COGNITIVE RADIOS AND ITS ARCHITECTURE
UNIT III  SPECTRUM SENSING AND IDENTIFICATION

UNIT IV  USER COOPERATIVE COMMUNICATIONS

UNIT V  INFORMATION THEORETICAL LIMITS ON CR NETWORKS

TOTAL: 45 PERIODS

OUTCOMES:
- The student would be able to appreciate the motivation and the necessity for cognitive radio communication 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:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I  OVERVIEW OF BUSINESS ANALYTICS

SUGGESTED ACTIVITIES:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

SUGGESTED EVALUATION METHODS:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II  ESSENTIALS OF BUSINESS ANALYTICS

SUGGESTED ACTIVITIES:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

SUGGESTED EVALUATION METHODS:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCEx

SUGGESTED ACTIVITIES:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

SUGGESTED EVALUATION METHODS:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.
UNIT IV        ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK

SUGGESTED ACTIVITIES:
• Practical – Install and configure Hadoop.
• Practical – Use web based tools to monitor Hadoop setup.
• Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

SUGGESTED EVALUATION METHODS:
• Evaluation of the practical implementations.
• Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V        OTHER DATA ANALYTICAL FRAMEWORKS
Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

SUGGESTED ACTIVITIES:
• Practical – Installation of NoSQL database like MongoDB.
• Practical – Demonstration on Sharding in MongoDB.
• Practical – Install and run Pig
• Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
• Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

SUGGESTED EVALUATION METHODS:
• Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student will be able to:
• Identify the real world business problems and model with analytical solutions.
• Solve analytical problem with relevant mathematics background knowledge.
• Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
• Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
• Use open source frameworks for modeling and storing data.
• Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:
OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION

UNIT IV FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.
UNIT V  PERIODIC AND PREVENTIVE MAINTENANCE

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

OE5093 OPERATIONS RESEARCH

OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I  LINEAR PROGRAMMING
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II  ADVANCES IN LINEAR PROGRAMMING
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis
UNIT III NETWORK ANALYSIS – I
Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<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>
<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>
<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>
<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>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS

OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.
UNIT II
INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III
PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV
COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V
QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION

Definition – Classification and characteristics of Composite materials – Advantages and application of composites – Functional requirements of reinforcement and matrix – Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers – Properties and applications of whiskers, particle reinforcements – Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures – Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES


UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES


UNIT V STRENGTH

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- CO1 – Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<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>
<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>
<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>
<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>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES:

OE5096 WASTE TO ENERGY L T P C 3 0 0 3

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

UNIT IV BIOMASS COMBUSTION 9
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY 9
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features
<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<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>
<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>
<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>
<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>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES:

AUDIT COURSES (AC)

AX5091  ENGLISH FOR RESEARCH PAPER WRITING       L T P C

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

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


### 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**

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**


### UNIT III

**DISASTER PRONE AREAS IN INDIA**

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**

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**
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

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6
Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6
Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS
OUTCOMES
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES
1. “Abhyasputakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094 VALUE EDUCATION

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.
SUGGESTED READING

AX5095 CONSTITUTION OF INDIA L T P C
2 0 0 0

OBJECTIVES
Students will be able to:
• Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
• To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
• To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

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

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

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

UNIT V LOCAL ADMINISTRATION:

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

TOTAL: 30 PERIODS

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

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

AX5096 PEDAGOGY STUDIES

OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to understand:
- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING


AX5097 STRESS MANAGEMENT BY YOGA

OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharyya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharyya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. ‘Yogic Asanas for Group Tarining-Part-I”:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students
UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (don't's) - Verses-71,73,75,78 (do's)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016

TOTAL: 30 PERIODS