VISION OF THE DEPARTMENT:
The Department of Information Science and Technology pledges to educate students with conceptual knowledge and technical skills to forge ahead in the field of IT, while inculcating deep moral and ethical values to achieve excellence, by providing a vibrant academic and research environment in collaboration with industry.

MISSION OF THE DEPARTMENT:

1. To inculcate in students, affirm foundation in theory and practice of IT skills coupled with the thought process for disruptive innovation and research methodologies, to keep pace with emerging technologies.
2. To provide a conducive environment for all academic, administrative, and interdisciplinary research activities using state-of-the-art technologies.
3. To produce graduates and doctorates, who will enter the workforce as productive IT engineers, researchers, and entrepreneurs with necessary soft skills, and continue higher professional education with competence in the global market.
4. To enable seamless collaboration with the IT industry and Government for consultancy and sponsored research.
5. To cater to cross-cultural, multi-national and demographic diversity of students.
6. To educate the students on the social, ethical, and moral values needed to make significant contributions to society.
1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
   1. To prepare students to excel in research and to succeed in Information Technology Profession by adapting to the rapid advances in new emerging technologies through rigorous post-graduate education.
   2. To provide students with a solid foundation in mathematical, scientific, and computing fundamentals required to develop IT solutions to real-world problems of Industries, Businesses and Society.
   3. To train students with multimedia computing knowledge and creative thinking to comprehend, analyze, design innovative products with immersive user experience.
   4. To inculcate leadership qualities, teamwork, and effective communication skills in students for successful professional growth.
   5. To be aware of and practice ethical codes and guidelines and contribute to sustainable development of society.

2. PROGRAMME OUTCOMES (POs):
   After going through the two years of study, our M.Tech Information Technology (Specialization In Artificial Intelligence and Data Science) Graduates will exhibit the ability to:

<table>
<thead>
<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
<th>Programme Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Research Aptitude</td>
<td>An ability to independently carry out research / Investigations, identify problems and develop solutions to solve practical problems</td>
</tr>
<tr>
<td>2</td>
<td>Technical documentation</td>
<td>An ability to write and present a substantial technical report/ document</td>
</tr>
<tr>
<td>3</td>
<td>Technical competence</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
</tr>
<tr>
<td>4</td>
<td>Handle complex problems</td>
<td>Use research based knowledge, methods, appropriate techniques, resources and tools to solve complex engineering issues with an understanding of the limitations</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Sustainability and societal Ethics</td>
<td>Ensure development of socially relevant and eco friendly indigenous products by applying technical knowledge, ethical principles and, sound engineering practices</td>
</tr>
<tr>
<td>6</td>
<td>Life-long learning</td>
<td>Recognize the need for independent, life-long learning and engage in the broadest context of technological change</td>
</tr>
</tbody>
</table>
3. CO/ POMapping:

<table>
<thead>
<tr>
<th>Programme Educational Objectives</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE01</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PE02</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE03</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PE04</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PE05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

4. Mapping of Course Outcome and Programme Outcome

<table>
<thead>
<tr>
<th>Year</th>
<th>Sem.</th>
<th>Course Name</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR II</td>
<td>SEM I</td>
<td>Probability and Statistical Methods</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Research Methodology and IPR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Data Structures and Algorithms</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2.5</td>
<td>2.16</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fundamentals of Data Science</td>
<td>3</td>
<td>2.83</td>
<td>2.66</td>
<td>2.66</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Artificial Intelligence</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced Database Management Systems</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1.83</td>
</tr>
<tr>
<td>YEAR II</td>
<td>SEM II</td>
<td>Foundation of Machine Learning</td>
<td>2.5</td>
<td>2</td>
<td>2.16</td>
<td>2</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foundation of Deep Learning</td>
<td>1.33</td>
<td>1.5</td>
<td>1</td>
<td>1.16</td>
<td>1.66</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Big Data Analytics</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEAR II</td>
<td>SEM III</td>
<td>Next Generation Wireless Networks</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional Elective V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Work I</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Work II</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Attested

[Signature]

Director

Centre for Academic Courses
Anna University, Chennai-600 025
## ANNA UNIVERSITY, CHENNAI
### UNIVERSITY DEPARTMENTS
#### REGULATIONS – 2023
##### CHOICE BASED CREDIT SYSTEM
##### M.TECH INFORMATION TECHNOLOGY
##### (Specialization in Artificial Intelligence and Data Science)
##### CURRICULUM 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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA3160</td>
<td>Probability and Statistical Methods</td>
<td>FC</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>RM3151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>IF3151</td>
<td>Advanced Data Structures and Algorithms</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>DS3101</td>
<td>Fundamentals of Data Science</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>DS3102</td>
<td>Artificial Intelligence</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>IF3152</td>
<td>Advanced Database Management Systems</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td>18</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

### 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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>DS3201</td>
<td>Foundations of Machine Learning</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>DS3202</td>
<td>Foundations of Deep Learning</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>DS3203</td>
<td>Big Data Analytics</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>Professional Elective I</td>
<td></td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>Professional Elective II</td>
<td></td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td>15</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
### SEMESTER III

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>IF3351</td>
<td>Next Generation Wireless Networks</td>
<td>PCC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Professional Elective III</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</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>Professional Elective V</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>DS3311</td>
<td>Project Work I</td>
<td>EEC</td>
<td>0 0 12</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>12 0 20</td>
<td>32</td>
<td>22</td>
</tr>
</tbody>
</table>

### SEMESTER IV

<table>
<thead>
<tr>
<th>S.NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>DS3411</td>
<td>Project Work II</td>
<td>EEC</td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

**TOTAL CREDITS: 74**

### LIST OF FOUNDATION COURSES (FC)

<table>
<thead>
<tr>
<th>S.NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MA3160</td>
<td>Probability and Statistical Methods</td>
<td>FC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

### LIST OF RESEARCH METHODOLOGY AND IPR COURSE (RMC)

<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>RM3151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2 1 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>2 1 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
# List of Professional Core Courses (PCC)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Lectures</th>
<th>Theory</th>
<th>Practical</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IF3151</td>
<td>Advanced Data Structures and Algorithms</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>4.5</td>
</tr>
<tr>
<td>2.</td>
<td>DS3101</td>
<td>Fundamentals of Data Science</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>DS3102</td>
<td>Artificial Intelligence</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>IF3152</td>
<td>Advanced Database Management systems</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>DS3201</td>
<td>Foundations of Machine Learning</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>4.5</td>
</tr>
<tr>
<td>6.</td>
<td>DS3202</td>
<td>Foundation of Deep Learning</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>DS3203</td>
<td>Big Data Analytics</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>IF3351</td>
<td>Next Generation Wireless Networks</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td>24</td>
<td>0</td>
<td>12</td>
<td>36</td>
<td>30</td>
</tr>
</tbody>
</table>

# List of Employability Enhancement Courses (EEC)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Lectures</th>
<th>Theory</th>
<th>Practical</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DS3311</td>
<td>Project Work I</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>DS3411</td>
<td>Project Work II</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td>0</td>
<td>0</td>
<td>36</td>
<td>36</td>
<td>18</td>
</tr>
</tbody>
</table>

# List of Professional Electives (PEC) (Group – I)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Lectures</th>
<th>Theory</th>
<th>Practical</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IF3051</td>
<td>Artificial Life and Robotics</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>IF3057</td>
<td>Information Retrieval</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>IF3055</td>
<td>Human Computer Interaction</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>IF3052</td>
<td>Autonomous Ground Vehicle Systems</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>IF3060</td>
<td>Open Source Technologies</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>IF3061</td>
<td>Reasoning Methods in Computer Science</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>IF3062</td>
<td>Social Network Analysis</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
# LIST OF PROFESSIONAL ELECTIVES (PEC)
## (GROUP – 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>L</td>
<td>T</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>DS3001</td>
<td>Streaming Analytics</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>DS3002</td>
<td>Cognitive Computing</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>DS3003</td>
<td>Agent Based Systems</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>DS3004</td>
<td>Text and Speech Analytics</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>DS3005</td>
<td>Reinforcement Learning</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>IF3059</td>
<td>Mobile Application Development and Deployment</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>IF3053</td>
<td>Blockchain Technologies</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>IF3054</td>
<td>Building IoT Systems</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>IF3063</td>
<td>Visualization Methods and Techniques</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>IF3056</td>
<td>Image Processing and Computer Vision</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>IF3058</td>
<td>Mixed Reality Techniques</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>DS3006</td>
<td>Framework for Artificial Intelligence and Machine Learning with Python</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>DS3007</td>
<td>Explainable AI</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>DS3008</td>
<td>Financial Technologies</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>DS3009</td>
<td>Quantum AI</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>DS3010</td>
<td>Recommender Systems</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>DS3011</td>
<td>Artificial Neural Networks</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

---

# M.TECH INFORMATION TECHNOLOGY
(Specialization in Artificial Intelligence and Data Science)

<table>
<thead>
<tr>
<th>S.NO</th>
<th>SUBJECT AREA</th>
<th>CREDITS PER SEMESTER</th>
<th>CREDITS TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>1</td>
<td>FC</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>PCC</td>
<td>15.5</td>
<td>10.5</td>
</tr>
<tr>
<td>3</td>
<td>PEC</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>EEC</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>MC</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>22.5</td>
<td>17.5</td>
</tr>
</tbody>
</table>
UNIT I ONE DIMENSIONAL RANDOM VARIABLES
Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY

UNIT IV TESTING OF HYPOTHESES
Sampling distributions - Type I and Type II errors - 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

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
CO1: Use the appropriate and relevant, fundamental and applied mathematical and statistics knowledge and methodologies in solving practical problem.
CO2: Bring together and flexibly apply knowledge to characterize, analyse and solve a wide range of problems.
CO3: Understand the balance between the complexity/accuracy of the mathematical/statistical models used and the timeliness of the delivery of the solution.
CO4: Steeped in research methods and rigor.
CO5: Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

REFERENCES:

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

RM3151 RESEARCH METHODOLOGY AND IPR

UNIT I RESEARCH PROBLEM FORMULATION 9
Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9
Statistical design of experiments - types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9
Sampling, sampling error, measures of central tendency and variation; test of hypothesis-concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9
Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; IP & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9
Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of the course, the student can
CO1: Describe different types of research; identify, review and define the research problem
CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data
CO3: Explain the process of data analysis; interpret and present the result in suitable form
CO4: Explain about Intellectual property rights, types and procedures
CO5: Execute patent filing and licensing

REFERENCES:
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,

IF3151 ADVANCED DATA STRUCTURES AND ALGORITHMS  L  T  P  C
                                             3  0  3 4.5
UNIT I  ALGORITHMS IN COMPUTING  9

UNIT II  ALGORITHM DESIGN TECHNIQUES  9

UNIT III  HIERARCHICAL DATA STRUCTURES  9

UNIT IV  GRAPH ALGORITHMS  9

UNIT V  NP-COMPLETE AND NP –HARD  9
PRACTICAL EXERCISES:
Implement the following programs using C/ Python:
1. Iterative and recursive algorithms and its complexity analysis.
3. Quick sort algorithm using randomized algorithmic approach.
5. Activity selection and Huffman coding using Greedy approach.
7. Implementation of basic heap operations.
8. Implementation of Top down Splay and Fibonacci Heap operations using Amortized analysis.
9. Representation of Graphs and Graph traversals.
10. Implementation of a Spanning tree for a given graph using Prim’s algorithm.
11. Implementation of a Shortest path of a given graph using Dijkstra’s algorithm and

TOTAL: 90 PERIODS

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

CO1: Analyze and implement suitable iterative or recursive algorithms for a given problem with minimum complexity.

CO2: Create suitable design strategies to solve a problem in an efficient manner.

CO3: Implement hierarchical data structures to approach a real time problem and also to solve it in amortized runs.

CO4: Understand and develop algorithms using graph structures for suitable applications.

CO5: Solve NP Complete problems efficiently.

CO6: Apply appropriate data structures and suitable algorithmic design to implement real time applications.

REFERENCES:
UNIT I  INTRODUCTION
Introduction to Data Science - Overview of Data - Sources of Data - Types of Data – Small Data and Big Data - Data collection methods - Surveys - Interviews - Log and Diary data - User studies in Lab and Field - Web Scraping - Public datasets - Data cleaning - Tools for Data Science.

UNIT II  DESCRIPTIVE DATA ANALYSIS

UNIT III  DATA VISUALIZATION
Overview of python libraries matplotlib and seaborn - Histogram - Kernel density estimate plots - Box and violin plots - Regression plots - Heatmaps - Clustered matrices – Three Dimensional plot - Surface and Contour plot - Geographic data visualization.

UNIT IV  PREDICTIVE ANALYTICS AND EVALUATION
Overview of Machine learning concepts – Model construction using regression and Classification models - Linear regression and multiple regression models – KNN classification models - Comparison models - Training Data construction - Normalization - Cross-validation techniques - Accuracy metrics for evaluation of models – Contingency table, ROC curve, Precision-recall curves - A/B testing

UNIT V  DATA SCIENCE APPLICATIONS
Fraud Detection, Stock Market; Personalized Recommendation System, Content Development using Data Analytics, Analytics for Campaigns - Targeted marketing through Customer Segmentation, Medical Image Analysis and Diagnosis, Drug Discovery, Patient data management, Customer Sentiment Analysis, Natural Language Processing for Review Analysis – Chatbot.

PRACTICAL EXERCISES: 30
1. Use Beautiful Soup scrapping tool to extract text content from a given URL.
2. Write simple python scripts to remove missing/NULL values from the given variable in a sample UCI dataset or to replace with the variable’s mean.
3. Use excel sheet to perform t-hypothesis testing for a given sample data.
4. Download IRIS dataset from UCI repository and generate a box plot, scatter plot and histogram using any tool.
5. Use simple python matplotlib functions to generate various types of plots.
6. Use python program to train a decision tree classification model and generate a decision tree for Car Evaluation Dataset from UCI repository.
8. Write a python program to generate the confusion matrix for classification using decision tree for car evaluation dataset. Also derive various metrics like accuracy, precision, recall, sensitivity and F-measure and give your inferences about the model’s performance.
9. Create a simple chat bot to answer very simple know-how queries.
10. Use ChatGPT to debug simple python codes and check the same with python interpreter.

TOTAL: 75 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Clearly demonstrate the data collection methods.
CO2: Collect, investigate, clean, munge, and alter data.
CO3: Use Data Visualization techniques to explore data.
CO4: Use regression and classification models and evaluate it.
CO5: Use Python-based toolkits to create data science applications.
CO6: Implement suitable data science applications.

REFERENCES:
4. https://www.coursehero.com/study-guides/introstats1/

<table>
<thead>
<tr>
<th>PO/CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

DS3102 ARTIFICIAL INTELEGENCE

UNIT I INTELLIGENT AGENTS AND SEARCH TECHNIQUES 9

UNIT II KNOWLEDGE AND REASONING 9
Categories - Reasoning with Default Information

UNIT III   BAYESIAN NETWORKS  9
Directed Graphical Models – Bayesian Networks – Exploiting Independence Properties – From
Distributions to Graphs – Inference in Graphical Models - Bayes model - Generative and
Discriminative model - Maximum-likelihood parameter learning: Continuous models - Bayesian
parameter learning - Bayesian linear regression

UNIT IV   DECISION MAKING/ DECISION PROCESS  9
Decision Process formulation, utility theory, utility functions, decision networks, value
of information, Making Complex Decisions: Sequential Decision Problems - Algorithms for MDPs -
Bandit Problems - partially observable MDPs - Algorithms for Solving POMDPs - Reinforcement
learning

UNIT V   AI APPLICATIONS  9
Learning AI model deployment - Containers - Dockers - Discussion of AI Applications - Natural
Language Processing - Chatbots - Dialog Flow - Image Classification - Robotics - Model
deployment with containers such as Docker.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Relate the type of agents and environments in the real-world scenarios
CO2: Analyse different search techniques with computational complexity
CO3: Understand the working of Bayesian techniques to solve AI problems
CO4: Use the decision-making process to solve simple and complex problems
CO5: Understand the different learning techniques
CO6: Apply relevant AI techniques in the real-world applications.

REFERENCES:
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, Third Edition,
4. NPTEL Artificial Intelligence Course by Prof. Dasgupta –
   http://nptel.ac.in/courses/106105079/2
5. https://cloud.google.com/dialogflow

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
UNIT I DISTRIBUTED DATABASES 9

UNIT II NOSQL DATABASES 9

UNIT III ADVANCED DATABASE SYSTEMS 9

UNIT IV DOCUMENT DATABASES 9

UNIT V GRAPH DATABASES 9

PRACTICAL EXERCISES: 30
1. Create a distributed database using horizontal and vertical fragmentation in any DBMS.
2. Creation of distributed queries using the fragmented data created.
3. Create a document based database using MongoDB and manipulate the data.
4. Create a document database using Cassandra and manipulate the data.
5. Create a database to store multimedia elements and perform data retrieval operations.
6. Create a temporal database and explore the usage of temporal queries in it.
8. Given JSON and BSON document database and manipulate the data.
9. Create a simple Recommendation engine in E commerce use graph database.
10. Develop a social media application using Graph database.

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Design a distributed database system and execute distributed queries.
CO2: Implement NoSQL database systems and manipulate the data associated with it.
CO3: Disseminate knowledge on advanced database system concepts.
CO4: Create real time applications using Spatial, temporal and Mobile Databases.
CO5: Design and develop document databases using XML /JSON/ BSON databases.
CO6: Build a simple real time application using graph databases and execute queries on it.

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

DS3201 FOUNDATIONS OF MACHINE LEARNING L T P C

UNIT I INTRODUCTION

UNIT II DATA PREPARATION

UNIT III SUPERVISED LEARNING I
Random Forest - Boosting – AdaBoost.

**UNIT IV PROBABILISTIC GRAPHICAL MODELS**

**UNIT V UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING**

**PRACTICAL EXERCISES:**

1. Develop an application that makes predictions from data using Linear Regression.
2. Develop an application that makes predictions from data using Logistic Regression.
3. Implement a classifier using ID3, C4.5 and CART algorithms.
4. Implement a classifier using Perceptron and Multi Layer Perceptron.
5. Develop a system to implement a classifier using SVM.
7. Develop a system that can extract the word from the given sentences using the Hidden Markov model.
8. Develop a system that can automatically group articles by similarity using K–Means clustering.
9. Implement CNN model using an appropriate dataset for an image processing application.
10. Implement LSTM model using an appropriate dataset for a time series application.

**TOTAL: 90 PERIODS**

**COURSE OUTCOMES:**
Upon completion of this course, the student should be able to:

**CO1:** Disseminate the key elements of machine learning and the basics of learning theory.

**CO2:** Apply regression analysis and decision tree models for regression and classification problems.

**CO3:** Implement SVM or Neural Network model for an appropriate application and improve the performance using ensemble models.

**CO4:** Design and implement an BBN, HMM for a sequence model type of application and implement a PGM for any real time application using an open-source tool.

**CO5:** Use a tool to implement typical clustering algorithms for different types of applications.

**CO6:** Identify suitable learning tasks to which Reinforcement learning techniques can be applied.

**REFERENCES:**

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

DS3202 FOUNDATIONS OF DEEPLearnIng L T P C 3 0 0 3

UNIT I BASICSoFneuralnetworks 9
Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

UNIT II CONVoLUTIoNALneuralnetworks 9

UNIT III ADVANCED DEEPLearning ARCHITECTURES 9

UNIT IV DEEPReINFORCEMENT LEARNING 9

UNIT V APPLICATIONSOF DEEP LEARNING 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Understand the role of Deep Learning in Machine Learning Applications.
CO2: To get familiar with using TensorFlow / Keras in Deep Learning Applications.
CO3: To design and implement Deep Learning Applications.
CO5: To design and implement Convolutional Neural Networks.
CO6: To know about applications of Deep Learning in NLP and Image Processing

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

DS3203 BIG DATA ANALYTICS

UNIT I INTRODUCTION TO BIG DATA

UNIT II MAPREDUCE AND NEW SOFTWARE STACK
Distributed File System – MapReduce, algorithms using MapReduce, Extensions – Communication model – Complexity Theory for MapReduce. Overview of Spark.

UNIT III BIG-DATA TECHNOLOGY OVERVIEW

UNIT IV STREAMING ANALYTICS AND LINK ANALYSIS
UNIT V  RECOMMENDER SYSTEMS AND SOCIAL NETWORK MINING  9
Advertising on the Web – Online Algorithms – matching Problem – Adwords problem and
Implementation – recommendation systems – Collaboration filtering – Dimensionality reduction –
mining social – Network graphs – Clustering of social network graphs – Partitioning of graphs –

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Understand the basics of Big Data.
CO2: Know about Hadoop and MapReduce.
CO3: Know about Big Data Technology, Tools, and Algorithms.
CO4: Analyze the stream data and link analysis.
CO5: Know about the role of big data in Recommender systems and social network analysis.
CO6: Design and Implementation of basic data-intensive applications.

REFERENCES:
1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets,
2. Arshdeep Bagga and Vijay Madisetti, Big Data Science & Analytics, A Hands-on Approach,
   Arshdeep Bahga & Vijay Madisetti, 2016.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

IF3351  NEXT GENERATION WIRELESS NETWORKS  L T P C
3 0 2 4

UNIT I  5G INTERNET AND LEAP TO 6G VISION  9
Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G
Other 6G Considerations

UNIT II  SMALL CELLS FOR 5G MOBILE NETWORKS  9
Introduction to Small Cells – Capacity Limits and Achievable Gains with Densification – Mobile
Data Demand – Demand vs. Capacity – Small Cell Challenges.

UNIT III  COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS  9
Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding, Cooperative

UNIT IV NETWORKING TECHNIQUES AND APPLICATIONS FOR 5G NETWORKS 9

UNIT V FUTURISTIC TECHNOLOGICAL ASPECTS OF 6G 9

PRACTICAL EXERCISES: 30
1. Model, Simulate and Test 5G NR PHY in Matlab
2. Evaluating 5G cloud based networks system using C-RAN Simulator.
3. Model a simulator software to generates realistic spatial and temporal wideband channel impulse response using NYUSIM
4. Model and simulate 6G-enabling technologies with MATLAB
5. Create and optimize your intellectual property (IP) for 6G using open MATLAB functions and compare your innovations to existing benchmarks.
7. Scale your simulations for massive MIMO, larger bandwidths, and higher sampling rates.
   Manage large and long-running simulations by distributing them on multiple cores, clusters, or the cloud and by leveraging GPUs.
8. Perform faster and more accurate RF component modeling for new mmWave and sub-THz frequencies.
9. Simulate propagation loss and channel models in mmWave and sub-THz frequency ranges.
10. Model non-terrestrial networks (NTN) by performing end-to-end link-level simulations, scenario modeling, orbit propagation, and visualization.
11. Explore RF sensing and detect the presence of events or persons in a scene by analyzing RF waveforms.
12. Examine the effect of reconfigurable intelligent surfaces (RIS) on overall system performance.
13. Apply artificial intelligence (AI) techniques, including machine learning, deep learning, or reinforcement learning workflows to solve 6G wireless communications problems.

TOTAL: 75 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
CO1: Compare the 5G network with older generations of networks.
CO2: Identify suitable small cells for different applications in 5G networks.
CO3: Simulate 5G network scenarios.
CO4: Connect applications of FOG Computing

Attested
DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
CO5: Design applications with 5G network support.
CO6: Analyze the 6G Networks

REFERENCES:
4. 5G Mobile Communications: Concepts and Technologies 1st Edition

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

DS3311 PROJECT WORK I
L T P C
0 0 12 6

Individual student carry out project I, the goal of project I is to choose the final year project, Perform Literature Survey, refer IEEE papers, IEEE/ACM papers, study the implementation issues, familiarize with the tools needed for implementation, study necessary simulation software (if any) and implement the initial phase of the project. Three reviews needs to be conducted project report has to be submitted by the team. Final review will be conducted by external member.

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Work as an individual, identify a real-world problem that can be solved using IT tools and techniques.
CO2: Analyse existing artifacts and solutions and design novel effective approaches.
CO3: Explore, select, and deploy the appropriate tools for effective implementation of the design.
CO4: Prepare the documentation for the design and implementation, write reports and make presentations justifying the choices made.
CO5: Develop the required collaboration and communication skills to work in a professional team and multi-disciplinary context.
CO6: Quickly develop Proof-of-Concept of solutions to problems.
Individual student carry out project II, which can be a continuation of project I work or a new problem can be formulated, with necessary Literature Survey by referring to IEEE/ACM transactions/standard peer reviewed journals/conference papers, identify the challenges to be addressed/gaps in the existing research works, propose a solution with necessary architecture with modular design including data required, relevant algorithms, study of necessary simulation software (if any), implement the project, evaluate the work with relevant metrics and finally present the project work with a detailed report.

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Apply the acquired knowledge of basic science and engineering concepts to solve real-world problems.
CO2: Analyse, design and develop IT solutions following best practices.
CO3: Explore, select, and deploy the appropriate tools for effective implementation of projects.
CO4: Prepare the documentation for the design and implementation, write reports and make presentations justifying the choices made.
CO5: Develop the required collaboration and communication skills to work in a professional team and multi-disciplinary context.
CO6: Develop and showcase the complete solution for a given problem in industry/research.

---

IF3051 ARTIFICIAL LIFE AND ROBOTICS

UNIT I ARTIFICIAL LIFE
The Artificial Life - foundations, scope, problems, and approaches of AI, reactive, deliberative, goal-driven, utility-driven, and learning agents-Behavior systems – Emergent behavior Approaches for Designing the Behavior Programs - Modeling Adaptive Autonomous Agents -
Characteristics of Agent Architectures - Example Autonomous Agents.

UNIT II  INTRODUCTION TO ROBOTICS


UNIT III  ROBOTIC SENSORS AND TRAJECTORY PLANNING


UNIT IV  COMPUTER VISION IN ROBOTICS AND ROBOT PROGRAMMING

Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image representation - Picture coding - Object recognition and categorization - Depth measurement with vision systems- Robot guidance with vision systems. Robot control sequencing - Robot programming languages - Sample programs - Smart sensors, MEMS based sensors, -Artificial Intelligence and robot programming.

UNIT V  ROBOTICS APPLICATIONS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO1: Design and implement an intelligent autonomous agent for problem solving
CO2: Demonstrate and illustrate the fundamentals of Robotics.
CO3: Develop robotic design with proper navigation to solve real time problems.
CO4: Apply program able automation in different subfields of robotics.
CO5: Develop vision-based systems for robot guidance.
CO6: Design and implement a robot for few real time applications.

REFERENCES:


<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

IF3057 INFORMATION RETRIEVAL L T P C
3 0 0 3

UNIT I INTRODUCTION TO INFORMATION RETRIEVAL 9

UNIT II TEXT REPRESENTATION AND QUERYING 9
Porter stemmer; Zipf’s law; morphology; index term selection; using thesauri; Metadata and markup languages (SGML, HTML, XML, DTD) and schema Web linking technologies - Query Operations and Languages – Relevance Feedback – Query Expansion – Query Languages.

UNIT III CATEGORIZATION AND CLUSTERING 9

UNIT IV INFORMATION EXTRACTION AND INTEGRATION 9
Search Engines, Spidering, Web Crawling, Meta-crawlers, Directed spidering, link analysis, Static ranking: Page Rank HITS, shopping agents, Query log analysis, Adversarial IR; Extracting data from text, XML, Ontologies, Thesauri, Semantic Web, collecting and integrating specialized information on the web.

UNIT V RECOMMENDER SYSTEMS AND IR EVALUATION 9
Benchmark Text Collections.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Build an Information Retrieval system using the available tools.

CO2: Identify and design the various components of an Information Retrieval system.

CO3: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.

CO4: Analyze the Web content structure.

CO5: Analyze the approaches used for recommendation systems.

CO6: Design an efficient search engine

REFERENCES:

<table>
<thead>
<tr>
<th>PO/CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

IF3055 HUMAN COMPUTER INTERACTION  L T P C  3 0 0 3

UNIT I INTRODUCTION TO HUMAN-COMPUTER INTERACTION  9

UNIT II DESIGNING INTERACTIVE SYSTEMS  9
UNIT III  EVALUATION AND UNIVERSAL DESIGN PRINCIPLES


UNIT IV  MODELS AND THEORIES


UNIT V  HCI IN COLLABORATIVE APPLICATIONS


TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Demonstrate a comprehensive understanding of the concepts and theories related to human-computer interaction and their application in designing interactive systems.

CO2: Apply user centered design principles and guidelines to create intuitive and effective user interfaces for interactive systems.

CO3: Utilize appropriate evaluation methods and techniques to assess the usability and user experience of interactive systems, and report evaluation resultseffectively.

CO4: Analyze and apply various HCI models, such as task models and dialogue models, to design interactive systems.

CO5: Explore and discuss the challenges and implications of HCI in collaborative applications, such as groupware and computer-mediated communication.

CO6: Demonstrate a comprehensive understanding of the principles, theories, and methodologies of human-computer interaction and effectively apply them in the design of user-friendly and efficient interactive systems.

REFERENCES:
UNIT I  INTRODUCTION TO AUTONOMOUS DRIVING  9
Autonomous Driving Technologies Overview – Autonomous Driving Algorithms – Autonomous Driving Client System – Autonomous Driving Cloud Platform – Components of autonomy – Difference between Unmanned and Autonomous Vehicles – Introduction to Unmanned Aerial Vehicles (UAVs) – History of UAVs – Classification: scale, lift generation method – Applications: Military, Government and Civil, Application of CARLA simulator in AGVs

UNIT II  SENSORS FOR AUTONOMOUS GROUND VEHICLES  9

UNIT III  ENVIRONMENT PERCEPTION AND MODELING  9
Road Recognition: Basic Mean Shift Algorithm, Mean Shift Clustering, Mean Shift Segmentation, Mean Shift Tracking, Road Recognition Algorithm – Vehicle Detection and Tracking: Generating ROIs, Multi Resolution Vehicle Hypothesis, Vehicle Validation using Gabor Features and SVM, Boosted Gabor Features – Multiple Sensor Based Multiple Object Tracking.

UNIT IV  NAVIGATION FUNDAMENTALS  9

UNIT V  VEHICLE CONTROL AND CONNECTED VEHICLE  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Identify the requirements and design challenges of AGVs.
CO2: Select suitable sensors to sense the internal state and external world of AGVs.
CO3: Implement lane detection, road detection & vehicle detection algorithms.
CO4: Simulate/implement ground vehicle navigation algorithms.
CO5: Simulate/implement ground vehicle control systems.
CO6: Design communication protocols for connected vehicles.

REFERENCES:

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

IF3060 OPEN SOURCE TECHNOLOGIES

UNIT I INTRODUCTION 9

UNIT II PROCEDURAL PROGRAMMING 9
Object Oriented Programming in Python - Bank account simulations - Problems with procedural implementation - Building software with Classes, Objects and Instantiation

UNIT III WEB DEVELOPMENT WITH PYTHON 9

UNIT IV WORKING WITH DATABASES 9

UNIT V WORKING WITH CONTAINERS 9
Running software in containers - Installing Dockers - Working with databases such as Redis - Building Docker images - Deployment of applications with Docker

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Use shell commands for executing programs and applications.
CO2: Use Git for collaboration and maintaining different versions.
CO3: Develop a web application using the Flask framework.
CO4: Work with NoSQL Databases
CO5: Develop a server side web application using Python.
CO6: Deploy an application using containers

REFERENCES:
3. Irv Kalb, Object-Oriented Python, O’Reilly, 2022

<table>
<thead>
<tr>
<th>PO/CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>--</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

IF3061 REASONING METHODS IN COMPUTER SCIENCE L T P C
3 0 0 3

UNIT I PROPOSITION LOGIC
Introduction to Logic - Foundation in mathematics - Natural Deduction - Formal language Syntax and Semantics - Normal Forms - Applications in AI.
UNIT II  PREDICATE LOGIC  9
Syntax and semantics - Natural Deduction rules - Expressiveness – Micromodels of software -
Inference mechanisms in AI

UNIT III  MODAL LOGIC  9
Higher order logic - Modal logic syntax - Semantics - Accessibility relation - Types of modal logic -
Natural deduction

UNIT IV  TEMPORAL LOGIC  9
Linear Temporal Logic - Syntax - Semantics - Model Checking - Computational Tree Logic -
Syntax - Semantics - Application in Operating Systems and Distributed systems

UNIT V  EPISTEMIC LOGIC  9
Logic of knowledge - Syntax - Semantics - Natural Deduction - Multi-agent reasoning -
Applications in Distributed systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1:  Understand the mathematical underpinnings of Logic
CO2:  Apply Proposition Logic to Computer Science domains
CO3:  Understand the reasoning process of Predicate Logic
CO4:  Understand the advantages of Higher Order Logic over Lower Order Logic
CO5:  Apply Temporal Logic to Distributed Systems
CO6:  Design Multiagent systems using Epistemic Logic

REFERENCES:
1. Michael Huth and Mark Ryan, Logic in Computer Science, Modelling and Reasoning about
2. Johan van Benthem, Hans van Ditmarsch, Jan van Eijck, Jan Jaspars, Logic in Action, an

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

IF3062  SOCIAL NETWORK ANALYSIS  L T P C 3 0 0 3

UNIT I  INTRODUCTION  9
Social Network Analysis: Definition and Features – The Development of Social Network Analysis –
Basic Graph Theoretical Concepts of Social Network Analysis – Ties, Density, Path, Length,
Distance, Betweenness, Centrality, Clique – Electronic Sources for Network Analysis – Electronic Discussion Networks, Blogs and Online Communities, Web-based Networks – Applications of Social Network Analysis.

UNIT II SOCIALNETWORK PROFILES
Introduction to Social Networks Profiles – Types of Commercial Social Network Profiles (CSNP) – Quantitative and Qualitative Analysis of CSNP – Analysis of Social Networks Extracted from Log Files – Data Mining Methods Related to SNA and Log Mining – Clustering Techniques – Case Study.

UNIT III SEMANTICS OF SOCIAL NETWORKS
Introduction to Ontology based Knowledge Representation – Ontology Languages for the Semantic Web – RDF and OWL – Modeling Social Network Data – Network Data Representation, Ontological Representation of Social Individuals and Relationships – Aggregating and Reasoning with Social Network Data – Advanced Representations.

UNIT IV SOCIAL NETWORK MINING

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Understand basic principles behind network analysis algorithms and develop practical skills in network analysis.

CO2: Model and represent knowledge for social semantic Web.

CO3: Apply datamining techniques on social networks.

CO4: Use extraction and mining tools for analyzing Social networks.

CO5: Develop secure social network applications.

CO6: Develop personalized visualization for Social networks

REFERENCES:
IGI Global, 2009.

<table>
<thead>
<tr>
<th>PO/CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

DS3001  STREAMING ANALYTICS  L T P C 3 0 2 4

UNIT I  STREAMING TECHNOLOGY
Introduction to Streaming media - Video encoding, Audio encoding, Preprocessing, Stream serving, Live webcasting, Media players. Associated Technologies and Applications - Rights management, Content distribution, Applications for streaming media.

UNIT II  STREAM ANALYTICS

UNIT III  STREAMING DATA ANALYSIS
Data-Flow Management in Streaming Analysis - Processing Streaming Data - Exploratory Data analysis -- Graphical Presentation of Data - Storing Streaming Data - Delivering Streaming Metrics - Exact Aggregation and Delivery - Statistical Approximation of Streaming Data - Approximating Streaming Data with Sketching - Beyond Aggregation - Data Analysis Using R.

UNIT IV  ADVANCED CONTENT DELIVERY, STREAMING, AND CLOUD SERVICES
Cloud-Based Content Delivery and Streaming - Live Streaming Ecosystems - Practical Systems for Live Streaming - Efficiency of Caching and Content Delivery in Broadband Access Networks -- Anycast Request Routing for Content Delivery Networks - Cloud-Based Content Delivery to Home Ecosystems - Mobile Video Streaming.

UNIT V  VISUALIZING STREAMING DATA
Streaming the Data - Processing Streaming Data for Visualization - Developing a Client - Presenting Streaming Data - Visualization Components - Streaming Analysis - Workflow Visualization - Streaming Data Dashboard - Machine Learning and Streaming Data Visualization -- Collaboration - Exports.
PRACTICAL EXERCISES:
1. Write map reduce functions for calculating the following from real-time stream data: (i) filtering for elements with specific values or property, (ii) counting distinct words from a distributed text corpus.
2. Write and implement a program in python for estimating 1st, 2nd and nth order moments from a sample stream data.
3. Implementing DGIM algorithm using any Programming Language
4. Use R tool for data visualization. Given a data set, explore the features using data analysis in R.
5. Install and configure MongoDB/Cassandra to execute NoSQL Commands.
7. Explore, transform, and load data into the Data Warehouse using Apache Spark.
8. Design and develop Streaming Data Dashboard-Machine Learning and Streaming Data Visualization (mini project)
9. Implement the mobile Video streaming (mini project)
10. Real time data collection, storing, implement analytical

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Understand and apply various analytics on stream data.
CO2: Understand the fundamental concepts of streaming technology and data analytics.
CO3: Comprehend and work with streaming data analysis techniques.
CO4: Implement suitable data analysis for stream data.
CO5: Understand various advanced content delivery, streaming, and cloud services.
CO6: Describe and implement the basic and advanced techniques for visualizing streaming data.

REFERENCES:
1. Aragues, A, “Visualizing Streaming Data: Interactive Analysis Beyond Static Limits”, O'Reilly Media, Inc., 2018

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
UNIT I  FOUNDATION OF COGNITIVE COMPUTING  9

UNIT II  KNOWLEDGE REPRESENTATION  9

UNIT III  NEURAL AND COGNITIVE COMPUTING  9
Biological neurons - Evolution of Artificial Neural Network (ANN) models - Activation functions - Data Exploration and Feature Engineering, ANN: Perceptron, Logistic Regression, and MLP, Deep Neural Networks, DNN Compression & Quantization - Modern DNNs for Classification, Detection and NLP.

UNIT IV  NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEM  9

UNIT V  CASE STUDIES  9

PRACTICAL EXERCISES:  30
1. Implement Long Term Memory encoding approach.
2. Implement Models of semantic memory.
3. Implement Decision Making models.
4. Implement Machine Learning algorithms for cognitive computing and observe the results like hyper parameters, learning curves, analysis, model/dataset comparison.
5. Implement a simple bag-of-word classifier for sentence classification.
7. Implement a part-of-speech tagger.

TOTAL:75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Understand the foundation concepts of cognitive computing.
CO2: Identify and design an ontology for the representation of knowledge and make an association with semantic web.
CO3: Analyze and evaluate the various ANN Models that can be adopted for different cognitive systems.
CO4: Apply theoretical knowledge in developing computational models for cognitive modeling, language understanding and decision support.

CO5: Explore and critically analyze recent research on cognitive modeling.

CO6: Assess the current state of the art in Cognitive Systems and develop a perception about its future direction.

REFERENCES:

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

DS3003 AGENT BASED SYSTEMS L T P C 3 0 2 4

UNIT I INTRODUCTION 9

UNIT II LEARNING IN AGENTS 9

UNIT III COMMUNICATION AND COOPERATION IN AGENTS 9

UNIT IV DEVELOPING INTELLIGENT AGENT SYSTEMS 9
UNIT V APPLICATIONS
Agent for workflow and business process management - Mobile agents - Agents for distributed systems - agents for information retrieval and management - Agents for electronic commerce - agent for human- computer interface - agents for virtual environments - agents for social simulation

PRACTICAL EXERCISES:
1. Implementation of an uninformed search agent
2. Implementation of an informed search agent
3. Implementation of game search
4. Development of a propositional agent
5. Automatic inference mechanism of an agent
6. Implementation of goal based agent
7. Exploration of OWL based tools
8. Development of ontology
9. Inference mechanism using ontology
10. Mini project

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Build an architecture for intelligent agents.
CO2: Apply the reasoning mechanisms of proposition and predicate logic to agents.
CO3: Use the learning mechanisms for an artificial agent.
CO4: Execute different communication and co-operation methodologies in a multi-agent setup.
CO5: Distinguish the agent types.
CO6: Develop intelligent agents' applications.

REFERENCES:
4. Ronald Brachman, Hector Levesque “Knowledge Representation and Reasoning”, Morgan Kaufmann, 2004

<table>
<thead>
<tr>
<th>PO/CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DS3004 TEXT AND SPEECH ANALYTICS

UNIT I NATURAL LANGUAGE BASICS

UNIT II TEXT CLASSIFICATION

UNIT III QUESTION ANSWERING AND DIALOGUE SYSTEMS

UNIT IV TEXT-TO-SPEECH SYNTHESIS

UNIT V AUTOMATIC SPEECH RECOGNITION

PRACTICAL EXERCISES: 30
1. Implement NLP using RNN
2. Implement NLP using LSTM
3. Compare NLP accuracy using different deep learning methods
4. Implement different ranking algorithms
5. Design a chatbot with a simple dialog system
6. Convert text to speech and find accuracy
7. Design a speech recognition system and find the error rate

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Explain existing and emerging deep learning architectures for text and speech processing
CO2: Apply deep learning techniques for NLP tasks, language modelling and machine translation
CO3: Explain co-reference and coherence for text processing
CO4: Build question-answering systems, chatbots and dialogue systems
CO5: Apply deep learning models for building speech recognition and text-to-speech systems
CO6: Design an automatic speech recognition system

REFERENCES:
5. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’Reilly, 2009

<table>
<thead>
<tr>
<th>PO/CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

DS3005 REINFORCEMENT LEARNING

UNIT I INTRODUCTION TO REINFORCEMENT LEARNING
9

UNIT II MARKOV DECISION PROCESS AND DYNAMIC PROGRAMMING
9

UNIT III MONTE CARLO METHODS AND TEMPORAL METHODS
9

UNIT IV DEEP Q NETWORKS AND ITS VARIANTS
9
UNIT V FUNCTION APPROXIMATION

PRACTICAL EXERCISES:
1. Write a python program to implement Markov chain for simple prediction.
2. Write a python program to implement Markovian decision process.
3. Write a python program to implement Q-Learning algorithm.
4. Implement SARSA algorithm.
5. Implement Monte-Carlo and Temporal learning algorithm.

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Understand different terminologies of RL and Concepts of Probability.
CO3: Apply dynamic programming techniques on Markov decision process and Monte Carlo methods.
CO4: Implement Time difference learning for real world problems.
CO5: Apply Approximation methods of learning and Q-Learning Technique.
CO6: Understand the need for function approximation algorithms.

REFERENCES:
UNIT I  INTRODUCTION  9
Introduction to Mobile Computing – Characteristics and Benefits – Mobile Software Engineering–
Mobile Application Development Environment — Application Models – Infrastructure and

UNIT II  USER INTERFACE  9
Generic UI Development – UI Components – Event Handling – Designing the Right UI –
Multimodal and Multichannel UI -Gesture Based UI – Screen Elements and Layouts – Voice XML.

UNIT III  APPLICATION DESIGN  9
Memory Management – Design Patterns for Limited Memory - Work Flow for Application
Development – Java API - Dynamic Linking - Plugins and Rule of Thumb for using Dlls -

UNIT IV  APPLICATION DEVELOPMENT I  9
Mobile OS: Android, IOS – Android Application Architecture - Android Basic Components- Intents
and Services – Storing and Retrieving Data – Packaging and Deployment – Security and Hacking.

UNIT V  APPLICATION DEVELOPMENT II  9
Communication Via the Web – Notification and Alarms – Graphics and Multimedia: Layer
Animation, Event Handling and Graphics Services – Telephony – Location Based Services –
Cloud Database Connectivity: Firebase, AWS, Google Cloud.

PRACTICAL EXERCISES:  30
1. Install and configure java development kit (JDK), android studio and android SDK.
2. Develop an application that uses GUI components, fonts and colors.
3. Design an application that uses Layout Managers, Event listeners, Event handling and
push notification in Android.
4. Build a simple native calculator application to do simple arithmetic operations.
5. Create animations and graphical primitives in Android environment.
6. Develop an application that makes use of SQL Lite mobile database.
7. Develop an application that makes use of internet for communication using Firebase to
send SMS and E-Mail services.
8. Implement an android application that writes data into the SD card and makes use of
Notification Manager.
9. Develop a native application that uses Location based services such as GPS tracking, geo
fencing, and activity recognition using Google play services.
10. Implement simple gaming application using open source tools like flutter or Unity.

TOTAL:75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Design the right user interface for mobile application
CO2: Implement mobile application using UI toolkits and frameworks
CO3: Design mobile applications that is aware of the resource constraints of mobile devices
CO4: Develop web based mobile application that accesses internet and location data
CO5: Implement android application to use telephony for SMS communication
CO6: Implement android application with multimedia support

REFERENCES:

<table>
<thead>
<tr>
<th>CO-PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

IF3053  BLOCKCHAIN TECHNOLOGIES  L T P C
3 0 2 4

UNIT I  INTRODUCTION TO BLOCKCHAIN
History of Blockchain – Blockchain Architecture - Distributed Ledger Technology (DLT); Blocks and Chain Structure; Types of Blockchain – Consensus – Consensus algorithms- Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

UNIT II  BITCOIN AND CRYPTOCURRENCIES

UNIT III  ETHEREUM

UNIT IV  WEB3 AND HYPERLEDGER
UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS


PRACTICAL EXERCISES:

1. Construct the simple blockchain based application to store and retrieve the crypto-currencies.
2. Create the wallet to send the digital currencies from one account to another account.
3. Understand the technology components of Blockchain and how it works behind – the scenes.
4. Be aware of different approaches to developing decentralized applications.
5. Perform bitcoin transactions using Python - bitcoinlib.
6. Understand the Bitcoin and its limitations by comparing with other alternative coins.
7. Develop the environment for Ethereum by using Ganache.
8. Create the nodes on Ethereum blockchain and mine the blockchain.
9. Establish deep understanding of the Ethereum model, its consensus model and code execution.
10. Learn Solidity programming language and develop simple Ethereum based applications.
11. Build the decentralized app and deploy it to provide Ethereum environment.
12. Build a simple application using hyperledger in blockchain environment.
14. Design a smart contract and test it in a Ethereum environment.
15. Develop a block chain based applications which is suitable for your online shopping services.

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Understand the technology components of Blockchain and how it works behind-the-scenes.
CO2: Aware of different approaches to developing decentralized applications.
CO3: Understand the Bitcoin and its limitations by comparing with other alternative coins.
CO4: Establish deep understanding of the Ethereum model, its consensus model, code execution.
CO5: Understand the architectural components of a Hyperledger and its development framework.
CO6: Know the Alternative blockchains and emerging trends in blockchain.

REFERENCES:


<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

IF3054  BUILDING IoT SYSTEMS  L T P C  3 0 2 4

UNIT I  INTRODUCTION

UNIT II  DEVICE LAYER

UNIT III  DEVELOPING IOT SYSTEMS

UNIT IV  CLOUD OFFERINGS AND ANALYTICS

UNIT V  IoT MANAGEMENT & CASE STUDIES

PRACTICAL EXERCISES:
1. Develop a BLINK sketch in Arduino.
2. Develop an Arduino sketch that repeats an LED to glow brightly, decrease the brightness,
switches off the LED, increases the brightness and LED glows with maximum intensity (a sketch for fading).

3. Develop an Arduino sketch that takes sensor readings for five seconds during the startup, and tracks the highest and lowest values it gets. These sensor readings during the first five seconds of the sketch execution define the minimum and maximum of expected values for the readings taken during the loop (a sketch for calibrating a sensor).

4. Develop an Arduino sketch that reads the value of a variable resistor as an analog input and changes blink rate of the LED.

5. Develop an Arduino sketch to use a piezo element to detect the vibration.

6. Develop a Python program to control an LED using Raspberry Pi.

7. Develop a Python program to interface an LED with a switch using Raspberry Pi.

8. Miniproject.

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Understand the evolution of the Internet and the impact of IoT in the society.

CO2: Design portable IoT devices using Arduino IDE/ Raspberry Pi with Python.

CO3: Apply appropriate protocols in various parts of IoT based systems.

CO4: Use cloud offerings and big data tools in IoT based systems.

CO5: Implement Map-Reduce based programs using Apache frameworks.

CO6: Design, deploy and manage complex IoT based systems.

REFERENCES:


5. Andy King, "Programming the Internet of Things: An Introduction to Building Integrated, Device to Cloud IoT solutions", O'REILLY, 2021

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
UNIT I  INTRODUCTION  9

UNIT II  VISUAL REPRESENTATION  9

UNIT III  MULTIMODAL PRESENTATION  9

UNIT IV  INTERACTION TYPES  9

UNIT V  ADVANCE DESIGN TECHNIQUES  9

PRACTICAL EXERCISES:  30
1. Representing data in different visualization chart ( bar, pie, etc) R language
2. Exploring various Visualization tools ( Open Source)
3. Implementation of the interactive forms.
4. Implementing various types of data representation.
5. Creating Interoperable Web Visualization Components using Candela tool.
6. Implementing Line and Stacked charts with Labels and Notes using Data wrapper tool.
7. Creating Interactive Charts using Google Chart tool.
8. Working with animation using Chartist.js tool.

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Understand the concepts and techniques used in Visualization Techniques.
CO2: Implement different techniques of information representation.
CO3: Implement various presentations of information.
CO4: Apply different interaction types used to present information.
CO5: Design and implement effective Visualization.
CO6: Create and evaluate interactive data Visualization real-time problem.

REFERENCES:

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

IF3056 IMAGE PROCESSING AND COMPUTER VISION  

UNIT I   FUNDAMENTALS OF IMAGE PROCESSING  9

UNIT II   IMAGE ENHANCEMENT AND TRANSFORMS  9

UNIT III   RESTORATION AND BOUNDARY DETECTION  9

UNIT IV   IMAGE SEGMENTATION AND FEATURE EXTRACTION  9

Attested

DIRECTOR  
Centre for Academic Courses  
Anna University, Chennai-600 025
UNIT V IMAGE CLASSIFIER AND APPLICATIONS


PRACTICAL EXERCISES:

1. Implementation of Reading and Writing of Images in Matlab and OpenCV/Octave/SciLab.
2. Implementation of simple spatial filters like Low Pass Filters and High Pass Filters in Matlab/OpenCV.
3. Implementation of Histogram Techniques in Matlab/Octave/OpenCV.
5. Implementation of Fourier and Wavelet Transforms in Matlab/Octave.
8. Implementation of Image Classifier using SVM in Matlab/Octave/ OpenCV.
10. Implementation of Feature extraction in images using Matlab/Octave / Opencv

TOTAL:75 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO1: Implement basic image processing operations.

CO2: Apply and develop new techniques in the areas of image enhancement and frequency transforms.

CO3: To restore images from noise and to extract edges and boundaries.

CO4: Understand the image segmentation algorithms and Extract features from images.

CO5: Apply classifiers and clustering algorithms for image classification and clustering.

CO6: Design and develop an image processing application that uses different concepts of image processing.

REFERENCES:


<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
# IF3058  MIXED REALITY TECHNIQUES

<table>
<thead>
<tr>
<th>UNIT I</th>
<th>INTRODUCTION TO MIXED REALITY</th>
<th>9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT II</th>
<th>INTERACTION DESIGN IN MIXED REALITY</th>
<th>9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT III</th>
<th>MIXED REALITY SYSTEMS</th>
<th>9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT IV</th>
<th>MIXED REALITY AND HUMAN-ROBOT INTERACTION</th>
<th>9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT V</th>
<th>APPLICATIONS OF MIXED REALITY</th>
<th>9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PRACTICAL EXERCISES:</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Design and implement an interactive MR application with gesture or motion controller input for interacting with virtual objects.</td>
<td></td>
</tr>
<tr>
<td>2. Create a virtual tour MR application for exploring historical sites or museum exhibits with informative content.</td>
<td></td>
</tr>
<tr>
<td>3. Develop an AR experience using marker-based tracking for scanning physical markers to reveal interactive virtual content.</td>
<td></td>
</tr>
<tr>
<td>4. Design and implement a collaborative MR application for multiple users to interact and collaborate in a shared virtual space.</td>
<td></td>
</tr>
<tr>
<td>5. Create an MR puzzle game where users solve virtual puzzles and challenges using interactions with virtual objects and the real-world environment.</td>
<td></td>
</tr>
<tr>
<td>7. Design an AR educational experience that reveals interactive 3D models and additional information when scanning textbook pages or learning materials.</td>
<td></td>
</tr>
<tr>
<td>8. Create an immersive MR storytelling experience where users interact with characters and objects to progress through a narrative.</td>
<td></td>
</tr>
<tr>
<td>9. Develop an MR training simulation for practicing specific tasks or skills in a safe and controlled environment.</td>
<td></td>
</tr>
<tr>
<td>10. Design and implement an AR wayfinding application for overlaying navigation instructions and points of interest onto the real-world environment.</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL: 75 PERIODS**
COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Demonstrate knowledge and understanding of VR, AR, and MR concepts, technologies, and applications.
CO2: Apply design principles and considerations specific to Mixed Reality platforms.
CO3: Understand interaction design principles in Mixed Reality.
CO4: Apply software design and implementation skills for Mixed Reality systems.
CO5: Demonstrate knowledge of the intersection of Mixed Reality and Human-Robot Interaction (HRI).
CO6: Analyze and evaluate the integration of Mixed Reality technologies and principles into real-world applications.

REFERENCES:

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

DS3006 FRAMEWORK FOR ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING WITH PYTHON

UNIT I PYTHON BASICS
IDE – Use of Functions - Collaborative version control system – git - Condition Statements - if then else - Nested conditionals - Loops - For -While - do while - List - Nested lists - slicing operation - Tuples - Dictionary - creation of python modules.

UNIT II FILE HANDLING AND ARRAYS
Files processing - NumPy - Array Indexing - Array Slicing - Reshaping - Concatenation - Splitting - Aggregation - Broadcasting - Sorting - Vectorizing - Matrix operations.

UNIT III DATA PROCESSING
Pandas - Series object - Use of Data frames - importing and exporting data to csv/ other formats - Data indexing and selection - Handling missing data - Replacing data items - Combining datasets - Pivot Tables - working with time series.
UNIT IV DATA VISUALIZATION
Importing matplotlib and seaborn libraries - setting styles - simple line plots - Scatter plots - visualizing errors - density and contour plots - histograms - legend - colorbars - subplots - three-dimensional plotting.

UNIT V STATISTICAL LEARNING
Scikit-learn – working with predefined datasets – classification with multiple algorithms – training - testing ratio - fitting with different parameters – normalization – cross validation.

PRACTICAL EXERCISES:
1. Working with Git
2. Implementation of a calculator using python functions
3. Development of different python modules and integration
4. Different array and tensor operations using NumPy
5. Descriptive data analysis using Pandas
6. Visualization using different plots with matplotlib and seaborn
7. Development of python modules for normalization of data
8. Development of python modules for cross validation

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Develop and execute programs with loops and other data structures.
CO2: Work with files and arrays using numpy.
CO3: Work with data using Pandas.
CO4: Write programs for visualization using matplotlib and seaborn.
CO5: Develop separate functions for statistical learning.
CO6: Develop computer applications for data science/ machine learning projects.

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
UNIT I  FUNDAMENTALS  9

UNIT II  INTERPRETABLE MODELS  9

UNIT III  TABULAR DATA EXPLAINABILITY  9
Permutation feature importance - Permutation Feature Importance from Scratch - Permutation Feature importance from python library Scikit learn - Shapley Values - Partial Dependence Plots and Related Plots.

UNIT IV  IMAGE DATA EXPLAINABILITY  9
Integrated gradients - XRAI - Working and implementation - Grad CAM - LIME implementation - Guided Backpropagation and guided Grad CAM.

UNIT V  TEXT DATA EXPLAINABILITY AND RECENT TRENDS  9
Tokenization - Word embeddings - LIME working with text - Gradient x Input - Layer integrated gradients - Language interpretability tool - Emerging topics - Time series data - Multimodal data - Interacting with Explainable AI.

PRACTICAL EXERCISES:  30
1. Prediction of a linear regression model.
2. Installation of LIME and explaining the prediction of linear regression.
3. Classification and Regression with IRIS dataset.
4. Explainability on classification and Regression with IRIS/ other tabular data.
5. Classification of image dataset with CNN.
6. Explainability on classification using Keras.
7. Explainability on classification using pytorch.
8. Explainability on classification using Random Forest.
10. A mini project demonstrating explainability AI on a real world dataset.

TOTAL:75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Understand the different types of learning models with interpretation mechanisms
CO2: Apply different computation interpretable techniques to ML models
CO3: Automate the AI explanation mechanism to Tabular data
CO4: Automate the AI explanation to Image data
CO5: Apply the AI explainable techniques to text data
CO6: Explore the recent AI computation tools

REFERENCES:
2. Michael Munn, David Pitman, Explainable AI for Practitioners, O'Reilly Media, Inc., 2022

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

DS3008 FINANCIAL TECHNOLOGIES

UNIT I FINTECH

UNIT II INNOVATIONS OF FINTECH
Advancements in Payments and Digital Wallets - Banks' disintermediation of credit, Individual Payments, Mobile Money, RTGS Systems, ABCDs of Alternative Finance, Building a New stack Cryptocurrencies, Blockchain, Robo-Advisors and Wealth Management, The Benefits from New Payment Stacks (Applications of Ripple), Artificial Intelligence (AI) and Machine Learning (ML) in Fintech

UNIT III FINTECH REGULATIONS AND DATA REGULATION

UNIT IV DIGITAL FINANCE AND ALTERNATIVE FINANCE

UNIT V BUILDING & MANAGING A SUCCESSFUL FINTECH STARTUP
Understanding the impact of Macro & Micro factors on the Business Dynamics- Art & Science of Design Thinking- Managing Growth, Fund Raising-Developing the Minimum Viable Products and Exits. Implementing Effective Marketing and Growth Strategies; Managing Risk and Ensuring
Compliance: Disruptive Technology Cases in FinTech

PRACTICAL EXERCISES:
1. Experiment on Retail Payments System
2. Experiment on risk predictions
3. Experiment on Financial time series modeling using deep nets
4. Install and Getting Started with the Bitcoin core client. Write a program to get a Bitcoin and create transaction.
5. Setup the Ethereum development environment. Generate addresses and create transaction.
6. Development of Smart contract
7. Experiment on Fraud prevention techniques
8. Experiment on digital signatures
9. Analysis of various cryptocurrencies
10. Toy application using deep nets
11. Naive Blockchain construction
12. Memory Hard algorithm - Hashcash implementation
13. Mining puzzles
14. Mobile Money

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Apply the concepts and computational basics in the real-world financial market scenario
CO2: Formulate trading strategies by identifying the patterns in trading and market price movements
CO3: Evaluate portfolios through systematic technical and fundamental analysis
CO4: Collaborate and compete with trading groups in a simulated environment and extend to the real investment scenarios
CO5: Demonstrate decision dynamics to attain the investment objectives in a stock market environment
CO6: Learn to assess the future of fintech and think strategically about challenges faced by financial companies

REFERENCES:

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

TOTAL: 75 PERIODS
DS3009  QUANTUM AI  L T P C  3 0 2 4

UNIT I  QUANTUM COMPUTING  9
Basic Concepts- Bit and Quantum Bits (Qubit), Working with Qubits (Computation with Qubits-Computation with one Qubit, Computation with m Qubit, Matrix Representation of Serial and Parallel Operations, Entanglement, Quantum Boolean Circuits, Deutsch Algorithm, Deutsch Jozsa Algorithm, Amplitude Distribution, Geometric Operations), Working with Multiple Qubits, Quantum States, Quantum Hardware Approaches, Quantum computer working.

UNIT II  QUANTUM COMPUTATION AND ALGORITHMS  9

UNIT III  ADVANCED QUANTUM COMPUTING: INTERFERENCE AND ENTANGLEMENT  9

UNIT IV  QUANTUM ML and QUANTUM DL  9

UNIT V  QUANTUM BLOCKCHAIN  9
Quantum Internet, Quantum Networks: A Deeper Dive, Quantum Cryptography and Quantum Key Distribution, Quantum Security: Blockchain Risk of Quantum Attack, Quantum-Resistant Cryptography for Blockchains.

PRACTICAL EXERCISES:
1. Implementation of Quantum Algorithms.
2. Demonstrating the Quantum Complexity.
3. Experiment on Quantum Key Distribution.
5. Experiments on Quantum Cryptography.

TOTAL:75 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Gain understanding of the QAI's fundamentals.
CO2: Learn more about quantum computation and algorithm development.
CO3: Understand how to use artificial intelligence, machine learning, and deep learning to extract value from large amounts of data.
CO4: Understand and be fluent on the concepts of advanced quantum computing.
CO5: Learn to assess the use QAI to develop the Quantum Blockchain.
CO6: Learn Quantum statistics.

REFERENCES:

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

DS3010 RECOMMENDER SYSTEMS

UNIT I INTRODUCTION
Basic taxonomy of recommender systems - Data mining methods for recommender systems - Recommender system functions - Understanding ratings - Applications of recommendation systems - Issues with recommender system.

UNIT II COLLABORATIVE FILTERING
Nearest-neighbor collaborative filtering (CF). User-based and item-based CF, comparison, Components of neighborhood methods Hybrid recommender systems. Attacks on collaborative recommender systems.

UNIT III CONTENT-BASED RECOMMENDATION
High-level architecture of content-based systems - Advantages and drawbacks of content- based filtering, Item profiles - Discovering features of documents - Obtaining item features from tags - Representing item profiles - Methods for learning user profiles - Similarity based retrieval - Classification algorithms.

UNIT IV KNOWLEDGE-BASED RECOMMENDATION
Knowledge representation and reasoning – Constraint-based recommenders – Case-based recommenders - Hybrid approaches: Opportunities for hybridization - Monolithic hybridization design - Parallelized hybridization design - Pipelined hybridization design.
UNIT V  EVALUATING RECOMMENDER SYSTEM

Introduction - Evaluation designs - Evaluation on historical datasets - Community-Based Web Search - Social Tagging Recommenders Systems - Trust and Recommendations.

PRACTICAL EXERCISES:
1. Implement a movie recommendation system based on user ratings and similarities with other users, using techniques like user-based or item-based collaborative filtering.
2. Design and develop a book recommendation system that suggests books to users based on their preferences and so on.
3. Create a hybrid recommender system for an e-commerce platform by combining collaborative filtering and content-based filtering techniques.
4. Develop a knowledge-based recommender system that suggests personalized travel destinations, activities, and itineraries.
5. Implement a music recommendation system using matrix factorization techniques based on user listening histories and item features.
6. Develop a real-time recommender system for news articles that suggests relevant and personalized articles to users based on their interests, reading history, and article content.
7. Create a deep learning-based recommender system for video streaming platforms that captures temporal dependencies or visual features in videos to recommend personalized content to users.
8. Build a context-aware recommender system for mobile apps that recommends suitable applications based on contextual information like time of day, location, user activity, and device usage patterns.
9. Implement a social collaborative filtering recommender system for social media platforms.

TOTAL:45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:

CO1: Develop an understanding of recommender systems and data mining techniques used.

CO2: Apply collaborative filtering techniques and addressing attacks on collaborative recommender systems.

CO3: Design content-based recommender systems using similarity retrieval or classification algorithms.

CO4: Employ knowledge representation and reasoning in recommender systems and opportunities for hybridization.

CO5: Evaluate and improve recommender systems for real-time application.

CO6: Develop state-of-the-art recommender systems.

REFERENCES:
<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

DS3011  
ARTIFICIAL NEURAL NETWORKS  
L T P C  
3 0 2 4

UNIT I  
ARTIFICIAL NEURAL NETWORK  

UNIT II  
MULTILAYER FEEDFORWARD NETWORKS  

UNIT III  
SINGLE-LAYER FEEDBACK NETWORKS  

UNIT IV  
ASSOCIATIVE MEMORIES  
Basic Concepts - Linear Associator - Basic Concepts of Recurrent Autoassociative Memory - Performance Analysis of Recurrent Autoassociative Memory - Bidirectional Associative Memory - Associative Memory of Spatio-temporal Patterns

UNIT V  
APPLICATIONS OF NEURAL ALGORITHMS AND SYSTEMS  

PRACTICAL EXERCISES:  
1. Study about Biological Neural Network & Artificial Neural Network
2. Write a MATLAB program to plot a few activation functions that are being used in neural networks
3. Implement a logic gate (AND, OR, NOT, NAND, NOR), using McCulloh - Pitts model.
4. Implement a Perceptron model
5. With a suitable example simulate the perceptron learning network and separate the boundaries. Plot the points assumed in the respective quadrants using different symbols for identification.
6. Implement a Hopfield model
7. Implement a Back propagation learning algorithm.
8. Implement a Multi layer perceptron
9. Create a network that learns to take eight-bit patterns and reproduce them on the output layer after re-coding them in a three-unit hidden layer
10. Mini Project

TOTAL: 75 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO1: Understand the fundamental concept behind neural network
CO2: Implement the feed forward network
CO3: Understand the working of feedback neural network
CO5: Design and develop applications using neural networks
CO6: Explore the recent advances in neural networks

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>