PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Acquire core competence and excel in computing and networking based industries.
II. Analyze and understand the foundations of networking as well as advanced techniques and tools so as to build or improve current techniques to a higher standard.
III. Possess creativity and understanding to build innovative and research-oriented systems, and provide solutions of varying complexity.
IV. Effectively communicate technical information, function effectively on teams, and apply computer engineering solutions within a global, societal, and environmental context
V. Provide consultancy and offer networking solutions for establishments.

PROGRAM OUTCOMES (POs):

1. An ability to independently carry out research/investigation and development work to solve practical problems
2. An ability to write and present a substantial technical report/document
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4. To use mathematical, algorithmic and theoretical foundations in the study of computing systems
5. To adapt to emerging generations of networking technologies to design, build and dream up innovative interconnected systems.
6. To acquire in-depth knowledge of core and emerging technologies of Computer Networks and apply them to various situations for classifying networks, analyzing performance and implementing new technologies.
ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. COMPUTER SCIENCE AND ENGINEERING (WITH SPECIALIZATION IN NETWORKS)
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>MA4151</td>
<td>Applied Probability and Statistics for Computer Science Engineers</td>
<td>FC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>RM4151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>CP4151</td>
<td>Advanced Data Structures and Algorithms</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>CP4152</td>
<td>Database Practices</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>CP4153</td>
<td>Network Technologies</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>MP4152</td>
<td>Wireless Communications</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</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>
</tbody>
</table>

PRACTICALS

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>8.</td>
<td>CP4161</td>
<td>Advanced Data Structures and Algorithms Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>NE4111</td>
<td>Networks Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

TOTAL 19 1 10 30 23

*Audit course is optional

SEMESTER II

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>CP4291</td>
<td>Internet of Things</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>CP4252</td>
<td>Machine Learning</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>NE4251</td>
<td>Network Security</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Professional Elective I</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective II</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Audit Course – II*</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

PRACTICALS

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>7.</td>
<td>NE4211</td>
<td>Term Paper Writing and seminar</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>NE4212</td>
<td>Network Design and Programming Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>NE4261</td>
<td>Network Security Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

TOTAL 17 0 12 29 21

*Audit course is optional
# Semester III

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Per Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</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>
<tr>
<td>1.</td>
<td>MU4152</td>
<td>Multimedia Communication Networks</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Professional Elective III</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Professional Elective IV</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Open Elective</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Practical

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Per Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</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>5.</td>
<td>NE4311</td>
<td>Project Work I</td>
<td>EEC</td>
<td>0 0 12</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total** 12 0 14 26 19

# Semester IV

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Per Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</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>
<tr>
<td>1.</td>
<td>NE4411</td>
<td>Project Work II</td>
<td>EEC</td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

**Total** 0 0 24 24 12

**Total No. of Credits:** 75

## Professional Electives

### Semester II, Elective I

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Per Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</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>
<tr>
<td>1.</td>
<td>NE4071</td>
<td>Wireless Sensor Networks and Protocols</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>EL4391</td>
<td>Optical Networks</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>NE4091</td>
<td>Haptic Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>IF4095</td>
<td>Social Network Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>NE4001</td>
<td>IoT Architecture and Protocols</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>SE4071</td>
<td>Agile Methodologies</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### SEMESTER II, ELECTIVE II

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CP4094</td>
<td>Mobile and Pervasive Computing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>SE4151</td>
<td>Advanced Software Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MP4091</td>
<td>Cognitive Computing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>NE4002</td>
<td>High Speed Switching Architectures</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER III, ELECTIVE III

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CP4096</td>
<td>Software Quality Assurance</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CP4095</td>
<td>Performance Analysis of Computer Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>NE4003</td>
<td>Simulation of Computer Systems and Networks</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>NE4004</td>
<td>Next Generation Networks</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CP4091</td>
<td>Autonomous Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER III, ELECTIVE IV

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MP4291</td>
<td>Cyber Physical Systems</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>CP4071</td>
<td>Bioinformatics</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>IF4071</td>
<td>Deep Learning</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>MP4292</td>
<td>Mobile Application Development</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>BC4291</td>
<td>Ethical Hacking</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AX4091</td>
<td>English for Research Paper Writing</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX4092</td>
<td>Disaster Management</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX4093</td>
<td>Constitution of India</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX4094</td>
<td>கணாமியுடன் உருவாக்கம்</td>
<td>2 0 0</td>
<td>0</td>
</tr>
</tbody>
</table>
## FOUNDATION COURSES (FC)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MA4151</td>
<td>Applied Probability and Statistics for Computer Science Engineers</td>
<td>3 Lecture, 1 Tutorial, 0 Practical</td>
<td>4</td>
<td>I</td>
</tr>
</tbody>
</table>

## PROFESSIONAL CORE COURSES (PCC)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CP4151</td>
<td>Advanced Data Structures and Algorithms</td>
<td>3 Lecture, 0 Tutorial, 0 Practical</td>
<td>3</td>
<td>I</td>
</tr>
<tr>
<td>2.</td>
<td>CP4152</td>
<td>Database Practices</td>
<td>3 Lecture, 0 Tutorial, 2 Practical</td>
<td>4</td>
<td>I</td>
</tr>
<tr>
<td>3.</td>
<td>CP4153</td>
<td>Network Technologies</td>
<td>3 Lecture, 0 Tutorial, 0 Practical</td>
<td>3</td>
<td>I</td>
</tr>
<tr>
<td>4.</td>
<td>MP4152</td>
<td>Wireless Communications</td>
<td>3 Lecture, 0 Tutorial, 0 Practical</td>
<td>3</td>
<td>I</td>
</tr>
<tr>
<td>5.</td>
<td>CP4161</td>
<td>Advanced Data Structures and Algorithms Laboratory</td>
<td>0 Lecture, 0 Tutorial, 4 Practical</td>
<td>2</td>
<td>I</td>
</tr>
<tr>
<td>6.</td>
<td>NE4111</td>
<td>Networks Laboratory</td>
<td>0 Lecture, 0 Tutorial, 4 Practical</td>
<td>2</td>
<td>I</td>
</tr>
<tr>
<td>7.</td>
<td>CP4291</td>
<td>Internet of Things</td>
<td>3 Lecture, 0 Tutorial, 2 Practical</td>
<td>4</td>
<td>II</td>
</tr>
<tr>
<td>8.</td>
<td>CP4252</td>
<td>Machine Learning</td>
<td>3 Lecture, 0 Tutorial, 2 Practical</td>
<td>4</td>
<td>II</td>
</tr>
<tr>
<td>9.</td>
<td>NE4251</td>
<td>Network Security</td>
<td>3 Lecture, 0 Tutorial, 0 Practical</td>
<td>3</td>
<td>II</td>
</tr>
<tr>
<td>10.</td>
<td>NE4212</td>
<td>Network Design and Programming Laboratory</td>
<td>0 Lecture, 0 Tutorial, 4 Practical</td>
<td>2</td>
<td>II</td>
</tr>
<tr>
<td>11.</td>
<td>NE4261</td>
<td>Network Security Laboratory</td>
<td>0 Lecture, 0 Tutorial, 2 Practical</td>
<td>1</td>
<td>II</td>
</tr>
<tr>
<td>12.</td>
<td>MU4152</td>
<td>Multimedia Communication Networks</td>
<td>3 Lecture, 0 Tutorial, 0 Practical</td>
<td>3</td>
<td>III</td>
</tr>
</tbody>
</table>

## RESEARCH METHODOLOGY AND IPR COURSES (RMC)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>RM4151</td>
<td>Research Methodology and IPR</td>
<td>2 Lecture, 0 Tutorial, 0 Practical</td>
<td>2</td>
<td>I</td>
</tr>
</tbody>
</table>

## EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>NE4211</td>
<td>Term Paper and seminar</td>
<td>0 Lecture, 0 Tutorial, 2 Practical</td>
<td>1</td>
<td>II</td>
</tr>
<tr>
<td>2.</td>
<td>NE4311</td>
<td>Project Work I</td>
<td>0 Lecture, 0 Tutorial, 12 Practical</td>
<td>6</td>
<td>III</td>
</tr>
<tr>
<td>3.</td>
<td>NE4411</td>
<td>Project Work II</td>
<td>0 Lecture, 0 Tutorial, 24 Practical</td>
<td>12</td>
<td>IV</td>
</tr>
</tbody>
</table>
## SUMMARY

### NAME OF THE PROGRAMME: M.E.COMPUTER SCIENCE AND ENGINEERING (WITH SPECIALIZATION IN NETWORKS)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>SUBJECT AREA</th>
<th>CREDITS PER SEMESTER</th>
<th>CREDITS TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1.</td>
<td>FC</td>
<td>04</td>
<td>00</td>
</tr>
<tr>
<td>2.</td>
<td>PCC</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>3.</td>
<td>PEC</td>
<td>00</td>
<td>06</td>
</tr>
<tr>
<td>4.</td>
<td>RMC</td>
<td>02</td>
<td>00</td>
</tr>
<tr>
<td>5.</td>
<td>OEC</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>6.</td>
<td>EEC</td>
<td>00</td>
<td>01</td>
</tr>
<tr>
<td>7.</td>
<td>Non Credit/Audit Course</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>8.</td>
<td>TOTAL CREDIT</td>
<td>23</td>
<td>21</td>
</tr>
</tbody>
</table>
MA4151  APPLIED PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE ENGINEERS  

COURSE OBJECTIVES: 
- To encourage students to develop a working knowledge of the central ideas of Linear Algebra. 
- To enable students to understand the concepts of Probability and Random Variables. 
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the central limit theorem. 
- To apply the small / large sample tests through Tests of hypothesis. 
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis.

UNIT I  LINEAR ALGEBRA  

UNIT II  PROBABILITY AND RANDOM VARIABLES  

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

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

UNIT V  MULTIVARIATE ANALYSIS  
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.

TOTAL : 60 PERIODS

COURSE OUTCOMES: 
At the end of the course, students will be able to
CO1: apply the concepts of Linear Algebra to solve practical problems. 
CO2: use the ideas of probability and random variables in solving engineering problems. 
CO3: be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis. 
CO4: use statistical tests in testing hypotheses on data. 
CO5: develop critical thinking based on empirical evidence and the scientific approach to knowledge development.
REFERENCES:

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

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

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

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

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

UNIT V PATENTS 6

TOTAL : 30 PERIODS

REFERENCES

CP4151 ADVANCED DATA STRUCTURES AND ALGORITHMS  L T P C
3 0 0 3

CURSE OBJECTIVES:
- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY 9
ANALYSIS

UNIT II HIERARCHICAL DATA STRUCTURES 9

UNIT III GRAPHS 9

UNIT IV ALGORITHM DESIGN TECHNIQUES 9

UNIT V NP COMPLETE AND NP HARD 9

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:
1. Write an algorithm for Towers of Hanoi problem using recursion and analyze the complexity (No of disc-4)
2. Write any one real time application of hierarchical data structure
3. Write a program to implement Make_Set, Find_Set and Union functions for Disjoint Set Data Structure for a given undirected graph G(V,E) using the linked list representation
4. Find the minimum cost to reach last cell of the matrix from its first cell
5. Discuss about any NP completeness problem

COURSE OUTCOMES:
CO1: Design data structures and algorithms to solve computing problems.
CO2: Choose and implement efficient data structures and apply them to solve problems.
CO3: Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
CO4: Design one’s own algorithm for an unknown problem.
CO5: Apply suitable design strategy for problem solving.

REFERENCES:

CP4152 DATABASE PRACTICES

COURSE OBJECTIVES
- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT I RELATIONAL DATA MODEL

Suggested Activities:
Data Definition Language
- Create, Alter and Drop
- Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
- Creating Views

Data Manipulation Language
- Insert, Delete, Update
• Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
• Aggregate Functions
• Set Operations
• Nested Queries

Transaction Control Language
• Commit, Rollback and Save Points

UNIT II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY 15


Suggested Activities:
• Distributed Database Design and Implementation
• Row Level and Statement Level Triggers
• Accessing a Relational Database using PHP, Python and R

UNIT III XML DATABASES 15


Suggested Activities:
• Creating XML Documents, Document Type Definition and XML Schema
• Using a Relational Database to store the XML documents as text
• Using a Relational Database to store the XML documents as data elements
• Creating or publishing customized XML documents from pre-existing relational databases
• Extracting XML Documents from Relational Databases
• XML Querying

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS 15


Suggested Activities:
• Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.
• Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

UNIT V DATABASE SECURITY 15

SUGGESTED ACTIVITIES:
Implementing Access Control in Relational Databases

COURSE OUTCOMES
At the end of the course, the students will be able to

- Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
- Understand and write well-formed XML documents
- Be able to apply methods and techniques for distributed query processing.
- Design and implement secure database systems.
- Use the data control, definition, and manipulation languages of the NoSQL databases

REFERENCES:

CP4153

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

COURSE OBJECTIVES:
- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To learn about Network Function Virtualization
- To understand the paradigm of Software defined networks

UNIT I
NETWORKING CONCEPTS

UNIT II
WIRELESS NETWORKS
Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT III
MOBILE DATA NETWORKS

UNIT IV SOFTWARE DEFINED NETWORKS
9

UNIT V NETWORK FUNCTIONS VIRTUALIZATION
9
Motivation- Virtual Machines – NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN – Network virtualization – VLAN and VPN

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Explain basic networking concepts
CO2: Compare different wireless networking protocols
CO3: Describe the developments in each generation of mobile data networks
CO4: Explain and develop SDN based applications
CO5: Explain the concepts of network function virtualization

SUGGESTED ACTIVITIES:
1: Execute various network utilities such as tracert, pathping, ipconfig
2: Implement the Software Defined Networking using Mininet
3: Implement routing in Mininet
4: Install a virtual machine and study network virtualization
5: Simulate various network topologies in Network Simulator

REFERENCES:
2. HoudaLabiod, Costantino de Santis, HosamAfifi – “Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007 (UNIT 2)
COURSE OBJECTIVES:

- To understand the basic concepts in cellular communication.
- To learn the characteristics of wireless channels.
- To understand 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.

SUGGESTED ACTIVITIES:

1: Survey on various features of cellular networks
2: Study the nature of cellular networks
3: A comparative study on the performance of different digital modulation techniques
4: Perform a review of various diversity techniques in wireless communication
5: Presentation on design of multicarrier systems for 5G

COURSE OUTCOMES:

CO1: Design solutions for cellular communication
CO2: Determine the capacity of wireless channels
CO3: Analyze the performance of the digital modulation techniques in fading channels
CO4: Apply various diversity techniques in wireless communication
CO5: Design multicarrier systems in wireless communication

TOTAL : 45 PERIODS

REFERENCES:

CP4161 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY

COURSE OBJECTIVES:
- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures
- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems.

LIST OF EXPERIMENTS:
1: Implementation of recursive function for tree traversal and Fibonacci
2: Implementation of iteration function for tree traversal and Fibonacci
3: Implementation of Merge Sort and Quick Sort
4: Implementation of a Binary Search Tree
5: Red-Black Tree Implementation
6: Heap Implementation
7: Fibonacci Heap Implementation
8: Graph Traversals
9: Spanning Tree Implementation
10: Shortest Path Algorithms (Dijkstra’s algorithm, Bellman Ford Algorithm)
11: Implementation of Matrix Chain Multiplication
12: Activity Selection and Huffman Coding Implementation

HARDWARE/SOFTWARE REQUIREMENTS
1: 64-bit Open source Linux or its derivative
2: Open Source C++ Programming tool like G++/GCC

TOTAL : 60 PERIODS

COURSE OUTCOMES:
CO1: Design and implement basic and advanced data structures extensively
CO2: Design algorithms using graph structures
CO3: Design and develop efficient algorithms with minimum complexity using design techniques
CO4: Develop programs using various algorithms.
CO5: Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

REFERENCES:

NE4111 NETWORKS LABORATORY
(Experiments using NS2/QUALNET/NS3/OMNET/ equivalent) L T P C 0 0 4 2

COURSE OBJECTIVES:
- To understand the functioning of various protocols in wired and wireless environments.
- To perform real time experiments using the existing infrastructure.
- To impart programming skills using NS2/QUALNET.
- To gain knowledge in constructing LAN, WLAN, and VLAN in a real-time environment.
- To understand the security algorithms for networks.

LIST OF EXPERIMENTS:
1. AODV/DSR routing
2. Security algorithms in wired networks
3. MAC protocols wired and wireless networks
4. Configuration of LAN
5. Configuration of VLAN- Tunnelling
6. Configuration of WLAN
7. Mini Project

HARDWARE/SOFTWARE REQUIREMENTS
1: C/Java/Python
2: NS2/QUALNET/NS3/OMNET/ equivalent

COURSE OUTCOMES:
CO1: Design MAC and routing protocols in Wired and Wireless Environment using NS2/QUALNET.
CO2: Acquire the technical competence to meet out the industry expectation on the state – of the art wired / wireless technologies.
CO3: Acquire the ability to design WLAN/ LAN systems meeting out real time requirements.
CO4: Design and configure a network.
CO5: Design VLAN for secured communication.
REFERENCES:
4. ns-3 Manual
5. OMNeT++ - Simulation Manual

CP4291 INTERNET OF THINGS L T P C 3 0 2 4

COURSE OBJECTIVES:
- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To understand the basics of cloud architecture
- To gain experience in Raspberry Pi and experiment simple IoT application on it

UNIT I INTRODUCTION
Internet of Things - Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications - Structure of IoT - IoT Map Device - IoT System Management with NETCONF-YANG

UNIT II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS
IETF architecture for IoT - IoT reference architecture - First Generation - Description & Characteristics - Advanced Generation - Description & Characteristics - Integrated IoT Sensors - Description & Characteristics

UNIT III IoT PROTOCOLS AND TECHNOLOGY

UNIT IV CLOUD ARCHITECTURE BASICS
The Cloud types; IaaS, PaaS, SaaS - Development environments for service development; Amazon, Azure, Google Appcloud platform in industry

UNIT V IOT PROJECTS ON RASPBERRY PI
Building IOT with RASPBERRY PI - Creating the sensor project - Preparing Raspberry Pi - Clayster libraries - Hardware Interacting with the hardware - Interfacing the hardware - Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

SUGGESTED ACTIVITIES:
1. Develop an application for LED Blink and Pattern using Arduino or Raspberry Pi
2. Develop an application for LED Pattern with Push Button Control using Arduino
3. Develop an application for LM35 Temperature Sensor to display temperature values using arduino or Raspberry Pi
4. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor
5. Develop an application for home intrusion detection web application
6. Develop an application for Smart parking application using python and Django for web application

COURSE OUTCOMES:

CO1: Understand the various concept of the IoT and their technologies
CO2: Develop the IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing
CO5: Develop and deploy the IoT application into cloud environment

TOTAL: 75 PERIODS

REFERENCES:

UNIT II  SUPERVISED LEARNING

UNIT III  UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING

UNIT IV  PROBABILISTIC METHODS FOR LEARNING-

UNIT V  NEURAL NETWORKS AND DEEP LEARNING
Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases

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

PRACTICAL EXERCISES:
1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?" (use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbours. In this question, you will use the scikit-learn’s KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.
dataset
6. Implement the Naïve Bayes Classifier using
https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.
   a. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
   b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
   c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
   d. You must properly provide references to any work that is not your own in the write-up.
   e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

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

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

REFERENCES

TOTAL: 75 PERIODS

NE4251 NETWORK SECURITY

COURSE OBJECTIVES:
- To learn the fundamentals of cryptography and its application to network security.
- To understand the mathematics behind cryptography.
- To learn about the security issues in internet protocol.
- To understand the security issues in other layers.
- To study about intrusion detection and prevention system and wireless hacking.

UNIT I INTRODUCTION TO NETWORK SECURITY

UNIT II SYMMETRIC AND ASYMMETRIC CIPHERS

UNIT III SECURITY ISSUES IN INTERNET PROTOCOL

UNIT IV SECURITY IN OTHER LAYERS

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

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

NE4211 TERM PAPER WRITING AND SEMINAR L T P C
0 0 2 1

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

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

Please keep a file where the work carried out by you is maintained.
Activities to be carried out

<table>
<thead>
<tr>
<th>Activity</th>
<th>Instructions</th>
<th>Submission week</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of area of interest and Topic</td>
<td>You are requested to select an area of interest, topic and state an objective</td>
<td>2nd week</td>
<td>3 % Based on clarity of thought, current relevance and clarity in writing</td>
</tr>
<tr>
<td>Stating an Objective</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Collecting Information about your area & topic | 1. List 1 Special Interest Groups or professional society  
2. List 2 journals  
3. List 2 conferences, symposia or workshops  
4. List 1 thesis title  
5. List 3 web presences (mailing lists, forums, news sites)  
6. List 3 authors who publish regularly in your area  
7. Attach a call for papers (CFP) from your area. | 3rd week | 3%  
( the selected information must be area specific and of international and national standard) |
| Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter | • You have to provide a complete list of references you will be using. Based on your objective - Search various digital libraries and Google Scholar  
• When picking papers to read - try to:  
  • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,  
  • Favour papers from well-known journals and conferences,  
  • Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),  
  • Favour more recent papers,  
  • Pick a recent survey of the field so you can quickly gain an overview,  
  • Find relationships with respect to each other and to your topic area (classification scheme/categorization)  
• Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered | 4th week | 6%  
( the list of standard papers and reason for selection) |
| Reading and notes for first 5 papers | Reading Paper Process  
• For each paper form a Table answering the following questions:  
  • What is the main topic of the article?  
  • What was/were the main issue(s) the author said they want to discuss?  
  • Why did the author claim it was important?  
  • How does the work build on other’s work, in the author’s opinion? | 5th week | 8%  
( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
<table>
<thead>
<tr>
<th>Reading and notes for next 5 papers</th>
<th>Repeat Reading Paper Process</th>
<th>6th week</th>
<th>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading and notes for final 5 papers</td>
<td>Repeat Reading Paper Process</td>
<td>7th week</td>
<td>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</td>
</tr>
<tr>
<td>Draft outline 1 and Linking papers</td>
<td>Prepare a draft Outline, your survey goals, along with a classification / categorization diagram</td>
<td>8th week</td>
<td>8% (this component will be evaluated based on the linking and classification among the papers)</td>
</tr>
<tr>
<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
<td>9th week</td>
<td>6% (Clarity, purpose and conclusion) 6% Presentation &amp; Viva Voce</td>
</tr>
<tr>
<td>Introduction Background</td>
<td>Write an introduction and background sections</td>
<td>10th week</td>
<td>5% (clarity)</td>
</tr>
<tr>
<td>Sections of the paper</td>
<td>Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey</td>
<td>11th week</td>
<td>10% (this component will be evaluated based on the linking and classification among the papers)</td>
</tr>
</tbody>
</table>
Your conclusions | Write your conclusions and future work | 12th week | 5% (conclusions – clarity and your ideas)
---|---|---|---
Final Draft | Complete the final draft of your paper | 13th week | 10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar | A brief 15 slides on your paper | 14th & 15th week | 10% (based on presentation and Viva-voce)

**TOTAL: 30 PERIODS**

**NE4212 NETWORK DESIGN AND PROGRAMMING LABORATORY**

**COURSE OBJECTIVES:**
- To practice LAN and WAN design
- To learn network programming in UNIX C and Python
- Establish a LAN with a switch/hub with 3 PCs and check the connectivity and configuration
- Establish an internetwork with 2 routers and two or more LANs using static routes and check the connectivity and configuration
- Establish a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration

**SUGGESTED ACTIVITIES:**
1: Develop a C program that demonstrates inter process communication
2: Develop a TCP client/server application
3: Develop a UDP client/server application
4: Develop an Iterative UDP server with 2 or 3 clients
5: Develop a concurrent TCP server with 2 or 3 clients
6: Develop a multiprotocol server with TCP and UDP and 2 clients
7: Develop a simple Python program that uses frequently used syntactic constructs
8: Develop a Socket based application in Python
9: Build client applications for major APIs (Amazon S3, Twitter etc) in Python
10: Develop an application that interacts with e-mail servers in Python

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**
- **CO1:** Design and implement LANs and internetworks
- **CO2:** Develop network based applications in UNIX C and Python
- **CO3:** Develop TCP UDP servers with multiple clients
- **CO4:** Build client applications for major API in Python
- **CO5:** Develop applications that interact with e-mail server, remote servers
NE4261  NETWORK SECURITY LABORATORY  L T P C  0 0 2 1

COURSE OBJECTIVES:

- To explore the digital signature standard.
- Learn to implement security algorithms using Wireshark
- To analyze the effectiveness of intrusion detection system
- To learn the security issues in Virtual Private Network
- To identify mechanism for secured Email communication

SUGGESTED ACTIVITIES:

1. Implement the SIGNATURE SCHEME - Digital Signature Standard
2. Implement how to capture and analyze packets using Wireshark
3. To Analysis Network using Wireshark for
   (a) Traffic Monitoring (TCP slow down and HTTP slow down)
   (b) Packet Sniffing
4. To perform man in middle attack using DNS spoofing
5. To Perform HTTP Session Hijacking through Cookie stealing
6. To Configure AAA (TACACS+) on Packet Tracer for User Authentication
7. Demonstrate intrusion detection system (ids) using any tool(snort or any other software)
8. Create a Virtual Private Network and evaluate application response time in the presence and absence of a firewall.
9. Implementation of Email incoming and outgoing authenticity controls and malware filtration and attachment security

COURSE OUTCOMES:

CO1: Implement the digital signature scheme
CO2: Develop the various security algorithms using wireshark
CO3: Use different open source tools for network security and analysis
CO4: Develop an Virtual Private Network with security.
CO5: Addressing the Email secured communication

MU4152  MULTIMEDIA COMMUNICATION NETWORKS  L T P C  3 0 0 3

COURSE OBJECTIVES:

- To recapitulate the fundamentals of networking and understand the requirements for multimedia communication.
- To learn guaranteed service model.
- To learn communication protocols that is frequently used in IoT ecosystems.
- To explore the support provided for multimedia communication in 3G and 4G networks.
- To study about VoIP and real time multimedia network applications.

UNIT I  INTRODUCTION

Switched Networks and Shared media Networks – Circuit Switching, Packet Switching and Virtual Circuits – Flow Control and Congestion Control – TCP/IP reference model – Network Externalities

**Suggested Activities:**
- Flipped classroom on network externalities and Economies of scale.
- External learning – Inter-continental backbone network and Autonomous Systems model of the Internet.
- Assignments on computing the playout time of packets.

**Suggested Evaluation Methods:**
- Quiz and discussion on network externalities and economies of scale.
- Assignments on proprietary protocols used in IoT and M2M.
- Assignments on problems related to playout time of multimedia applications.

**UNIT II GUARANTEED SERVICE MODEL**

9

**Suggested Activities:**
- Flipped classroom on IntServ and DiffServ networks.
- External learning – Exploring the ways of using DSCP in IP header.
- Assignments on finish time problems related to WFQ and its variants.

**Suggested Evaluation Methods:**
- Quiz and discussion on IntServ and DiffServ networks.
- Assignments on configuring a router in such a way that DSCP fielder is exploited to provide QoS.
- Assignments on problems related to the virtual finish and actual finish of packets in WFQ and its variants.

**UNIT III MULTIMEDIA TRANSPORT**

9

**Suggested Activities:**
- External learning – Exploring various media players available and the ways to customize them.
- Exploring the ways to configure RTP.
- Flipped classroom on RTP and RTCP.

**Suggested Evaluation Methods:**
- Assignments on media players available and configuring them.
- Configuring RTP and RTSP.
UNIT IV  MULTIMEDIA OVER WIRELESS NETWORKS

Suggested Activities:
- Flipped classroom on IMSVoLTE architecture.
- External learning – Multimedia support in 5G networks.
- Analyzing the protocols of IP media subsystem.

Suggested Evaluation Methods:
- Quiz and discussion on IMSVoLTE architecture.
- Assignments on multimedia support in 5G networks.
- Assignments on analyzing the headers of IP multimedia subsystem.

UNIT V  MULTIMEDIA NETWORKED APPLICATIONS

Suggested Activities:
- Flipped classroom on SCIBus and S.100.
- External learning – Multimedia access networks and edge networks.
- Exploring the ways to configure SIP.

Suggested Evaluation Methods:
- Quiz and discussion on SCIBus and S.100.
- Assignments on multimedia access networks and edge networks.
- Configuring SIP using suitable commands.

COURSE OUTCOMES:
On completion of the course, the students will be able to:
CO1: Deploy the right multimedia communication models.
CO2: Apply QoS to multimedia network applications at the network level with efficient scheduling and routing techniques.
CO3: Apply QoS to multimedia network applications at the end system level with efficient scheduling and routing techniques.
CO4: Understand IP multimedia subsystem and IP initiatives in cellular networks to support multimedia traffic.
CO5: Design and implement VoIP based solutions for multimedia transport.
CO6: Develop the real-time multimedia network applications.
REFERENCES:

NE4071 WIRELESS SENSOR NETWORKS AND PROTOCOLS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To learn about the issues in the design of wireless ad hoc networks
- To understand the working of protocols in different layers of mobile ad hoc and sensor networks
- To expose the students to different aspects in sensor networks
- To understand various security issues in ad hoc and sensor networks and solutions to the issues

UNIT I WIRELESS SENSOR NETWORK ARCHITECTURE
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 - Physical layer and transceiver design considerations.

UNIT II MAC & ROUTING IN WIRELESS SENSOR NETWORKS

UNIT III TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS

UNIT IV SECURITY IN AD HOC AND SENSOR NETWORKS

UNIT V TOOLS FOR WSN
COURSE OUTCOMES:
CO1: Identify different issues in wireless ad hoc and sensor networks
CO2: To analyze protocols developed for ad hoc and sensor networks
CO3: To identify and understand security issues in ad hoc and sensor networks
CO4: To learn the significance of Transport layer and QoS in wireless sensor networks.
CO5: To analyze the tools used for Wireless Sensor Networks

TOTAL: 45 PERIODS

REFERENCES

EL4391 OPTICAL NETWORKS

COURSE OBJECTIVES:
- Understand the concepts of optical components and networks.
- To gain an understanding of various issues in designing a high speed, and huge bandwidth optical network.
- To acquire knowledge of architecture and standards of optical networks.
- Thorough knowledge about the routing and access mechanism in optical networks.
- Thorough understanding of the scientific and engineering principles underlying the 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 9
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 9

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

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

TOTAL: 45 PERIODS

REFERENCES

NE4091 HAPTIC TECHNOLOGY

COURSE OBJECTIVES:
• To provide an overview of Haptic technology
• To learn the concepts of Haptic rendering system.
• To analyze the effectiveness of multimedia haptic in real time applications.
• To enable the student to create applications in a collaborative environment.

UNIT I INTRODUCTION 9
UNIT II  HUMAN HAPTIC PERCEPTION AND MACHINE HAPTICS  9

UNIT III  COMPUTER HAPTICS  9
Haptic Rendering Subsystem-Polygon based Representation and Scene Graph-Collision Detection Techniques and Bounding Volumes-Penetration Depth and Collision Response-Haptic Rendering of Surface Properties-Haptic Rendering of other Representation methods- Haptic Rendering of more than 3-DOF-Control Methods for Haptic systems-Benchmarking Haptic Rendering systems-Haptic Software Frameworks

UNIT IV  MULTIMEDIA HAPTICS  9

UNIT V  TOUCHING THE FUTURE: CHALLENGES AND TRENDS  9

COURSE OUTCOMES:
CO1: Demonstrate knowledge in human perception, Machine and Multimedia Haptics.
CO2: Create integrated and collaborative haptic systems
CO3: Identify and representation of Haptic Rendering subsystem
CO4: Analyze and characterize Multimedia Haptics
CO5: Learn the challenges, recent trends and applications of Haptic Technology

TOTAL: 45 PERIODS

REFERENCES
2. http://haptic.mech.nwu.edu

IF4095  SOCIAL NETWORK ANALYSIS  L T P C
3 0 0 3

COURSE OBJECTIVES:
- Formalise different types of entities and relationships as nodes and edges and represent this information as relational data.
• Understand the fundamental concepts in analyzing the large-scale data that are derived from social networks
• Understand the basic concepts and principles of different theoretical models of social networks analysis.
• Transform data for analysis using graph-based and statistics-based social network measures
• Choose among social network designs based on research goals

UNIT I  GRAPH THEORY AND STRUCTURE

UNIT II  SOCIAL NETWORK GRAPH ANALYSIS
Social network exploration/ processing and properties: Finding overlapping communities, similarity between graph nodes, counting triangles in graphs, neighborhood properties of graphs. Pregel paradigm and Apache Giraph graph processing system.

UNIT III  INFORMATION DIFFUSION IN SOCIAL NETWORKS

UNIT IV  CASCADING IN SOCIAL NETWORKS

UNIT V  LINK ANALYSIS & COMMUNITY DETECTION

SUGGESTED ACTIVITIES:
1: Twitter Intelligence project performs tracking and analysis of the Twitter
2: Large-Scale Network Embedding as Sparse Matrix Factorization
3: Implement how Information Propagation on Twitter
4: Social Network Analysis and Visualization software application.
5: Implement the Structure of Links in Networks
COURSE OUTCOMES:
CO1: Plan and execute network analytical computations.
CO2: Implement mining algorithms for social networks
CO3: Analyze and evaluate social communities.
CO4: Use social network analysis in behavior analytics
CO5: Perform mining on large social networks and illustrate the results.

TOTAL: 45 PERIODS

REFERENCES
1. Practical Social Network Analysis with Python, Krishna Raj P. M. Ankith Mohan and K. G. Srinivasa. Springer, 2018

NE4001 IoT ARCHITECTURE AND PROTOCOLS

COURSE OBJECTIVES:
- To learn about the basics of IoT
- To study the architecture of IoT with its reference model
- To discuss the various IoT network layer protocols.
- To identify the various IoT application layer protocols with its features
- To develop various IoT-based real time applications.

UNIT I BASICS OF IoT
Introduction to IoT - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates- Domain Specific IoTs - IoT and M2M - Applications of IoT, Use cases of IoT

UNIT II IoT ARCHITECTURE

UNIT III IoT NETWORK LAYER PROTOCOL

UNIT IV IOT APPLICATION LAYER PROTOCOLS
Message Queuing Protocol (AMQP) - Representational State Transfer (REST) – Comparative Analysis

UNIT V APPLICATIONS AND CASE STUDY
Real world design constraints – Applications: Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - Case study : Cloud-Based Smart-Facilities Management, Healthcare, Environment Monitoring System.

COURSE OUTCOMES:
CO1: Comprehend the essentials of IoT and its applications
CO2: Understand the concepts of IoT Architecture Reference model and IoT reference architecture
CO3: Use of IoT network layer protocols with security challenges.
CO4: Analyze various IoT Application layer Protocols
CO5: Design IoT-based systems for real-world problems

REFERENCES

SE4071 AGILE METHODOLOGIES

COURSE OBJECTIVES:
• To learn the fundamental principles and practices associated with each of the agile development methods
• To apply the principles and practices of agile software development on a project of interest and relevance to the student.
• To provide a good understanding of software design and a set of software technologies and APIs.
• To do a detailed examination and demonstration of Agile development and testing techniques.
• To understand Agile development and testing.

UNIT I AGILE SOFTWARE DEVELOPMENT
Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges . Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project / How Agile helps to build quality
UNIT II AGILE AND SCRUM PRINCIPLES 9

UNIT III AGILE PRODUCT MANAGEMENT 9
Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue

UNIT IV AGILE REQUIREMENTS AND AGILE TESTING 9

UNIT V AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS 9

COURSE OUTCOMES:

CO1: Analyze existing problems with the team, development process and wider organization
CO2: Apply a thorough understanding of Agile principles and specific practices
CO3: Select the most appropriate way to improve results for a specific circumstance or need
CO4: Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems
CO5: Evaluate likely successes and formulate plans to manage likely risks or problems

TOTAL: 45 PERIODS

REFERENCES
COURSE OBJECTIVES:

- To understand the basics of Mobile Computing and Personal Computing
- To learn the role of cellular networks in Mobile and Pervasive Computing
- To expose to the concept of sensor and mesh networks
- To expose to the context aware and wearable computing
- To learn to develop applications in mobile and pervasive computing environment

UNIT I  INTRODUCTION


UNIT II  3G AND 4G CELLULAR NETWORKS


UNIT III  SENSOR AND MESH NETWORKS


UNIT IV  CONTEXT AWARE COMPUTING & WEARABLE COMPUTING


UNIT V  APPLICATION DEVELOPMENT

Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone

COURSE OUTCOMES:

CO1: Design a basic architecture for a pervasive computing environment
CO2: Design and allocate the resources on the 3G-4G wireless networks
CO3: Analyze the role of sensors in Wireless networks
CO4: Work out the routing in mesh network
CO5: Deploy the location and context information for application development
CO6: Develop mobile computing applications based on the paradigm of context aware computing and wearable computing

TOTAL: 45 PERIODS

REFERENCES

SE4151 ADVANCED SOFTWARE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the rationale for software development process models
- To understand why the architectural design of software is important;
- To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
- To understand the basic notions of a web service, web service standards, and service-oriented architecture;
- To understand the different stages of testing from testing during development of a software system

UNIT I SOFTWARE PROCESS & MODELING 9

UNIT II SOFTWARE DESIGN 9
UNIT III  SYSTEM DEPENDABILITY AND SECURITY  9

UNIT IV  SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING  9

UNIT V  SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT  9

SUGGESTED ACTIVITIES
1. Comparatively analyzing different Agile methodologies.
2. Describing the scenarios where ‘Scrum’ and ‘Kanban’ are used.
3. Mapping the data flow into suitable software architecture.
4. Developing behavioural representations for a class or component.
5. Implementing simple applications as RESTful service.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The Students will be able to

**CO1:** Identify appropriate process models based on the Project requirements

**CO2:** Understand the importance of having a good Software Architecture.

**CO3:** Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.

**CO4:** Understand the basic notions of a web service, web service standards, and service-oriented architecture;

**CO5:** Be familiar with various levels of Software testing

REFERENCES:
MP4091 COGNITIVE COMPUTING

COURSE OBJECTIVES:
- To familiarize Use the Innovation Canvas to justify potentially successful products.
- To learn various ways in which to develop a product idea.
- To understand about how Big Data can play vital role in Cognitive Computing
- To know about the business applications of Cognitive Computing
- To get into all applications of Cognitive Computing

UNIT I FOUNDATION OF COGNITIVE COMPUTING
Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition
Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services

UNIT II NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS
Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations

UNIT III BIG DATA AND COGNITIVE COMPUTING
Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics

UNIT IV BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING
Preparing for change, advantages of new disruptive models, knowledge meaning to business, difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan for the future, answering business questions in new ways, building business specific solutions, making cognitive computing a reality, cognitive application changing the market The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing

UNIT V APPLICATION OF COGNITIVE COMPUTING
Building a cognitive health care application: Foundations of cognitive computing for healthcare,
constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching

COURSE OUTCOMES:
CO1: Explain applications in Cognitive Computing.
CO2: Describe Natural language processor role in Cognitive computing.
CO3: Explain future directions of Cognitive Computing
CO4: Evaluate the process of taking a product to market
CO5: Comprehend the applications involved in this domain.

TOTAL:45 PERIODS

REFERENCES

NE4002 HIGH SPEED SWITCHING ARCHITECTURES

COURSE OBJECTIVES:
- To learn the basics of switching
- To explore the various space division switches
- To evaluate the performance of various switching architectures
- To study the architecture of IP routers
- To study about MPLS switches

UNIT I SWITCHING BASICS
Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals

UNIT II SWITCHING ARCHITECTURES
UNIT III

PACKET QUEUES AND DELAY ANALYSIS

Little’s theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – Pollaczek Khintchine formula –M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burkes theorem and Jackson theorem.

UNIT IV

P ROUTER ARCHITECTURE

Bus based router architecture with single processor and multiple processors – Architecture with multiple parallel forwarding engines – Switch based router architecture with multiple processors – Switch based router architecture with multiple processors – Switch based architecture with fully distributed processors – Critical and non critical data path processing – fast and slow path.

UNIT V

MPLS ROUTERS


COURSE OUTCOMES:

CO1: Apply switching concepts to build networks.
CO2: Deploy the network with appropriate type of switches.
CO3: Analyze the queuing disciplines and delay analysis
CO4: Select and configure the appropriate type of IP router
CO5: Design and implement MPLS networks

TOTAL: 45 PERIODS

REFERENCES

1. Damitri P Bertsekas and Gallager, Data Networks‖, 2nd edition, PHI, 1992
5. Luc De Ghein, MPLS Fundamentals‖, Cisco Press 2014

CP4096

SOFTWARE QUALITY ASSURANCE

L T P C
3 0 0 3

COURSE OBJECTIVES:

• Be exposed to the software quality factors, Quality Assurance (SQA) architecture and SQA components.
• Understand the integration of SQA components into the project life cycle.
• Be familiar with the software quality infrastructure.
• Be exposed to the management components of software quality.
• Be familiar with the Quality standards, certifications and assessments

UNIT I

INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE

Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall’s quality model – SQA system components – Pre project quality components – Development and
quality plans.

UNIT II  SQA COMPONENTS AND PROJECT LIFE CYCLE  9
Integrating quality activities in the project life cycle – Reviews – Software Testing – Quality of software maintenance components – Quality assurance for external participants contribution – CASE tools for software quality Management.

UNIT III  SOFTWARE QUALITY INFRASTRUCTURE  9
Procedures and work instructions – Supporting quality devices - Staff training and certification - Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control.

UNIT IV  SOFTWARE QUALITY MANAGEMENT & METRICS  9
Project process control – Software quality metrics – Cost of software quality – Classical quality cost model – Extended model – Application and Problems in application of Cost model

UNIT V  STANDARDS, CERTIFICATIONS & ASSESSMENTS  9

COURSE OUTCOMES:
CO1: Utilize the concepts of SQA in software development life cycle
CO2: Demonstrate their capability to adopt quality standards.
CO3: Assess the quality of software products.
CO4: Apply the concepts in preparing the quality plan & documents.
CO5: Ensure whether the product meets company's quality standards and client's expectations and demands

TOTAL: 45 PERIODS

REFERENCES

CP4095  PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS  L T P C
3 0 0 3

COURSE OBJECTIVES:
• To understand the mathematical foundations needed for performance evaluation of computer systems
• To understand the metrics used for performance evaluation
• To understand the analytical modeling of computer systems
• To enable the students to develop new queuing analysis for both simple and complex systems
• To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

UNIT I  OVERVIEW OF PERFORMANCE EVALUATION  9

UNIT II  MARKOV CHAINS AND SIMPLE QUEUES  9

UNIT III  MULTI-SERVER AND MULTI-QUEUE SYSTEMS  9
Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke’s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV  REAL-WORLD WORKLOADS  9

UNIT V  SMART SCHEDULING IN THE M/G/1  9

TOTAL : 45 PERIODS

COURSE OUTCOMES :
Upon completion of this course, the students should be able to
CO1:Identify the need for performance evaluation and the metrics used for it
CO2:Distinguish between open and closed queuing networks
CO3:Apply Little’e law and other operational laws to open and closed systems
CO4:Use discrete-time and continuous-time Markov chains to model real world systems
CO5:Develop analytical techniques for evaluating scheduling policies

REFERENCES:

NE4003 SIMULATION OF COMPUTER SYSTEMS AND NETWORKS

3 0 0 3

COURSE OBJECTIVES:
- To understand how simulators are built.
- To understand the statistical models used in simulations.
- To learn different ways of generating random numbers.
- To learn modeling of the data given as input to simulators.
- To understand how computer networks are simulated using case studies.

UNIT I STATISTICAL AND QUEUING MODELS

9

UNIT II RANDOM NUMBER AND RANDOM VARIATE GENERATION

9
Properties of random numbers – Generating uniform random numbers – Generating non-uniform random numbers - Tests for random numbers – Random-variate generation

UNIT III ANALYSIS OF SIMULATION DATA

9
Input modeling – Identifying the distribution – Parameter estimation – Goodness-of-fit tests – Multivariate and time-series input models – Verification and validation of simulation models

UNIT IV SIMULATION OF COMPUTER NETWORKS

9

UNIT V CASE STUDIES OF NETWORK SIMULATORS

9

COURSE OUTCOMES:
CO1: Understand the modeling and development of simulations and simulators
CO2: Differentiate the different ways in which simulators are designed
CO3: Analyze how computer networks are simulated
CO4: Use simulators like ns-3
CO5: Compare the features of different simulators

TOTAL: 45 PERIODS

REFERENCES

**NE4004 NEXT GENERATION NETWORKS**

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>To understand evolution of technologies of 4G and beyond.</td>
</tr>
<tr>
<td>To learn the fundamentals of 5G internet.</td>
</tr>
<tr>
<td>To explore NGN architecture and management activities.</td>
</tr>
<tr>
<td>To gain the knowledge of Cooperation for Next Generation Wireless Networks</td>
</tr>
<tr>
<td>To learn security risks in 5G networks.</td>
</tr>
</tbody>
</table>

**UNIT I 4G AND BEYOND**

**UNIT II 5G INTERNET**

**UNIT III NGN ARCHITECTURE AND MANAGEMENT**
Evolution towards NGN-Technology requirements - NGN functional architecture- Transport stratum, service stratum - NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management - Service and control manage

**UNIT IV COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS**

**UNIT V SECURITY AND SELF ORGANISING NETWORKS**

**COURSE OUTCOMES:**
CO1: Understand the issues and challenges of wireless domain in future generation network design.
CO2: To be able to explore the LTE concepts and technologies.
CO3: Gain the knowledge in Architecture of NGN and its management activities.
CO4: Explore the Cooperation for Next Generation Wireless Networks.
CO5: Analyze the security risks in 5G networks.

TOTAL: 45 PERIODS

REFERENCES


CP4091 AUTONOMOUS SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on the functional architecture of autonomous vehicles
- To impart knowledge on Localization and mapping fundamentals
- To impart knowledge on process end effectors and robotic controls
- To learn Robot cell design, Robot Transformation and Sensors
- To learn Micro/Nano Robotic Systems

UNIT I INTRODUCTION AND FUNCTIONAL ARCHITECTURE

Functional architecture - Major functions in an autonomous vehicle system, Motion Modeling - Coordinate frames and transforms, point mass model, Vehicle modeling (kinematic and dynamic bicycle model - two-track models), Sensor Modeling - encoders, inertial sensors, GPS.

UNIT II PERCEPTION FOR AUTONOMOUS SYSTEMS

SLAM - Localization and mapping fundamentals, LIDAR and visual SLAM, Navigation – Global path planning, Local path planning, Vehicle control - Control structures, PID control, Linear quadratic regulator, Sample controllers.

UNIT III ROBOTICS INTRODUCTION, END EFFECTORS AND CONTROL

UNIT IV  ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN


UNIT V  MICRO/NANO ROBOTICS SYSTEM

Micro/Nano robotics system overview-Scale effect-Top down and bottom up approach Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in targeted drug delivery system.

COURSE OUTCOMES:

CO1: Understand architecture and modeling of autonomous systems.
CO2: Employ localization mapping techniques for autonomous systems
CO3: Design solutions for autonomous systems control.
CO4: Analyze Robot Transformations, Sensors and Cell Design
CO5: Explain the working principles of Micro/Nano Robotic system

TOTAL : 45 PERIODS

REFERENCES


MP4291  CYBER PHYSICAL SYSTEMS  L T P C

COURSE OBJECTIVES:

- To learn about the principles of cyber-physical systems
- To familiarize with the basic requirements of CPS.
- To know about CPS models
- To facilitate the students to understand the CPS foundations
- To make the students explore the applications and platforms.
- To provide introduction to practical aspects of cyber physical systems.
- To equip students with essential tools to implement CPS.
UNIT I  INTRODUCTION TO CYBER-PHYSICAL SYSTEMS  6
Cyber-Physical Systems(CPS)-Emergence of CPS, Key Features of Cyber-Physical Systems,,
CPS Drivers-Synchronous Model : Reactive Components, Properties of Components, Composing
Components, Designs- Asynchronous Model of CPS: Processes, Design Primitives, Coordination
Protocols

UNIT II  CPS - REQUIREMENTS  12
Safety Specifications: Specifications, Verifying Invariants, Enumerative Search, Symbolic Search-
Liveness Requirements: Temporal Logic, Model Checking, Proving Liveness

UNIT III  CPS MODELS  9
Dynamical Systems: Continuous, Linear Systems-Time Models, Linear Systems, Designing
Controllers, Analysis Techniques- Timed Model: Processes, Protocols, Automata- Hybrid
Dynamical Models

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

UNIT V  APPLICATIONS AND PLATFORMS  9
Medical CPS- CPS Built on Wireless Sensor Networks- CyberSim User Interface- iClebo Kobuki -
IRobot Create- myRIO- Cybersim- Matlab toolboxes - Simulink.

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

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

TOTAL: 45+30=75 PERIODS

REFERENCES
1. Raj Rajkumar, Dionisio De Niz , and Mark Klein, Cyber-Physical Systems, Addison-Wesley
Professional, 2016
3. Lee, Edward Ashford, and Sanjit Arunkumar Seshia. Introduction to embedded systems: A
cyber physical systems approach. 2nd Edition, 2017
4. André Platzer, Logical Analysis of Hybrid Systems: Proving Theorems for Complex
7. documentation | KOBUKI (yujinrobot.com)

CP4071 BIO INFORMATICS

COURSE OBJECTIVES:
- Exposed to the need for Bioinformatics technologies
- Be familiar with the modeling techniques
- Learn microarray analysis
- Exposed to Pattern Matching and Visualization
- To know about Microarray Analysis

UNIT I INTRODUCTION
Need for Bioinformatics technologies – Overview of Bioinformatics technologies
Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System.

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS
Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

UNIT III MODELING FOR BIOINFORMATICS

UNIT IV PATTERN MATCHING AND VISUALIZATION

UNIT V MICROARRAY ANALYSIS

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:
1. Manipulating DNA strings
2. Use Protein Data Bank to visualize and Analyze the Proteins from protein database
3. Explore the Human Genome with the SciPy Stack
4. Hidden Markov Model for Biological Sequence
5. Molecular Modeling using MMTK package
6. Sequence Alignment using Biopython, Pairwise and multiple sequence alignment using ClustalW and BLAST
7. Simple generation and manipulation of genome graphs
8. DNA data handling using Biopython
9. Chaos Game Representation of a genetic sequence
10. Visualize the microarray data using Heatmap

TOTAL: 30 PERIODS

COURSE OUTCOMES:
CO1: Understand the different Data formats
CO2: Develop machine learning algorithms.
CO3: Develop models for biological data.
CO4: Apply pattern matching techniques to bioinformatics data – protein data genomic data.
CO5: Apply micro array technology for genomic expression study.

TOTAL: 45+30=75 PERIODS

REFERENCES

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

UNIT I DEEP LEARNING CONCEPTS 6

UNIT II NEURAL NETWORKS 9
UNIT III CONVOLUTIONAL NEURAL NETWORK 10

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN 10

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

LIST OF EXPERIMENTS: 30
1: Feature Selection from Video and Image Data
2: Image and video recognition
3: Image Colorization
4: Aspect Oriented Topic Detection & Sentiment Analysis
5: Object Detection using Autoencoder

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

TOTAL PERIODS: 45+30=75 PERIODS

REFERENCES
1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
COURSE OBJECTIVES:
- To facilitate students to understand android SDK
- To help students to gain basic understanding of Android application development
- To understand how to work with various mobile application development frameworks
- To inculcate working knowledge of Android Studio development tool
- To learn the basic and important design concepts and issues of development of mobile applications

UNIT I MOBILE PLATFORM AND APPLICATIONS

UNIT II INTRODUCTION TO ANDROID

UNIT III ANDROID APPLICATION DESIGN ESSENTIALS

UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA
User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation, Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

UNIT V ANDROID APIs
Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

LIST OF EXPERIMENTS:
1: Develop an application that uses GUI components, Font, Layout Managers and event listeners.
2: Develop an application that makes use of databases
3: Develop a native application that uses GPS location information
4: Implement an application that creates an alert upon receiving a message
5: Develop an application that makes use of RSS Feed.
6: Create an application using Sensor Manager
7: Create an android application that converts the user input text to voice.
8: Develop a Mobile application for simple and day to day needs (Mini Project)
COURSE OUTCOMES:
CO1: Identify various concepts of mobile programming that make it unique from programming for other platforms
CO2: Create, test and debug Android application by setting up Android development
CO3: Demonstrate methods in storing, sharing and retrieving data in Android applications
CO4: Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CO5: Create interactive applications in android using databases with multiple activities including audio, video and notifications and deploy them in marketplace

TOTAL: 45+30=75 PERIODS

REFERENCES
4. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd, 2010
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009

BC4291 ETHICAL HACKING

COURSE OBJECTIVES:
- To understand and analyze security threats & countermeasures related to ethical hacking.
- To learn the different levels of vulnerabilities at a system level.
- To gain knowledge on the different hacking methods for web services and session hijacking.
- To understand the hacking mechanisms on how a wireless network is hacked.

UNIT I ETHICAL HACKING OVERVIEW & VULNERABILITIES
Understanding the importance of security, Concept of ethical hacking and essential Terminologies Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking

UNIT II FOOTPRINTING & PORT SCANNING
Footprinting - Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase, Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS

UNIT III SYSTEM HACKING
Aspect of remote password guessing, Role of eavesdropping ,Various methods of password
UNIT IV Hacking Web Services & Session Hijacking

Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers. Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools

UNIT V Hacking Wireless Networks

Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLANScanners, WLANSniffers, Hacking Tools, Securing Wireless Network

LIST OF EXPERIMENTS:
1. Study of Guessing username and passwords using Hydra
2. Experiment on Recovering password Hashes
3. Implementation to crack Linux passwords
4. Experiments on SQL injections
5. Analysis of WEP flaws
6. Experiments on Wireless DoS Attacks
7. Implementation of Buffer Overflow Prevention
8. Prevention against Cross Site Scripting Attacks
9. Experiments on Metasploit Framework
10. Implementation to identify web vulnerabilities
11. Wireshark: Experiment to monitor live network capturing packets and analyzing over the live network
12. LOIC: DoS attack using LOIC
13. FTK: Bit level forensic analysis of evidential image and reporting the same.
14. Darkscomet: Develop a malware using Remote Access Tool Darkcomet to take a remote access over network
15. HTTrack: Website mirroring using Httrack and hosting on a local network.
16. XSS: Inject a client side script to a web application
17. Emailtrackerpro: Email analysis involving header check, tracing the route. Also perform a check on a spam mail and non-spam mail

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand vulnerabilities, mechanisms to identify vulnerabilities/threats/attacks
CO2: Use tools to identify vulnerable entry points
CO3: Identify vulnerabilities using sniffers at different layers
CO4: Handle web application vulnerabilities
CO5: Identify attacks in wireless networks

TOTAL: 45 + 30 = 75 PERIODS

REFERENCES

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010
5. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003

AUDIT COURSES

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

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

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

UNIT II PRESENTATION SKILLS 6

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

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

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

TOTAL: 30 PERIODS

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

AX4092 DISASTER MANAGEMENT  L  T  P  C
2  0  0  0

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

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS  6

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

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

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

TOTAL : 30 PERIODS

COURSE OUTCOMES:
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches.

REFERENCES:

AX4093 CONSTITUTION OF INDIA

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

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

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

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

TOTAL: 30 PERIODS

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

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

தானு கல்வி பாடுகள்

1. கண வளர்சி புரட்சி
   - சிறப்பு பிரிவால் நடவடிக்கை
2. மூந்திய இலக்கியம் முன்னேற்ற
   - சிறப்பு பிரிவு அறிமுகப்படுத்துபவை

UNIT IV

அதிகம் குறிப்பிட்டு

1. சிறப்பு வகைப்பாடு
   - பாரதி மாணவக்குரிய அகண்ட குறிப்பிட்டு, பாட்டு புதுச்சதுரம்
2. மூந்தியவகுத்தலாச் சிறப்பு
3. சிறப்பு (617, 618)
4. குற்றுச்சக்கர இலக்கியம் அறிமுகப்படுத்து
5. பாரதிக்கு
   - சிறப்பு வகைப்பாடு
6. அகாதாரம் (4) - சரணம்
   குறிநிதி (11) - தமிழ்
   குறிச்சொல் (11) - பாரதி, புது
   சிறப்பு (50) (27) - பாரதி
   சிறப்பு பாரதியானாக்கிகள்

UNIT V

துசா குறிப்பிட்டு வகைப்பாடு

1. அசவேனக குறிப்பிட்டு
   - சபையிட்டு புது புதுதியம்
   - சமையல் புது சுருக்கம்
   - குறிச்சொல் வகைப்பாடு
   - பாரதி வகைப்பாடு
   - தராம்
2. மாடா விசாகப்பு விளையாடப்படும் குறிப்பிட்டு வகைப்பாடு
3. முதலாம் விசாகப்பு வகைப்பாடு
4. பாரதி விசாகப்பு விளையாடப்படும் சிறப்பு வகைப்பாடு
5. அரியிச்சொல் குறிப்பிட்டு
6. தொலைவித்திய குறிப்பிட்டு
7. குறிச்சொல் விளையாடப்படும் குறிப்பிட்டு வகைப்பாடு.
தமிழ் திசைசிய அலைப்பொருள் / புதுக்கலைகள்

1. தமிழ் திசைசிய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியொ (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. தமிழ் விளையாட்டு அக்ஷர்பீடியா
4. மாணிக்கள் கல்விக்கழகம்
   - மாணிக்கள் பல்கலைக்கழகம், தன்னூர்
5. தமிழ் மாணிக்கள் கல்விக்கழகம்
   - தமிழ் மாணிக்கள் கல்விக்கழகம் (thamilvalarchithurai.com)
6. ஆற்றைறியன் கல்விக்கழகம்
   - ஆற்றைறியன் பல்கலைக்கழகம், தன்னூர்