



**THIRUVALLUVAR UNIVERSITY**

**SERKKADU, VELLORE-632115**

**B.Sc. DATA SCIENCE**

**SYLLABUS**

**FROM THE ACADEMIC YEAR**

**2023 - 2024**

# 1. Introduction

## **B.Sc. Data Science**

Data Science is a vast field comprising many topics of Statistics, Mathematics, and IT. A Data Science course syllabus for beginners covers basic and advanced concepts of data analytics, machine learning, statistics, and programming languages like Python or R. It also teaches students how to interpret large datasets and identify patterns to create predictive models. Data Science has come a long way. Data Scientists were once referred to as „business problem solvers“ who knew how to make sense of incoherent data clusters. Fast-forward to the present, Data Scientists are the most important resources for any business looking to thrive in this mad rush. They are now the „wizards of all problem solvers“.

The course is enabled to include several interdisciplinary areas like: programming languages, algorithms, operating systems, databases, machine learning, data mining, business intelligence, big data, probability and statistics, data optimization, statistical simulation and data analysis, management decision analysis, decision models and predictive analysis. Data Science has gained paramount importance in the computer science domain. The need for scientists who understand data in all its aspects will continue to grow strongly. Students graduating from the program will have significantly more depth and breadth in the broad area of Data Science and receive all the information they need to work with various kinds of data and statistical data. The program is designed so that students have in-depth knowledge of the many approaches, aptitudes, methodologies, and instruments needed to deal with corporate data. Students receive instruction in the abilities needed to find the needed solutions and assist in making significant judgments.

This is the primary reason the syllabus of Data Science courses includes concepts that touch base on cloud computing, big data, natural language processing, and data sentiment analysis. The future of Data Science is estimated to bring opportunities in various areas of banking, finance, insurance, entertainment, telecommunication, automobile, etc. A data scientist will help grow an organization by assisting them in making better decisions. Data science has become important due to

recent technology disruptions. Most fundamental is Moore's Law which has driven an exponential growth in computing, storage, and communications per rupee over the past 50 years. This rate of growth shows no signs of abating. Consequently, today we have the Internet of Things: a plethora of sensors costing 10s of rupees or less, a global Internet with almost limitless bandwidth, and enormous storage in global clouds. The present era is full of technological advances in almost all spectrum of life and we are flooded with enormous amount of data. There is an increasing demand of capturing, analyzing, and synthesizing this large amount of data sets in a number of application domains to better understand various phenomena and to convert the information available in the data into actionable strategies such as new scientific discoveries, business applications, policy making, and healthcare etc.

Data science is the area where applications of various tools and techniques from the disciplines of applied statistics, mathematics and computer science are used to get greater insight and to make better and informed decisions for various purposes by analyzing a large amount of data. Consequently, the study of data science as a discipline has become essential to cater the growing need for professionals and researchers to deal with the future challenges.

| <b>LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME</b> |  |
|---|--|
| <b>Programme:</b>   | <b>B.Sc., Data Science</b>   |
| <b>Programme Code:</b>  |  |
| <b>Duration:</b>  | <b>3 years [UG]</b>  |
| <b>Programme Outcomes:</b>  | <p><b>PO1: Disciplinary knowledge:</b> Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study</p> <p><b>PO2: Communication Skills:</b> Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.</p> <p><b>PO3: Critical thinking:</b> Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.</p> <p><b>PO4: Problem solving: Capacity</b> to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one’s learning to real life situations.</p> <p><b>PO5: Analytical reasoning:</b> Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.</p> <p><b>PO6: Research-related skills:</b> A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation</p> |

**PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team

**PO8: Scientific reasoning:** Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

**PO9: Reflective thinking:** Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.

**PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

**PO 11 Self-directed learning:** Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

**PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

**PO 13: Moral and ethical awareness/reasoning:** Ability to embrace moral/ethical values in conducting one’s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work.

Capable of demonstrating the ability to identify ethical issues related to one’s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

**PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way

|  |  |
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|  | <p><b>PO 15: Lifelong learning:</b> Ability to acquire knowledge and skills, including „learning how to learn“, that are necessary for participating in learning activities throughout life, through self- paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.</p>   |
| <p><b>Programme Specific Outcomes:</b></p> | <p><b>PSO1.</b> Able to apply data analytical skills that rely on mathematical and statistical methods to solve problems in a data-driven world.</p> <p><b>PSO2.</b> Able to analyze and interpret complex data to produce actionable insights.</p> <p><b>PSO3.</b> Able to understand the nuances of data analytical skills to evolve innovative ideas and communicate the social relevance and impact of their analytical findings.</p> <p><b>PSO4.</b> Becoming analytical experts and data entrepreneurs with exemplary behavior safeguarding the public interest.</p> <p><b>PSO5.</b> To uphold professional ethics, values, standards and social responsibilities to attain a better and more sustainable future</p> |

|              | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|--------------|------|-----|-----|-----|-----|-----|-----|-----|
| <b>PSO 1</b> | Y    | Y   | Y   | Y   | Y   | Y   | Y   | Y   |
| <b>PSO 2</b> | Y    | Y   | Y   | Y   | Y   | Y   | Y   | Y   |
| <b>PSO3</b>  | Y    | Y   | Y   | Y   | Y   | Y   | Y   | Y   |
| <b>PSO 4</b> | Y    | Y   | Y   | Y   | Y   | Y   | Y   | Y   |
| <b>PSO 5</b> | Y    | Y   | Y   | Y   | Y   | Y   | Y   | Y   |

**3 – Strong, 2- Medium, 1- Low**

**Highlights of the Revamped Curriculum:**

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Mathematics based problem solving skills are included as mandatory components in the ‘Training for Competitive Examinations’ course at the final semester, a first of its kind.

- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest - Artificial Intelligence.

**Value additions in the Revamped Curriculum:**

| <b>Semester</b>       | <b>Newly introduced Components</b>  | <b>Outcome / Benefits</b>  |
|-----------------------|---|--|
| <b>I</b>              | <b>Foundation Course</b><br>To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analysing the world through the literary lens gives rise to a new perspective. | <ul style="list-style-type: none"> <li>➤ Instill confidence among students</li> <li>➤ Create interest for the subject</li> </ul>   |
| <b>I, II, III, IV</b> | <b>Skill Enhancement papers</b> (Discipline centric / Generic / Entrepreneurial)  | <ul style="list-style-type: none"> <li>➤ Industry ready graduates</li> <li>➤ Skilled human resource</li> <li>➤ Students are equipped with essential skills to make them employable</li> </ul><br><ul style="list-style-type: none"> <li>➤ Training on language and communication skills enable the students gain knowledge and exposure in the competitive world.</li> </ul> |

|   |                 |  |
|---|-----------------|--|
|   |                 | <ul style="list-style-type: none"> <li>➤ Discipline centric skill will improve the Technical knowhow of solving real life problems.</li> </ul>   |
| <b>III, IV, V &amp; VI</b>                                      | Elective papers | <ul style="list-style-type: none"> <li>➤ Strengthening the domain knowledge</li> <li>➤ Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature</li> <li>➤ Emerging topics in higher education/ industry/ communication network / health sector etc. are introduced with hands-on-training.</li> </ul> |
| <b>IV</b>   | Elective Papers | <ul style="list-style-type: none"> <li>➤ Exposure to industry moulds students into solution providers</li> <li>➤ Generates Industry ready graduates</li> <li>➤ Employment opportunities enhanced</li> </ul>  |
| <b>V Semester</b>   | Elective papers | <ul style="list-style-type: none"> <li>➤ Self-learning</li> <li>➤ Application of the concept to real situation is conceived resulting in tangible outcome</li> </ul>   |
| <b>VI Semester</b>  | Elective papers | <ul style="list-style-type: none"> <li>➤ Enriches the study beyond the course.</li> <li>➤ Developing a research framework and presenting their Independent and Intellectual ideas effectively.</li> </ul>  |
| <b>Extra Credits:<br/>For Advanced Learners / Honors degree</b> |                 | <ul style="list-style-type: none"> <li>➤ To cater to the needs of peer learners / research aspirants</li> </ul>  |
| <b>Skills acquired from the Courses</b>                         |                 | Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill  |



### Credit Distribution for UG Programmes

| Sem I                                       | Credit    | H         | Sem II                                       | Credit    | H         | Sem III   | Credit    | H         | Sem IV   | Credit    | H         | Sem V  | Credit    | H         | Sem VI   | Credit    | H         |
|---|-----------|-----------|--|-----------|-----------|---|-----------|-----------|--|-----------|-----------|--|-----------|-----------|--|-----------|-----------|
| Part 1. Language – Tamil                    | 3         | 6         | Part..1. Language – Tamil                    | 3         | 6         | Part..1. Language – Tamil                                   | 3         | 6         | Part..1. Language – Tamil                        | 3         | 6         | 5.1 Core Course – \CC IX                           | 4         | 5         | 6.1 Core Course – CC XIII                      | 4         | 6         |
| Part.2 English                              | 3         | 6         | Part..2 English                              | 3         | 6         | Part..2 English   | 3         | 6         | Part..2 English                                  | 3         | 6         | 5.2 Core Course – CC X                             | 4         | 5         | 6.2 Core Course – CC XIV                       | 4         | 6         |
| 1.3 Core Course – CC I                      | 5         | 6         | 2..3 Core Course – CC III                    | 5         | 5         | 3.3 Core Course – CC V                                      | 5         | 5         | 4.3 Core Course – CC VII<br>Core Industry Module | 5         | 5         | 5. 3.Core Course CC -XI                            | 4         | 5         | 6.3 Core Course – CC XV                        | 4         | 6         |
| 1.4 Core Course – CC II                     | 5         | 5         | 2.4 Core Course – CC IV                      | 5         | 5         | 3.4 Core Course – CC VI                                     | 5         | 5         | 4.4 Core Course – CC VIII                        | 5         | 5         | 5. 4.Core Course –/ Project with viva-voce CC -XII | 4         | 5         | 6.4 Elective -VII Generic/ Discipline Specific | 3         | 5         |
| 1.5 Elective I Generic/ Discipline Specific | 3         | 5         | 2.5 Elective II Generic/ Discipline Specific | 3         | 6         | 3.5 Elective III Generic/ Discipline Specific               | 3         | 5         | 4.5 Elective IV Generic/ Discipline Specific     | 3         | 6         | 5.5 Elective V Generic/ Discipline Specific        | 3         | 4         | 6.5 Elective VIII Generic/ Discipline Specific | 3         | 5         |
| 1.6 Skill Enhancement Course SEC-1          | 2         | 2         | 2.6 Skill Enhancement Course SEC-2           | 2         | 2         | 3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill) | 1         | 1         | 4.6 Skill Enhancement Course SEC-6               | 2         | 2         | 5.6 Elective VI Generic/ Discipline Specific       | 3         | 4         | 6.6 Extension Activity                         | 1         | -         |
| 1.7 Skill Enhancement -(Foundation Course)  | 2         | 2         | 2.7 Skill Enhancement Course –SEC-3          | 2         | 2         | 3.7 Skill Enhancement Course SEC-5                          | 2         | 2         | 4.7 Skill Enhancement Course SEC-7               | 2         | 2         | 5.7 Value Education                                | 2         | 2         | 6.7 Professional Competency Skill              | 2         | 2         |
|   |           |           |  |           |           | 3.8 E.V.S.  | 2         | 2         |  |           |           | 5.8 Summer Internship /Industrial Training         | 2         |           |  |           |           |
|   | <b>23</b> | <b>32</b> |  | <b>23</b> | <b>32</b> |   | <b>24</b> | <b>32</b> |  | <b>23</b> | <b>32</b> |  | <b>26</b> | <b>30</b> |  | <b>21</b> | <b>30</b> |
| <b>Total – 140 Credits</b>                  |           |           |  |           |           |   |           |           |  |           |           |  |           |           |  |           |           |

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours**

**First Year – Semester-I**

| <b>Part</b> | <b>List of Courses</b>                     | <b>Credit</b> | <b>No. of Hours</b> |
|-------------|--|---------------|---------------------|
| Part-1      | Language – Tamil                           | 3             | 6                   |
| Part-2      | English                                    | 3             | 6                   |
| Part-3      | Core Courses & Elective Courses [in Total] | 13            | 16                  |
| Part-4      | Skill Enhancement Course SEC-1             | 2             | 2                   |
|             | Foundation Course                          | 2             | 2                   |
|             |  | <b>23</b>     | <b>32</b>           |

**Semester-II**

| <b>Part</b> | <b>List of Courses</b>  | <b>Credit</b> | <b>No. of Hours</b> |
|-------------|---|---------------|---------------------|
| Part-1      | Language – Tamil  | 3             | 6                   |
| Part-2      | English   | 3             | 6                   |
| Part-3      | Core Courses & Elective Courses including laboratory [in Total] | 13            | 16                  |
| Part-4      | Skill Enhancement Course -SEC-2                                 | 2             | 2                   |
|             | Skill Enhancement Course -SEC-3 (Discipline / Subject Specific) | 2             | 2                   |
|             |   | <b>23</b>     | <b>32</b>           |

**Second Year – Semester-III**

| <b>Part</b> | <b>List of Courses</b>  | <b>Credit</b> | <b>No. of Hours</b> |
|-------------|---|---------------|---------------------|
| Part-1      | Language - Tamil  | 3             | 6                   |
| Part-2      | English   | 3             | 6                   |
| Part-3      | Core Courses & Elective Courses including laboratory [in Total] | 13            | 15                  |
| Part-4      | Skill Enhancement Course -SEC-4 (Entrepreneurial Based)         | 1             | 1                   |
|             | Skill Enhancement Course -SEC-5 (Discipline / Subject Specific) | 2             | 2                   |
|             | E.V.S   | 2             | 2                   |
|             |   | <b>24</b>     | <b>32</b>           |

**Semester-IV**

| <b>Part</b> | <b>List of Courses</b>  | <b>Credit</b> | <b>No. of Hours</b> |
|-------------|---|---------------|---------------------|
| Part-1      | Language - Tamil  | 3             | 6                   |
| Part-2      | English   | 3             | 6                   |
| Part-3      | Core Courses & Elective Courses including laboratory [in Total] | 13            | 16                  |
| Part-4      | Skill Enhancement Course -SEC-6 (Discipline / Subject Specific) | 2             | 2                   |

|  |   |           |           |
|--|---|-----------|-----------|
|  | Skill Enhancement Course -SEC-7 (Discipline / Subject Specific) | 2         | 2         |
|  |   | <b>23</b> | <b>32</b> |

**Third Year  
Semester-V**

| Part          | List of Courses                                 | Credit    | No. of Hours |
|---------------|---|-----------|--------------|
| <b>Part-3</b> | Core Courses including Project / Elective Based | 22        | 26           |
| <b>Part-4</b> | Value Education                                 | 2         | 2            |
|               | Internship / Industrial Visit / Field Visit     | 2         | 2            |
|               |   | <b>26</b> | <b>30</b>    |

**Semester-VI**

| Part          | List of Courses                       | Credit    | No. of Hours |
|---------------|---------------------------------------|-----------|--------------|
| <b>Part-3</b> | Core Courses / Elective Based & LAB   | 18        | 28           |
| <b>Part-4</b> | Extension Activity                    | 1         | -            |
|               | Professional Competency Skill (SEC-8) | 2         | 2            |
|               |                                       | <b>21</b> | <b>30</b>    |

**Consolidated Semester wise and Component wise Credit distribution**

| Parts           | Sem I | Sem II | Sem III | Sem IV | Sem V | Sem VI | Total Credits |
|-----------------|-------|--------|---------|--------|-------|--------|---------------|
| <b>Part I</b>   | 3     | 3      | 3       | 3      | -     | -      | 12            |
| <b>Part II</b>  | 3     | 3      | 3       | 3      | -     | -      | 12            |
| <b>Part III</b> | 13    | 13     | 13      | 13     | 22    | 18     | 92            |
| <b>Part IV</b>  | 4     | 4      | 3       | 6      | 4     | 1      | 22            |
| <b>Part V</b>   | -     | -      | -       | -      | -     | 2      | 2             |
| <b>Total</b>    | 23    | 23     | 22      | 25     | 26    | 21     | <b>140</b>    |

**\*Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

## METHODS OF EVALUATION & METHODS OF ASSESSMENT

| <b>METHODS OF EVALUATION FOR THEORY SUBJECTS</b>    |  |   |
|---|--|---|
| <b>Internal Evaluation</b>                          | Continuous Internal Assessment Test – 10 Marks   | <b>25 Marks</b>   |
|   | Assignments / Snap Test / Quiz – 5 Marks   |   |
|   | Seminars – 5 Marks   |   |
|   | Attendance and Class Participation – 5 Marks   |   |
| <b>External Evaluation</b>                          | End Semester Examination   | <b>75 Marks</b>   |
| <b>Total</b>  |  | <b>100 Marks</b>  |
| <b>METHODS OF EVALUATION FOR PRACTICAL SUBJECTS</b> |  |   |
| <b>Internal Evaluation</b>                          | Preparation for the Practical Session  | <b>25 Marks</b>   |
|   | Executing an Exercise within the Stipulated Time   |   |
|   | Continuous Internal Practical Tests  |   |
|   | Completing All the Exercises of the Course   |   |
| <b>External Evaluation</b>                          | Coding / Solutions for the Two Problems  | <b>60 Marks</b> (Coding:20+20 marks + Solution:10+10 marks) |
|   | Preparation of the Record  | <b>10 marks</b>   |
|   | Viva   | <b>5 marks</b>  |
| <b>Total</b>  |  | <b>100 Marks</b>  |
| <b>METHODS OF ASSESSMENT</b>                        |  |   |
| <b>Remembering (K1)</b>                             | <ul style="list-style-type: none"> <li>The lowest level of questions require students to recall information from the course content</li> <li>Knowledge questions usually require students to identify information in the text book.</li> </ul>   |   |
| <b>Understanding (K2)</b>                           | <ul style="list-style-type: none"> <li>Understanding of facts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words.</li> <li>The questions go beyond simple recall and require students to combine data together</li> </ul>  |   |
| <b>Application (K3)</b>                             | <ul style="list-style-type: none"> <li>Students have to solve problems by using / applying a concept learned in the class room.</li> <li>Students must use their knowledge to determine a exact response.</li> </ul>   |   |
| <b>Analyze (K4)</b>                                 | <ul style="list-style-type: none"> <li>Analyzing the question is one that asks the students to break down something into its component parts.</li> <li>Analyzing requires students to identify reasons cause or motives and reach conclusions or generalizations.</li> </ul>   |   |
| <b>Evaluate (K5)</b>                                | <ul style="list-style-type: none"> <li>Evaluation requires an individual to make judgment on something.</li> <li>Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem.</li> <li>Students are engaged in decision-making and problem – solving.</li> <li>Evaluation questions do not have single right answers.</li> </ul> |   |

|                    |  |
|--------------------|--|
| <b>Create (K6)</b> | <ul style="list-style-type: none"><li>• The questions of this category challenge students to get engaged in creative and original thinking.</li><li>• Developing original ideas and problem solving skills</li></ul> |
|--------------------|--|

**Credit Distribution for all UG courses with LAB Hours**

**B.Sc. DATA SCIENCE  
SEMESTER – III**

| Part         | List of courses   | Credits   | No. of Hrs |
|--------------|---|-----------|------------|
| Part I       | Language – Tamil  | 3         | 6          |
| Part II      | English   | 3         | 6          |
| Part-III     | CC5- Fundamentals of Data Science   | 5         | 5          |
|              | CC6-Practical : Data Science Lab  | 5         | 5          |
|              | Elective Course III (Choose one from the list)<br>1. Discrete Mathematics – I<br>2. Computer Networks | 3         | 5          |
| Part- IV     | Skill Enhancement Course –SEC4<br>E-Commerce  | 1         | 1          |
|              | Skill Enhancement Course – SEC5<br>Big Data Analytics   | 2         | 2          |
|              | Environmental Studies   | 2         | 2          |
| <b>TOTAL</b> |   | <b>24</b> | <b>32</b>  |

**SEMESTER –IV**

| Part         | List of courses  | Credits   | No. of Hrs |
|--------------|--|-----------|------------|
| Part-I       | Language – Tamil   | 3         | 6          |
| Part-II      | English  | 3         | 6          |
| Part-III     | CC7- Relational Database Management System   | 5         | 5          |
|              | CC8- RDBMS Lab Using Oracle  | 5         | 5          |
|              | Elective Course IV (Choose one from the list)<br>1. Discrete Mathematics – II<br>2. Network Security | 3         | 3          |
| Part- IV     | Skill Enhancement Course –SEC6<br>Data Mining and Warehousing  | 2         | 2          |
|              | Skill Enhancement Course – SEC7<br>Open Source Software Technologies                                 | 2         | 2          |
| <b>TOTAL</b> |  | <b>23</b> | <b>32</b>  |

**SEMESTER –V**

| Part         | List of courses  | Credits   | No. of Hrs |
|--------------|--|-----------|------------|
| Part-III     | CC9: Machine Learning  | 4         | 5          |
|              | CC10: Machine Learning Lab   | 4         | 5          |
|              | CC11: Software Engineering   | 4         | 5          |
|              | Elective Course V (Choose one from the list)<br>1. Information Security<br>2. Financial Analytics<br>3. Cryptography           | 3         | 4          |
|              | Elective Course VI (Choose one from the list)<br>1. Operating System<br>2. Simulation and Modeling<br>3. Quantitative Aptitude | 3         | 4          |
|              | Core Course<br>CC12:Project with Viva Voce<br>Project (Individual)   | 4         | 5          |
| Part –IV     | Value Education  | 2         | 2          |
|              | Summer Internship /Industrial Training<br>(Summer vacation at the end of IV semester activity)                                 | 2         | -          |
| <b>TOTAL</b> |  | <b>26</b> | <b>30</b>  |

**SEMESTER –VI**

| Part         | List of courses   | Credits            | No. of Hrs |
|--------------|---|--------------------|------------|
| Part-III     | CC13: IoT and Cloud Technologies  | 4                  | 6          |
|              | CC14: IoT and Cloud Technologies Lab  | 4                  | 6          |
|              | CC15: Artificial Intelligence   | 4                  | 6          |
|              | Elective Course VII (Choose one from the list)<br>1. Introduction to Linear Algebra<br>2. Artificial Neural Networks<br>3. Analytics for Service Industry | 3                  | 5          |
|              | Elective Course VIII (Choose one from the list)<br>1. Computing Intelligence<br>2. Data Analytics using R Programming<br>3. Natural Language Processing   | 3                  | 5          |
|              | Skill Enhancement Course – SEC8<br>Cyber Forensics  | 2                  | 2          |
|              | Part –IV  | Extension Activity | 1          |
| <b>TOTAL</b> |   | <b>21</b>          | <b>30</b>  |

### SEMESTER – III

| Subject Code               | Subject Name  | Category | L | T | P | S   | Credits | Marks              |                              |       |
|----------------------------|---|----------|---|---|---|-----|---------|--------------------|------------------------------|-------|
|                            |   |          |   |   |   |     |         | CIA                | External                     | Total |
|                            | <b>FUNDAMENTALS OF DATA SCIENCE</b>   | CC 5     | 5 | - | - | III | 5       | 25                 | 75                           | 100   |
| <b>Learning Objectives</b> |   |          |   |   |   |     |         |                    |                              |       |
| LO1                        | To understand the basic concepts of Data Science  |          |   |   |   |     |         |                    |                              |       |
| LO2                        | To acquire a solid foundation in pandas   |          |   |   |   |     |         |                    |                              |       |
| LO3                        | To understand the principles of Data Loading, Storage, and File Formats   |          |   |   |   |     |         |                    |                              |       |
| LO4                        | To acquire a solid foundation in Data Wrangling   |          |   |   |   |     |         |                    |                              |       |
| LO5                        | To visualize data using plots in python   |          |   |   |   |     |         |                    |                              |       |
| UNIT                       | Contents  |          |   |   |   |     |         |                    | No. Of. Hours                |       |
| I                          | <b>Data Science:</b> definition, Datafication, Exploratory Data Analysis, The Data science process, A data scientist role in this process. NumPy Basics: The NumPy ndarray: A Multidimensional Array Object, Creating ndarrays ,Data Types for ndarrays, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Data Processing Using Arrays, Expressing Conditional Logic as Array Operations, Methods for Boolean Arrays , Sorting , Unique |          |   |   |   |     |         |                    | <b>15</b>                    |       |
| II                         | <b>Getting Started with pandas:</b> Introduction to pandas, Library Architecture, Features, Applications, Data Structures, Series, DataFrame, Index Objects, Essential Functionality (Reindexing, Dropping entries from an axis, Indexing, selection, and filtering), Sorting and ranking, Summarizing and Computing Descriptive Statistics, Unique Values, Value Counts, Handling Missing Data, filtering out missing data.  |          |   |   |   |     |         |                    | <b>15</b>                    |       |
| III                        | <b>Data Loading, Storage, and File Formats :</b> Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats, Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in MongoDB   |          |   |   |   |     |         |                    | <b>15</b>                    |       |
| IV                         | <b>Data Wrangling:</b> Combining and Merging Data Sets, Database style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap , Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Data Transformation, Removing Duplicates, Replacing Values.   |          |   |   |   |     |         |                    | <b>15</b>                    |       |
| V                          | <b>Plotting and Visualization:</b> A Brief matplotlib API Primer, Figures and Subplots, Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File, Plotting Functions in pandas, Line Plots, Bar Plots, Histograms and Density Plots, Scatter Plots.   |          |   |   |   |     |         |                    | <b>15</b>                    |       |
| <b>TOTAL HOURS</b>         |   |          |   |   |   |     |         | <b>75</b>          |                              |       |
| Course Outcomes            |   |          |   |   |   |     |         | Programme Outcomes |                              |       |
| CO                         | On completion of this course, students will   |          |   |   |   |     |         |                    |                              |       |
| CO1                        | To explain the basic concepts of data science and its application   |          |   |   |   |     |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |



|                        |   |                              |
|------------------------|---|------------------------------|
| CO2                    | Apply principles of NumPy and Pandas to the analysis of data.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO3                    | Make use of various file formats in loading and storage of data.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO4                    | Identify and apply the need and importance of pre-processing techniques.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5                    | Show the results and present them in a pictorial format   | PO1, PO2, PO3, PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                              |
| 1                      | Wes McKinney, "Python for Data Analysis", O'REILLY, ISBN:978-1-449-31979-3, 1st edition, October 2012.                    |                              |
| 2                      | Rachel Schutt & O'neil, "Doing Data Science", O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.                |                              |
| <b>Reference Books</b> |   |                              |
| 1.                     | Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015                                |                              |
| 2.                     | Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization", O'Reilly, 2016. |                              |

**Mapping with Programme Outcomes:**

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 2     | 3     | 3     | 3     | 3     |
| CO 2   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 4   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 5   | 2     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 14    | 15    | 15    | 15    | 15    |

**S-Strong-3    M-Medium-2    L-Low-1**

| Subject Code   | Subject Name            | Category    | L | T | P | S   | Credits | Marks |                       |       |
|--|-------------------------|-------------|---|---|---|-----|---------|-------|-----------------------|-------|
|  |                         |             |   |   |   |     |         | CIA   | External              | Total |
|  | <b>DATA SCIENCE LAB</b> | <b>CC 6</b> | - | - | 4 | III | 5       | 25    | 75                    | 100   |
| <b>Objectives:</b><br>The main objective of the course is to inculcate the basic understanding of Data Science and it's practical implementation using Python.   |                         |             |   |   |   |     |         |       |                       |       |
|  |                         |             |   |   |   |     |         |       | <b>Required Hours</b> |       |
| 1. Creating a NumPy Array<br>a. Basic ndarray<br>b. Array of zeros<br>c. Array of ones<br>d. Random numbers in ndarray<br>e. An array of your choice<br>f. Imatrix in NumPy<br>g. Evenly spaced ndarray                      |                         |             |   |   |   |     |         |       | <b>60</b>             |       |
| 2. The Shape and Reshaping of NumPy Array<br>a. Dimensions of NumPy array<br>b. Shape of NumPy array<br>c. Size of NumPy array<br>d. Reshaping a NumPy array<br>e. Flattening a NumPy array<br>f. Transpose of a NumPy array |                         |             |   |   |   |     |         |       |                       |       |
| 3. Expanding and Squeezing a NumPy Array<br>a. Expanding a NumPy array<br>b. Squeezing a NumPy array<br>c. Sorting in NumPy Arrays   |                         |             |   |   |   |     |         |       |                       |       |
| 4. Indexing and Slicing of NumPy Array<br>a. Slicing 1-D NumPy arrays<br>b. Slicing 2-D NumPy arrays<br>c. Slicing 3-D NumPy arrays<br>d. Negative slicing of NumPy arrays   |                         |             |   |   |   |     |         |       |                       |       |
| 5. Stacking and Concatenating Numpy Arrays<br>a. Stacking ndarrays<br>b. Concatenating ndarrays<br>c. Broadcasting in Numpy Arrays   |                         |             |   |   |   |     |         |       |                       |       |
| 6. Perform following operations using pandas<br>a. Creating dataframe<br>b. concat()<br>c. Setting conditions<br>d. Adding a new column  |                         |             |   |   |   |     |         |       |                       |       |

|  |  |
|--|--|
| 7. Perform following operations using pandas<br>a. Filling NaN with string<br>b. Sorting based on column values<br>c. groupby()  |  |
| 8. Read the following file formats using pandas<br>a. Text files<br>b. CSV files<br>c. Excel files<br>d. JSON files  |  |
| 9. Perform following preprocessing techniques on loan prediction dataset<br>a. Feature Scaling<br>b. Feature Standardization<br>c. Label Encoding<br>d. One Hot Encoding   |  |
| 10. Perform following visualizations using matplotlib<br>a. Bar Graph<br>b. Pie Chart<br>c. Box Plot<br>d. Histogram<br>e. Line Chart and Subplots<br>f. Scatter Plot  |  |
| <b>Web References</b>  |  |
| 1. <a href="https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/">https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/</a><br>2. <a href="https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/">https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/</a><br>3. <a href="https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/">https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/</a><br>4. <a href="https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/">https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/</a><br>5. <a href="https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-explorationpython/">https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-explorationpython/</a> |  |

### Mapping with Programme Outcomes:

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 2     | 3     | 3     | 3     | 3     |
| CO 2   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 4   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 5   | 2     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 14    | 15    | 15    | 15    | 15    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code               | Subject Name  | Category | L | T | P | S | Credits | Marks              |                              |       |  |
|----------------------------|---|----------|---|---|---|---|---------|--------------------|------------------------------|-------|--|
|                            |   |          |   |   |   |   |         | CIA                | External                     | Total |  |
|                            | <b>COMPUTER NETWORKS</b>  | Elect    | 4 | - | - | - | 3       | 25                 | 75                           | 100   |  |
| <b>Learning Objectives</b> |   |          |   |   |   |   |         |                    |                              |       |  |
| LO1                        | To make students understand the concepts of Network hardware and Network Software.  |          |   |   |   |   |         |                    |                              |       |  |
| LO2                        | To analyze different network models   |          |   |   |   |   |         |                    |                              |       |  |
| LO3                        | To impart knowledge on Design Issues of Data Link Layer   |          |   |   |   |   |         |                    |                              |       |  |
| LO4                        | To impart knowledge on IP Addresses and Routing algorithm   |          |   |   |   |   |         |                    |                              |       |  |
| LO5                        | To make the students understand the establishment of Network connection   |          |   |   |   |   |         |                    |                              |       |  |
| UNIT                       | Contents  |          |   |   |   |   |         |                    | No. Of. Hours                |       |  |
| I                          | Introduction – Uses of Computer Networks – Network Hardware-Network Software- OSI Reference Model – TCP/IP Reference Model.   |          |   |   |   |   |         |                    | 12                           |       |  |
| II                         | Physical Layer – Guided Transmission media – Wireless Transmission – Public Switched Telephone Network –Local Loop – Trunks – Multiplexing- Switching.                  |          |   |   |   |   |         |                    | 12                           |       |  |
| III                        | Data Link Layer – Design Issues- Error Detection and Correction-Simplex Stop and Wait Protocol- Sliding Window Protocol.  |          |   |   |   |   |         |                    | 12                           |       |  |
| IV                         | Network Layer – Design Issues – Routing Algorithm- IP Protocol – IP Addresses-Internet Control Protocols.   |          |   |   |   |   |         |                    | 12                           |       |  |
| V                          | Transport Layer: Addressing- Connection Establishment-Connection Release. Internet Transport Protocol: UDP-TCP. Application Layer: DNS- Electronic Mail-World Wide Web. |          |   |   |   |   |         |                    | 12                           |       |  |
| <b>TOTAL HOURS</b>         |   |          |   |   |   |   |         | <b>60</b>          |                              |       |  |
| Course Outcomes            |   |          |   |   |   |   |         | Programme Outcomes |                              |       |  |
| CO                         | On completion of this course, students will   |          |   |   |   |   |         |                    |                              |       |  |
| CO1                        | Usage of computer networks.<br>Describe the functions of each layer in OSI and TCP/IP model.  |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO2                        | Basics of Physical layer and apply them in real time applications.<br>Techniques in multiplexing and switching.   |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO3                        | Design of Data link layer.<br>Deduction of errors and correction. Flow control using protocols  |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO4                        | Design of Network layers.Generate IP address to find out the route through Routing algorithms   |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO5                        | Design of transport layer.Protocols needed for End–End delivery of packets. Role of Application layer in real time applications   |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |

| <b>Textbooks</b>       |   |
|------------------------|---|
| 1                      | A. S. Tanenbaum, “Computer Networks”, Prentice-Hall of India 2008, 4th Edition.   |
| <b>Reference Books</b> |   |
| 1.                     | Stallings, “Data and Computer Communications”, Pearson Education 2012, 7th Edition  |
| 2.                     | B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill 2007, 4th Edition.   |
| 3.                     | F. Halsall, “Data Communications, Computer Networks and Open Systems”, Pearson Education 2008.  |
| 4.                     | D. Bertsekas and R. Gallager, “Data Networks”, PHI 2008, 2nd Edition.   |
| 5.                     | Lamarca, “Communication Networks”, Tata McGraw Hill 2002.   |
| <b>Web Resources</b>   |   |
| 1.                     | <a href="https://www.geeksforgeeks.org/basics-computer-networking/">https://www.geeksforgeeks.org/basics-computer-networking/</a>                                       |
| 2.                     | <a href="https://en.wikipedia.org/wiki/Computer_network">https://en.wikipedia.org/wiki/Computer_network</a>   |
| 3.                     | <a href="https://www.tutorialspoint.com/computer_fundamentals/computer_networking.htm">https://www.tutorialspoint.com/computer_fundamentals/computer_networking.htm</a> |
| 4.                     | <a href="https://www.javatpoint.com/computer-network-tutorial">https://www.javatpoint.com/computer-network-tutorial</a>   |
| 5.                     | <a href="http://ceit.aut.ac.ir/~91131079/SE2/SE2%20Website/Lecture%20Slides.html">http://ceit.aut.ac.ir/~91131079/SE2/SE2%20Website/Lecture%20Slides.html</a>           |

#### Mapping with Programme Outcomes:

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| <b>CO 1</b>  | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>CO 2</b>  | 2     | 3     | 3     | 3     | 2     | 3     |
| <b>CO 3</b>  | 3     | 3     | 3     | 3     | 2     | 2     |
| <b>CO 4</b>  | 3     | 3     | 3     | 3     | 2     | 3     |
| <b>CO 5</b>  | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 15    | 15    | 15    | 12    | 14    |

S-Strong-3    M-Medium-2    L-Low-1

| Subject Code               | Subject Name   | Category     | L | T | P | S   | Credits | Marks              |                              |       |  |
|----------------------------|--|--------------|---|---|---|-----|---------|--------------------|------------------------------|-------|--|
|                            |  |              |   |   |   |     |         | CIA                | External                     | Total |  |
|                            | <b>E-COMMERCE</b>  | <b>SEC 4</b> | 2 | - | - | III | 1       | 25                 | 75                           | 100   |  |
| <b>Learning Objectives</b> |  |              |   |   |   |     |         |                    |                              |       |  |
| LO1                        | Understanding of the foundations and importance of E-commerce  |              |   |   |   |     |         |                    |                              |       |  |
| LO2                        | Understanding of retailing in E-commerce by in terms of branding and pricing strategies and determining the effectiveness of market research.  |              |   |   |   |     |         |                    |                              |       |  |
| LO3                        | Assess the Internet trading relationships including Business to Consumer, Business- to-Business, Intra-organizational.   |              |   |   |   |     |         |                    |                              |       |  |
| LO4                        | Knowing key features of Internet, Intranets and Extranets and how they relate to each other.   |              |   |   |   |     |         |                    |                              |       |  |
| LO5                        | Understanding legal issues and privacy in E-Commerce.  |              |   |   |   |     |         |                    |                              |       |  |
| UNIT                       | Contents   |              |   |   |   |     |         |                    | No. Of. Hours                |       |  |
| I                          | <b>E-Commerce:</b> E-Commerce Framework – E-Commerce and Media Convergence – The anatomy of E-commerce applications - E-Commerce Consumer Applications - E- Commerce Organization Applications.              |              |   |   |   |     |         |                    | <b>6</b>                     |       |  |
| II                         | <b>The Internet:</b> The Internet Terminology – NSFNET – Architecture and Components– National Research and Education Network – Internet Governance – An overview of Internet Applications.                  |              |   |   |   |     |         |                    | <b>6</b>                     |       |  |
| III                        | <b>E-Commerce and the World Wide Web:</b> Architectural Framework for E-commerce – WWW as the architecture – Technology behind the web – Security and the web.   |              |   |   |   |     |         |                    | <b>6</b>                     |       |  |
| IV                         | <b>Electronic Payment Systems:</b> Types of Electronic Payment Systems – Digital token Electronic Payment Systems – Credit Card Based Electronic Payment Systems – Risk and Electronic Payment Systems.      |              |   |   |   |     |         |                    | <b>6</b>                     |       |  |
| V                          | <b>Advertising and Marketing on the Internet:</b> E-Commerce Catalogs – Information Filtering – Consumer Data Interface – Emerging tools. Software Agents: Characteristics and Properties of Software Agents |              |   |   |   |     |         |                    | <b>6</b>                     |       |  |
| <b>TOTAL HOURS</b>         |  |              |   |   |   |     |         | <b>30</b>          |                              |       |  |
| Course Outcomes            |  |              |   |   |   |     |         | Programme Outcomes |                              |       |  |
| CO                         | On completion of this course, students will  |              |   |   |   |     |         |                    |                              |       |  |
| CO1                        | Demonstrate E-Commerce Frameworks. Distinguish E-Commerce and media Convergence. Illustrate E-Commerce Applications.   |              |   |   |   |     |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO2                        | Describe the E-Commerce Networks and Research Networks, Analyze the Internet Commercialization   |              |   |   |   |     |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO3                        | Evaluate the E-Commerce how incorporate the Internet, Construct the Web Security   |              |   |   |   |     |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |

|                        |   |                                 |
|------------------------|---|---------------------------------|
| CO4                    | Distinguish the different payment system.<br>Illustrate the data interchange  | PO1, PO2, PO3,<br>PO4, PO5, PO6 |
| CO5                    | Understanding the Advertising and Marketing on the Internet, Describe<br>Software Agents  | PO1, PO2, PO3,<br>PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                                 |
| 1                      | Ravi Kalakota & Andrew Whinston, “ <i>Frontiers of Electronic-Commerce</i> ”, Addison Wesley.   |                                 |
| 2                      | P.Rizwan Ahmed, E-Commerce and E-Business, Margham Publications, Chennai 2012   |                                 |
| <b>Reference Books</b> |   |                                 |
| 1.                     | Efrain Turvan, J. Lee, David Kug and Chung, “Electronic Commerce”, Pearson Education, Asia.   |                                 |
| 2.                     | Manlyn Greenstein and Miklos, “Electronic Commerce”, TMH.   |                                 |
| <b>Web Resources</b>   |   |                                 |
| 1.                     | <a href="https://www.the-reference.com/en/expertise/creation-and.../e-commerce">https://www.the-reference.com/en/expertise/creation-and.../e-commerce</a> |                                 |
| 2.                     | <a href="https://en.wikipedia.org/wiki/E-commerce">https://en.wikipedia.org/wiki/E-commerce</a>   |                                 |
| 3.                     | <a href="https://www.tutorialspoint.com/e_commerce/index.htm">https://www.tutorialspoint.com/e_commerce/index.htm</a>                                     |                                 |

#### Mapping with Programme Outcomes:

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 3   | 3     | 3     | 2     | 2     | 3     | 3     |
| CO 4   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 5   | 3     | 2     | 3     | 3     | 2     | 3     |
| <b>Weightage of course<br/>contributed to each<br/>PSO</b> | 15    | 14    | 14    | 14    | 14    | 15    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code               | Subject Name   | Category    | L | T | P | S | Credits | Marks              |                              |       |  |
|----------------------------|--|-------------|---|---|---|---|---------|--------------------|------------------------------|-------|--|
|                            |  |             |   |   |   |   |         | CIA                | External                     | Total |  |
|                            | <b>BIG DATA ANALYTICS</b>  | <b>SEC5</b> | 4 | - | - | - | 2       | 25                 | 75                           | 100   |  |
| <b>Learning Objectives</b> |  |             |   |   |   |   |         |                    |                              |       |  |
| LO1                        | To know the fundamental concepts of big data and analytics..   |             |   |   |   |   |         |                    |                              |       |  |
| LO2                        | To explore tools and practices for working with Big data   |             |   |   |   |   |         |                    |                              |       |  |
| LO3                        | To learn about stream computing.   |             |   |   |   |   |         |                    |                              |       |  |
| LO4                        | To know about the research that requires the integration of large amounts of data  |             |   |   |   |   |         |                    |                              |       |  |
| LO5                        | To analyze data by utilizing clustering and classification algorithms.   |             |   |   |   |   |         |                    |                              |       |  |
| UNIT                       | Contents   |             |   |   |   |   |         |                    | No. Of. Hours                |       |  |
| I                          | <b>Big data Introduction :</b> Big Data introduction - definition and taxonomy - Big data value for the enterprise - The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program. |             |   |   |   |   |         |                    | <b>12</b>                    |       |  |
| II                         | <b>Map reduce :</b> Introduction to Map Reduce frame work - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem- Streaming in Hadoop- Improving the performance using combiners- Chaining Map Reduce jobs- Joining data from different sources.                |             |   |   |   |   |         |                    | <b>12</b>                    |       |  |
| III                        | <b>Pig and Hive :</b> Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - Fundamentals of HBase and ZooKeeper.   |             |   |   |   |   |         |                    | <b>12</b>                    |       |  |
| IV                         | <b>Mongo DB :</b> No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export.  |             |   |   |   |   |         |                    | <b>12</b>                    |       |  |
| V                          | <b>Cassandra:</b> Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.   |             |   |   |   |   |         |                    | <b>12</b>                    |       |  |
| <b>TOTAL HOURS</b>         |  |             |   |   |   |   |         | <b>60</b>          |                              |       |  |
| Course Outcomes            |  |             |   |   |   |   |         | Programme Outcomes |                              |       |  |
| CO                         | On completion of this course, students will  |             |   |   |   |   |         |                    |                              |       |  |
| CO1                        | Understand Big Data and its analytics in the real world  |             |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO2                        | Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm.   |             |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |



|                        |   |                              |
|------------------------|---|------------------------------|
| CO3                    | Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO4                    | Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5                    | Implement Big Data Activities using Hive.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                              |
| 1                      | JSeema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015.   |                              |
| 2                      | Ramesh Sharda, Dursun Delen, Efraim Turban (2018), Business Intelligence, Pearson Education Services Pvt Ltd.   |                              |
| <b>Reference Books</b> |   |                              |
| 1.                     | Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013.  |                              |
| 2.                     | Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011.   |                              |
| 3.                     | Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012.  |                              |
| 4.                     | Russell Bradberry, Eric Blow, "Practical Cassandra A developers Approach", Pearson Education, 2014.   |                              |
| <b>Web Resources</b>   |   |                              |
| 1.                     | <a href="https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics">https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics</a> |                              |
| 2.                     | <a href="https://www.coursera.org/articles/big-data-analytics">https://www.coursera.org/articles/big-data-analytics</a>   |                              |

**Mapping with Programme Outcomes:**

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 2     | 3     | 3     | 3     | 2     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 2     | 2     |
| CO 4   | 3     | 3     | 3     | 3     | 2     | 3     |
| CO 5   | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 15    | 15    | 15    | 12    | 14    |

S-Strong-3 M-Medium-2 L-Low-1

## SEMESTER –IV

| Subject Code               | Subject Name  | Category | L | T | P | S | Credits | Marks |               |       |
|----------------------------|---|----------|---|---|---|---|---------|-------|---------------|-------|
|                            |   |          |   |   |   |   |         | CIA   | External      | Total |
|                            | <b>RELATIONAL DATABASE MANAGEMENT SYSTEM</b>  | CC 7     | 6 | - | - | V | 5       | 25    | 75            | 100   |
| <b>Learning Objectives</b> |   |          |   |   |   |   |         |       |               |       |
| LO1                        | To understand the different issues involved in the design and implementation of a database system.  |          |   |   |   |   |         |       |               |       |
| LO2                        | To study the physical and logical database designs, database modeling, relational, hierarchical, and network models   |          |   |   |   |   |         |       |               |       |
| LO3                        | To understand and use data manipulation language to query, update, and manage a database  |          |   |   |   |   |         |       |               |       |
| LO4                        | To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency,  |          |   |   |   |   |         |       |               |       |
| LO5                        | To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.  |          |   |   |   |   |         |       |               |       |
| UNIT                       | Contents  |          |   |   |   |   |         |       | No. Of. Hours |       |
| I                          | <b>Introduction:</b> Database System-Characteristics of Database Management Systems- Architecture of Database Management Systems-Database Models-System Development Life Cycle-Entity Relationship Model.   |          |   |   |   |   |         |       | <b>18</b>     |       |
| II                         | <b>Relational Database Model:</b> Structure of Relational Model-Types of keys. Relational Algebra: Unary operations-Set operations-Join operations. Normalization: Functional Dependency- First Normal form-Second Normal Form-Third Normal form- Boyce-Codd Normal Form-Fourth Normal Form.  |          |   |   |   |   |         |       | <b>18</b>     |       |
| III                        | <b>SQL:</b> Introduction. Data Definition Language: Create, alter, drop, rename and truncate statements. Data Manipulation Language: Insert, Update and Delete Statements. Data Retrieval Language: Select statement. Transaction Control Language: Commit, Rollback and Savepoint statements. Single row functions using dual: Date, Numeric and Character functions. Group/Aggregate functions: count, max, min, avg and sum functions. Set Functions: Union, union all, intersect and minus. Subquery: Scalar, Multiple and Correlated subquery. Joins: Inner and Outer joins.Defining Constraints: Primary Key, Foreign Key, Unique, Check, Not Null. |          |   |   |   |   |         |       | <b>18</b>     |       |
| IV                         | <b>PL/SQL:</b> Introduction-PL/SQL Basic-Character Set- PL/SQL Structure-SQL Cursor-Subprograms-Functions-Procedures.   |          |   |   |   |   |         |       | <b>18</b>     |       |

|                        |   |                              |
|------------------------|---|------------------------------|
| V                      | <b>Exception Handling:</b> Introduction-Predefined Exception-User Defined Exception-Triggers-Implicit and Explicit Cursors-Loops in Explicit Cursor.  | <b>18</b>                    |
| <b>TOTAL HOURS</b>     |   | <b>90</b>                    |
| <b>Course Outcomes</b> |   | <b>Programme Outcomes</b>    |
| CO                     | On completion of this course, students will   |                              |
| CO1                    | To demonstrate the characteristics of Database Management Systems.<br>To study about the concepts and models of database.<br>To impart the concepts of System Development Life Cycle and E-R Model.           | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO2                    | To classify the keys and the concepts of Relational Algebra.<br>To impart the applications of various Normal Forms<br>Classification of Dependency.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO3                    | To elaborate the different types of Functions and Joins and their applications.<br>Introduction of Views, Sequence, Index and Procedure.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO4                    | Representation of PL-SQL Structure.<br>To impart the knowledge of Sub Programs, Functions and Procedures.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5                    | Representation of Exception and Pre-Defined Exception.<br>To Point out the Importance of Triggers, Implicit and Explicit Cursors.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                              |
| 1                      | Pranab Kumar Das Gupta and P. Radha Krishnan, "Database Management System Oracle SQL and PL/SQL", Second Edition, 2013, PHI Learning Private Limited.   |                              |
| 2                      | P.Rizwan Ahmed, RDBMS and Oracle, Margham Publications, Chennai. 2018   |                              |
| <b>Reference Books</b> |   |                              |
| 1                      | RamezElmasri and Shamkant B. Navathe, " <i>Fundamentals of Database Systems</i> ", Seventh Edition, Pearson Publications.   |                              |
| 2                      | Abraham Silberschatz, Henry Korth, S. Sudarshan, " <i>Database System Concepts</i> ", Seventh Edition, TMH.   |                              |
| <b>Web Resources</b>   |   |                              |
| 1                      | <a href="http://www.amazon.in/DATABASE-MANAGEMENT-SYSTEM-ORACLE-SQLebook/dp/B00LPGBWZ0#reader_B00LPGBWZ0">http://www.amazon.in/DATABASE-MANAGEMENT-SYSTEM-ORACLE-SQLebook/dp/B00LPGBWZ0#reader_B00LPGBWZ0</a> |                              |

**Mapping with Programme Outcomes:**

| CO/PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--------|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 2     |

|  |    |    |    |    |    |    |
|--|----|----|----|----|----|----|
| <b>CO 2</b>  | 3  | 3  | 3  | 2  | 3  | 3  |
| <b>CO 3</b>  | 3  | 3  | 3  | 3  | 3  | 3  |
| <b>CO 4</b>  | 2  | 3  | 3  | 3  | 3  | 3  |
| <b>CO 5</b>  | 3  | 3  | 3  | 3  | 3  | 3  |
| <b>Weightage of course<br/>contributed to each<br/>PSO</b> | 14 | 15 | 15 | 14 | 15 | 14 |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code | Subject Name                  | Category    | L | T | P | S | Credits | Marks |          |       |
|--------------|-------------------------------|-------------|---|---|---|---|---------|-------|----------|-------|
|              |                               |             |   |   |   |   |         | CIA   | External | Total |
|              | <b>RDBMS LAB USING ORACLE</b> | <b>CC X</b> | - | - | 5 | V | 5       | 25    | 75       | 100   |

**Learning Objectives**

1. To explain basic database concepts, applications, data models, schemas and instances.
2. To demonstrate the use of constraints and relational algebra operations
3. Describe the basics of SQL and construct queries using SQL.
4. To emphasize the importance of normalization in databases
5. To facilitate students in Database design

**LAB EXERCISES:**

**SQL:**

1. DDL commands.
2. Specifying constraints-Primary Key, Foreign Key, Unique, Check, Not Null.
3. DML commands.
4. Set Operations.
5. Joins.
6. Sub-queries.

**PL/SQL:**

7. Control Constructs.
8. Exception Handlers.
9. Implicit Cursor.
10. Explicit Cursor.
11. Procedures.
12. Functions.
13. Triggers.
14. TCL Commands usage (Commit, Rollback, Savepoint)

**Course Outcomes**

| CO  | On completion of this course, students will   |
|-----|---|
| CO1 | To demonstrate the characteristics of Database Management Systems.<br>To study about the concepts and models of database.<br>To impart the concepts of System Development Life Cycle and E-R Model. |
| CO2 | To classify the keys and the concepts of Relational Algebra.<br>To impart the applications of various Normal Forms<br>Classification of Dependency.   |
|     | To elaborate the different types of Functions and Joins and their applications.   |

|     |   |
|-----|---|
| CO3 | Introduction of Views, Sequence, Index and Procedure.   |
| CO4 | Representation of PL-SQL Structure.<br>To impart the knowledge of Sub Programs, Functions and Procedures.                         |
| CO5 | Representation of Exception and Pre-Defined Exception.<br>To Point out the Importance of Triggers, Implicit and Explicit Cursors. |

**Mapping with Programme Outcomes:**

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 2     |
| CO 2   | 3     | 3     | 3     | 2     | 3     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 4   | 2     | 3     | 3     | 3     | 3     | 3     |
| CO 5   | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course<br/>contributed to each<br/>PSO</b> | 14    | 15    | 15    | 14    | 15    | 14    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code | Subject Name            | Category | L | T | P | S | Credits | Inst. Hours | Marks |          |       |
|--------------|-------------------------|----------|---|---|---|---|---------|-------------|-------|----------|-------|
|              |                         |          |   |   |   |   |         |             | CIA   | External | Total |
|              | <b>NETWORK SECURITY</b> | Elective | 2 | - | - | - | 3       | 3           | 25    | 75       | 100   |

**Learning Objectives:**(for teachers: what they have to do in the class/lab/field)

- To study the number theory used for network security
- To understand the design concept of cryptography and authentication
- To develop experiments on algorithm used for security

**Course Outcomes:**(for students: To know what they are going to learn)

**CO1:** Develop an understanding of the fundamentals of networking and security

**CO2:** Gain an appreciation for the complexities of protecting networks and systems from attack

**CO3:** Learn about the tools used to detect and protect against malicious attacks

**CO4:** Develop the skills to configure various security-related technologies

**CO5:** Utilize protocols such as TLS/SSL, IPSec, and SNMP in order to build secure systems.

| Units      | Contents  | Required Hours |
|------------|---|----------------|
| <b>I</b>   | Model of network security–Security attacks, services and attacks– OSI security architecture – Classical encryption techniques – SDES – Block cipher Principles DES– Strength of DES–Block cipher design principles – Block cipher mode of operation | <b>6</b>       |
| <b>II</b>  | Number Theory– Prime number–Modular arithmetic–Euclid’s algorithm   | <b>6</b>       |
| <b>III</b> | Authentication requirement – Authentication function – MAC – Hash function –Security of hash function and MAC – SHA - HMAC – CMAC   | <b>6</b>       |
| <b>IV</b>  | Authentication applications – Kerberos – X.509 Authentication services - E-mail security–IP security- Web security.   | <b>6</b>       |
| <b>V</b>   | Intruder–Intrusion detection system–Virus and related threats– Counter measures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security   | <b>6</b>       |

**Learning Resources:**

**Recommended Texts**

1. William Stallings,“ Cryptography& Network Security”, Pearson Education, Fourth Edition 2010.

**Reference Books**

1. Behrouz A. Foruzan, “Cryptography and Network Security”, Tata McGraw-Hill, 2007.
2. AtulKahate, “*Cryptography and Network Security*”, Second Edition, 2003, TMH.
3. V. Arun Kumar, “*Network Security*”, 2011, First Edition, USP.

| <b>MAPPING TABLE</b>                               |             |             |             |             |             |             |
|--|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO/PSO</b>                                      | <b>PSO1</b> | <b>PSO2</b> | <b>PSO3</b> | <b>PSO4</b> | <b>PSO5</b> | <b>PSO6</b> |
| <b>CO1</b>   | <b>3</b>    | <b>2</b>    | <b>3</b>    | <b>2</b>    | <b>3</b>    | <b>2</b>    |
| <b>CO2</b>   | <b>2</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>2</b>    |
| <b>CO3</b>   | <b>2</b>    | <b>2</b>    | <b>2</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CO4</b>   | <b>3</b>    | <b>2</b>    | <b>2</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CO5</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>Weightage of course contributed to each PSO</b> | <b>13</b>   | <b>12</b>   | <b>13</b>   | <b>14</b>   | <b>15</b>   | <b>13</b>   |



| Subject Code | Subject Name                       | Category    | L | T | P | S | Credits | Marks |          |       |
|--------------|------------------------------------|-------------|---|---|---|---|---------|-------|----------|-------|
|              |                                    |             |   |   |   |   |         | CIA   | External | Total |
|              | <b>DATA MINING AND WAREHOUSING</b> | <b>SEC6</b> | 2 | - | - | - | 2       | 25    | 75       | 100   |

**Learning Objectives:**

- To provide the knowledge on Data Mining and Warehousing concepts and techniques.
- To study the basic concepts of cluster analysis
- To study a set of typical clustering methodologies, algorithms and applications.

**Course Outcomes:**

**CO1:** To understand the basic concepts and the functionality of the various data mining and data warehousing component

**CO2:** To know the concepts of Data mining system architectures

**CO3:** To analyze the principles of association rules

**CO4:** To get analytical idea on Classification and prediction methods.

**CO5:** To Gain knowledge on Cluster analysis and its methods.

**Recap:**(not for examination) Motivation/previous lecture/relevant portions required for the course)[This is done during 2 Tutorial hours)

| Units      | Contents  | Required Hours |
|------------|---|----------------|
| <b>I</b>   | Introduction: Data mining – Functionalities – Classification – Introduction to Data Warehousing – Data Preprocessing: Preprocessing the Data – Data cleaning – Data Integration and Transformation – Data Reduction.  | <b>6</b>       |
| <b>II</b>  | Data Mining, Primitives, Languages and System Architecture: Data Mining – Primitives – Data Mining Query Language, Architecture of Data mining Systems. Concept Description, Characterization and Comparison: Concept Description, Data Generalization and Summarization. | <b>6</b>       |
| <b>III</b> | Mining Association Rules: Basic Concepts – Single Dimensional Boolean Association Rules From Transaction Databases, Multilevel Association Rules from transaction databases.  | <b>6</b>       |
| <b>IV</b>  | Classification and Prediction: Introduction – Issues – Decision Tree Induction – Bayesian Classification – Classification of Back Propagation.  | <b>6</b>       |
| <b>V</b>   | Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Partitioning Methods – Hierarchical Methods-Density Based Methods   | <b>6</b>       |

**Learning Resources:****Recommended Texts**

1. Han and M. Kamber, "Data Mining Concepts and Techniques", 2001, Harcourt India Pvt. Ltd, New Delhi.
2. P.Rizwan Ahmed, Data Mining, Margham Publications, Chennai, 2012

**Reference Books**

1. K.P. Soman, Shyam Diwakar, V. Ajay "Insight into Data Mining Theory and Practice ", Prentice Hall of India Pvt. Ltd, New Delhi
2. Parteek Bhatia, 'Data Mining and Data Warehousing: Principles and Practical Techniques', Cambridge University Press, 2019

**MAPPING TABLE**

| <b>CO/PSO</b>                               | <b>PSO1</b> | <b>PSO2</b> | <b>PSO3</b> | <b>PSO4</b> | <b>PSO5</b> | <b>PSO6</b> |
|---|-------------|-------------|-------------|-------------|-------------|-------------|
| CO1   | 3           | 3           | 3           | 2           | 2           | 2           |
| CO2   | 3           | 3           | 3           | 3           | 3           | 2           |
| CO3   | 3           | 3           | 3           | 3           | 3           | 3           |
| CO4   | 3           | 2           | 2           | 3           | 3           | 3           |
| CO5   | 3           | 3           | 3           | 3           | 3           | 3           |
| Weightage of course contributed to each PSO | 15          | 14          | 14          | 14          | 14          | 13          |

| Subject Code            | Subject Name  | Category | L | T | P | S | Credits           | Inst. Hours | Marks     |              |        |
|-------------------------|---|----------|---|---|---|---|-------------------|-------------|-----------|--------------|--------|
|                         |   |          |   |   |   |   |                   |             | CIA       | External     | Total  |
|                         | <b>Open Source Software Technologies</b>  | SEC7     | 2 | - | - | - | 2                 | 2           | 25        | 75           | 100    |
| <b>Course Objective</b> |   |          |   |   |   |   |                   |             |           |              |        |
| C1                      | Able to Acquire and understand the basic concepts in Java,application of OOPS concepts.   |          |   |   |   |   |                   |             |           |              |        |
| C2                      | Acquire knowledge about operators and decision-making statements.   |          |   |   |   |   |                   |             |           |              |        |
| C3                      | To Identify the significance and application of Classes, arrays and interfaces and analyzing java arrays  |          |   |   |   |   |                   |             |           |              |        |
| C4                      | Understand about the applications of OOPS concepts and analyze overriding and packages through java programs.   |          |   |   |   |   |                   |             |           |              |        |
| C5                      | Can Create window-based programming using applet and graphics programming.  |          |   |   |   |   |                   |             |           |              |        |
| UNIT                    | Details   |          |   |   |   |   |                   |             |           | No. of Hours | C<br>O |
| I                       | <b>Open Source</b> – open source vs. commercial software – What is Linux? – Free Software – Where I can use Linux? - Linux kernel – Linux distributions.                  |          |   |   |   |   |                   |             |           | 6            | C1     |
| II                      | <b>Introduction Linux</b> Essential Commands – File System concept – Standard Files –The Linux Security Model – Introduction to Unix – Unix Components Unix Files –       |          |   |   |   |   |                   |             |           | 6            | C2     |
| III                     | <b>Introduction</b> - Apache Explained – Starting, Stopping and Restarting Apache –Modifying the Default configuration – Securing Apache – Set user and Group             |          |   |   |   |   |                   |             |           | 6            | C3     |
| IV                      | <b>MySQL:</b> Introduction to MySQL – The show databases and table – The USE command –Create Database and Tables – Describe Table –                                       |          |   |   |   |   |                   |             |           | 6            | C4     |
| V                       | <b>Introduction</b> –PHP Form processing – Database Access with PHP – MySQL, MySQL Functions – Inserting Records – Selecting Records – Deleting Records – Update Records. |          |   |   |   |   |                   |             |           | 6            | C6     |
| <b>Total</b>            |   |          |   |   |   |   |                   |             | <b>30</b> |              |        |
| Course Outcomes         |   |          |   |   |   |   | Programme Outcome |             |           |              |        |
| CO                      | On completion of this course, students will   |          |   |   |   |   |                   |             |           |              |        |
| 1                       | Acquire and understand the basic concepts in Java, application of OOPS concepts.  |          |   |   |   |   | PO1               |             |           |              |        |
| 2                       | Acquire knowledge about operators and decision-making statements.   |          |   |   |   |   | PO1,PO2           |             |           |              |        |
| 3                       | Identify the significance and application of Classes, arrays and interfaces and analyzing java arrays   |          |   |   |   |   | PO4,PO6           |             |           |              |        |
| 4                       | Understand about the applications of OOPS concepts and analyze overriding and packages through java programs.   |          |   |   |   |   | PO4,PO5,PO6       |             |           |              |        |
| 5                       | Create window-based programming using applet and graphics programming.  |          |   |   |   |   | PO3,PO8           |             |           |              |        |
| <b>Text Book</b>        |   |          |   |   |   |   |                   |             |           |              |        |
| 1                       | James Lee and Brent Ware “Open Source Web Development with LAMP using   |          |   |   |   |   |                   |             |           |              |        |

|                        |   |
|------------------------|---|
| 2                      | P.Rizwan Ahmed, Open Source Programming, Margham Publications, Chennai,2017 .   |
| <b>Reference Books</b> |   |
| 1.                     | Eric Rosebrock, Eric Filson, “Setting up LAMP: Getting Linux, Apache, MySQL and PHP and working together”, John Wiley and Sons, 2004. |
| 2.                     | Anthony Butcher , “Teach Yourself MySQL in 21 days”, 2nd Edition, Sams Publication.   |
| 3.                     | Rich Bower, Daniel Lopez Ridreejo, Alian Liska , “Apache Administrator’s Handbook”, Sams Publication.                                 |
| 4.                     | Tammy Fox, “RedHat Enterprise Linux 5 Administration Unleashed”, Sams Publication.  |
| 5.                     | Naramore Eligabette, Gerner Jason, Wrox Press, Wiley Dreamtech Press, “Beginning PHP5, Apache, MySQL Web Development”, 2005.          |
| <b>Web Resources</b>   |   |
| 1.                     | Introduction to Open-Source and its benefits - GeeksforGeeks  |
| 2.                     | <a href="https://www.bing.com/">https://www.bing.com/</a>   |

| <b>MAPPING TABLE</b>                        |             |             |             |             |             |             |
|---|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO/PSO</b>                               | <b>PSO1</b> | <b>PSO2</b> | <b>PSO3</b> | <b>PSO4</b> | <b>PSO5</b> | <b>PSO6</b> |
| CO1   | 3           | 2           | 3           | 2           | 3           | 2           |
| CO2   | 2           | 3           | 3           | 3           | 3           | 2           |
| CO3   | 2           | 2           | 3           | 3           | 3           | 3           |
| CO4   | 3           | 3           | 2           | 3           | 3           | 3           |
| CO5   | 3           | 3           | 3           | 3           | 3           | 3           |
| Weightage of course contributed to each PSO | 13          | 13          | 14          | 14          | 15          | 13          |

## SEMESTER –V

| Subject Code               | Subject Name  | Category   | L | T | P | S | Credits | Marks              |                              |       |  |
|----------------------------|---|------------|---|---|---|---|---------|--------------------|------------------------------|-------|--|
|                            |   |            |   |   |   |   |         | CIA                | External                     | Total |  |
|                            | <b>MACHINE LEARNING</b>   | <b>CC9</b> | 5 | - | - | V | 4       | 25                 | 75                           | 100   |  |
| <b>Learning Objectives</b> |   |            |   |   |   |   |         |                    |                              |       |  |
| LO1                        | To Learn about Machine Intelligence and Machine Learning applications   |            |   |   |   |   |         |                    |                              |       |  |
| LO2                        | To implement and apply machine learning algorithms to real-world applications   |            |   |   |   |   |         |                    |                              |       |  |
| LO3                        | To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems   |            |   |   |   |   |         |                    |                              |       |  |
| LO4                        | To create instant based learning  |            |   |   |   |   |         |                    |                              |       |  |
| LO5                        | To apply advanced learning  |            |   |   |   |   |         |                    |                              |       |  |
| UNIT                       | Contents  |            |   |   |   |   |         |                    | No. Of. Hours                |       |  |
| I                          | <b>Introduction Machine Learning</b> - Difference between AI, Machine Learning and Big data. Supervised and unsupervised learning, parametric vs non-parametric models, parametric models for classification and regression- Linear Regression, Logistic Regression, Naïve Bayes classifier, simple non-parametric classifier-K-nearest neighbour, support vector machines  |            |   |   |   |   |         |                    | <b>15</b>                    |       |  |
| II                         | <b>Neural networks and genetic algorithms</b> Neural Network Representation – Problems – Perceptions – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.  |            |   |   |   |   |         |                    | <b>15</b>                    |       |  |
| III                        | <b>Bayesian and computational learning</b> Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.  |            |   |   |   |   |         |                    | <b>15</b>                    |       |  |
| IV                         | <b>Instant based learning</b> K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.   |            |   |   |   |   |         |                    | <b>15</b>                    |       |  |
| V                          | <b>Advanced learning</b> Recommendation systems – opinion mining, sentiment analysis. Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning. |            |   |   |   |   |         |                    | <b>15</b>                    |       |  |
| <b>TOTAL HOURS</b>         |   |            |   |   |   |   |         | <b>75</b>          |                              |       |  |
| Course Outcomes            |   |            |   |   |   |   |         | Programme Outcomes |                              |       |  |
| CO                         | On completion of this course, students will   |            |   |   |   |   |         |                    |                              |       |  |
| CO1                        | Appreciate the importance of visualization in the data analytics solution   |            |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |

|                        |   |                              |
|------------------------|---|------------------------------|
| CO2                    | Apply structured thinking to unstructured problems  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO3                    | Understand a very broad collection of machine learning algorithms and problems                                    | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO4                    | Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory      | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5                    | Develop an appreciation for what is involved in learning from data.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                              |
| 1                      | Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.                          |                              |
| 2                      | Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning" 2015, MIT Press                           |                              |
| <b>Reference Books</b> |   |                              |
| 1.                     | EthemAlpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004. |                              |
| 2                      | Stephen Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.                                 |                              |

#### Mapping with Programme Outcomes:

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| <b>CO 1</b>  | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>CO 2</b>  | 3     | 3     | 3     | 3     | 2     | 3     |
| <b>CO 3</b>  | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>CO 4</b>  | 3     | 3     | 2     | 3     | 3     | 3     |
| <b>CO 5</b>  | 3     | 3     | 3     | 3     | 3     | 2     |
| <b>Weightage of course contributed to each PSO</b> | 15    | 15    | 14    | 15    | 14    | 14    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code | Subject Name                | Category    | L | T | P | S | Credits | Marks |          |       |
|--------------|-----------------------------|-------------|---|---|---|---|---------|-------|----------|-------|
|              |                             |             |   |   |   |   |         | CIA   | External | Total |
|              | <b>MACHINE LEARNING LAB</b> | <b>CC10</b> | - | - | 5 | - | 4       | 25    | 75       | 100   |

**Learning Objectives:**

To apply the concepts of Machine Learning to solve real-world problems and to implement basic algorithms in clustering & classification applied to text & numeric data

| <b>LAB EXERCISES</b>   | Required Hour |
|--|---------------|
| <ol style="list-style-type: none"> <li>1. Solving Regression &amp; Classification using Decision Trees</li> <li>2. Root Node Attribute Selection for Decision Trees using Information Gain</li> <li>3. Bayesian Inference in Gene Expression Analysis</li> <li>4. Pattern Recognition Application using Bayesian Inference</li> <li>5. Bagging in Classification</li> <li>6. Bagging, Boosting applications using Regression Trees</li> <li>7. Data &amp; Text Classification using Neural Networks</li> <li>8. Using Weka tool for SVM classification for chosen domain application</li> <li>9. Data &amp; Text Clustering using K-means algorithm</li> <li>10. Data &amp; Text Clustering using Gaussian Mixture Models</li> </ol> | <b>75</b>     |

| <b>Course Outcomes</b> |  |
|------------------------|--|
| CO                     | On completion of this course, students will                                  |
| CO1                    | Effectively use the various machine learning tools                           |
| CO2                    | Understand and implement the procedures for machine learning algorithms CO3  |
| CO3                    | Design Python programs for various machine learning algorithms               |
| CO4                    | Apply appropriate datasets to the Machine Learning algorithms                |
| CO5                    | Analyze the graphical outcomes of learning algorithms with specific datasets |

**Mapping with Programme Outcomes:**

| CO/PSO      | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|-------------|-------|-------|-------|-------|-------|-------|
| <b>CO 1</b> | 3     | 3     | 3     | 3     | 3     | 2     |
| <b>CO 2</b> | 3     | 3     | 3     | 2     | 3     | 3     |
| <b>CO 3</b> | 3     | 3     | 3     | 3     | 3     | 3     |

|  |    |    |    |    |    |    |
|--|----|----|----|----|----|----|
| <b>CO 4</b>  | 2  | 3  | 3  | 3  | 3  | 3  |
| <b>CO 5</b>  | 3  | 3  | 3  | 3  | 3  | 3  |
| <b>Weightage of course<br/>contributed to each<br/>PSO</b> | 14 | 15 | 15 | 14 | 15 | 14 |

**S-Strong-3 M-Medium-2 L-Low-1**



| Subject Code   | Subject Name  | Category    | L | T | P | S | Credits        | Marks |          |       |
|--|---|-------------|---|---|---|---|----------------|-------|----------|-------|
|  |   |             |   |   |   |   |                | CIA   | External | Total |
|  | <b>SOFTWARE ENGINEERING</b>   | <b>CC11</b> | 4 | - | - | - | 4              | 25    | 75       | 100   |
| <b>Learning Objectives:</b> <ul style="list-style-type: none"> <li>To understand the software engineering concepts and to create a system model in real life applications</li> </ul>   |   |             |   |   |   |   |                |       |          |       |
| <b>Course Outcomes:</b> (for students: To know what they are going to learn)<br><b>CO1:</b> Gain basic knowledge of analysis and design of systems<br><b>CO2:</b> Ability to apply software engineering principles and techniques<br><b>CO3:</b> Model a reliable and cost-effective software system<br><b>CO4:</b> Ability to design an effective model of the system<br><b>CO5:</b> Perform Testing at various levels and produce an efficient system. |   |             |   |   |   |   |                |       |          |       |
| Units  | Contents  |             |   |   |   |   | Required Hours |       |          |       |
| I  | <b>Introduction:</b> The software engineering discipline, programs vs. software products, why study software engineering, emergence of software engineering, Notable changes in software development practices, computer systems engineering.   |             |   |   |   |   | 12             |       |          |       |
| II   | <b>Requirements Analysis and Specification:</b> Requirements gathering and analysis, Software requirements specification (SRS) <b>Software Design:</b> Good software design, cohesion and coupling, neat arrangement, software design approaches, object-oriented vs function-oriented design |             |   |   |   |   | 12             |       |          |       |
| III  | <b>Function-Oriented Software Design:</b> Overview of SA/SD methodology, structured analysis, data flow diagrams (DFD's), structured design, detailed design.   |             |   |   |   |   | 12             |       |          |       |
| IV   | <b>Coding and Testing: Coding;</b> code review; testing; testing in the large vs testing in the small; unit testing; black-box testing; white-box testing; debugging; program analysis tools; integration testing; system testing; some general issues associated with testing.               |             |   |   |   |   | 12             |       |          |       |
| V  | <b>Software Maintenance:</b> Characteristic of software maintenance; software reverse engineering; software maintenance process models; estimation of maintenance cost;   |             |   |   |   |   | 12             |       |          |       |
|  |   |             |   |   |   |   | 60             |       |          |       |
| <b>Learning Resources:</b><br><b>Recommended Texts</b> <ol style="list-style-type: none"> <li>Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, Prentice-Hall of India, 2018</li> </ol> <b>Reference Books</b> <ol style="list-style-type: none"> <li>Richard Fairley, Software Engineering Concepts, Tata McGraw-Hill publishing company Ltd, Edition 1997.</li> </ol>   |   |             |   |   |   |   |                |       |          |       |

2. Roger S. Pressman, Software Engineering, Seventh Edition, McGraw-Hill.
3. James A. Senn, Analysis & Design of Information Systems, Second Edition, McGraw-Hill International Editions.

**Mapping with Programme Outcomes:**

| <b>CO/PSO</b>                                      | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> | <b>PSO 4</b> | <b>PSO 5</b> | <b>PSO 6</b> |
|--|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>CO 1</b>  | 3            | 3            | 3            | 2            | 3            | 2            |
| <b>CO 2</b>  | 2            | 2            | 3            | 2            | 3            | 3            |
| <b>CO 3</b>  | 3            | 3            | 3            | 2            | 3            | 3            |
| <b>CO 4</b>  | 2            | 3            | 3            | 3            | 2            | 3            |
| <b>CO 5</b>  | 3            | 2            | 3            | 3            | 3            | 3            |
| <b>Weightage of course contributed to each PSO</b> | 13           | 13           | 15           | 12           | 14           | 14           |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code | Subject Name                | Category     | L | T | P | S | Credits | Marks |          |       |
|--------------|-----------------------------|--------------|---|---|---|---|---------|-------|----------|-------|
|              |                             |              |   |   |   |   |         | CIA   | External | Total |
|              | <b>INFORMATION SECURITY</b> | <b>Elect</b> | 4 | - | - | - | 3       | 25    | 75       | 100   |

**Learning Objectives:**

- To know the objectives of information security
- Understand the importance and application of each of confidentiality, integrity, authentication and availability
- Understand various cryptographic algorithms
- Understand the basic categories of threats to computers and networks

**Course Outcomes:**

**CO1:** Understand network security threats, security services, and countermeasures

**CO2:** Understand vulnerability analysis of network security

**CO3:** Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.

**CO4:** Gain hands-on experience with programming and simulation techniques for security protocols.

**CO5:** Apply methods for authentication, access control, intrusion detection and prevention.

| Units      | Contents   | Required Hours |
|------------|--|----------------|
| <b>I</b>   | Introduction to Information Security : Security mindset, Computer Security Concepts (CIA), Attacks, Vulnerabilities and protections, Security Goals, Security Services, Threats, Attacks, Assets, malware, program analysis and mechanisms.  | <b>12</b>      |
| <b>II</b>  | The Security Problem in Computing: The meaning of computer Security, Computer Criminals, Methods of Defense. Cryptography: Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption   | <b>12</b>      |
| <b>III</b> | Symmetric and Asymmetric Cryptographic Techniques: DES, AES, RSA algorithms .Authentication and Digital Signatures: Use of Cryptography for authentication, Secure Hash function, Key management – Kerberos.   | <b>12</b>      |
| <b>IV</b>  | Program Security : Non-malicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors, Salami attack, Man-in-the- middle attacks, Covert channels. File protection Mechanisms, User Authentication Designing Trusted O.S: Security polices, models of security, trusted O.S design, Assurance in trusted O.S. Implementation examples. | <b>12</b>      |
| <b>V</b>   | Security in Networks: Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong Authentication, Access Controls, Wireless Security, Honeypots, Traffic flow security. Web Security: Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction.   | <b>12</b>      |

**Learning Resources:****Recommended Texts**

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson

**Reference Books**

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security : Forouzan Mukhopadhyay, Mc Graw Hill, 2"d Edition
3. Information Security, Principles and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM.Arthur Conklin, Greg White, TMH

**Mapping with Programme Outcomes:**

| CO/PSO                                      | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|-------|-------|-------|-------|-------|-------|
| CO 1  | 3     | 3     | 3     | 2     | 3     | 2     |
| CO 2  | 3     | 2     | 3     | 2     | 3     | 3     |
| CO 3  | 3     | 3     | 3     | 2     | 3     | 3     |
| CO 4  | 3     | 3     | 3     | 3     | 2     | 3     |
| CO 5  | 3     | 3     | 3     | 2     | 3     | 2     |
| Weightage of course contributed to each PSO | 15    | 14    | 15    | 11    | 14    | 13    |

S-Strong-3 M-Medium-2 L-Low-1

| Subject Code               | Subject Name   | Category     | L | T | P | S | Credits | Marks                     |                              |       |  |
|----------------------------|--|--------------|---|---|---|---|---------|---------------------------|------------------------------|-------|--|
|                            |  |              |   |   |   |   |         | CIA                       | External                     | Total |  |
|                            | <b>FINANCIAL ANALYTICS</b>   | <b>Elect</b> | 4 | - | - | - | 3       | 25                        | 75                           | 100   |  |
| <b>Learning Objectives</b> |  |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO1</b>                 | To analyze and model financial data.   |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO2</b>                 | To construct and optimize asset portfolios.  |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO3</b>                 | To evaluate and model Risk on various financial assets.  |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO4</b>                 | To use the most powerful and sophisticated routines in R for analytical finance.   |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO5</b>                 | To acquire logical & analytical skills in financial analytics.   |              |   |   |   |   |         |                           |                              |       |  |
| <b>UNIT</b>                | <b>Contents</b>  |              |   |   |   |   |         |                           | <b>No. Of. Hours</b>         |       |  |
| I                          | <b>Financial Analytics:</b> Introduction: Meaning-Importance of Financial Analytics uses-Features-Documents used in Financial Analytics: Balance Sheet, Income Statement, Cash flow statement-Elements of Financial Health: Liquidity, Leverage, Profitability. Financial Securities: Bond and Stock investments - Housing and Euro crisis - Securities Datasets and Visualization - Plotting multiple series. |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| II                         | <b>Descriptive Analytics:</b> Data Exploration, Dimension Reduction and Data Clustering Geographical Mapping, Market Basket Analysis. Predictive Analytics, Fraud Detection, Churn Analysis, Crime Mapping, Content Analytics, Sentiment Analysis. Analyzing financial data and implement financial models.  |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| III                        | <b>Forecasting Analytics:</b> Estimating Demand Curves and Optimize Price, Price Bundling, Non Linear Pricing and Price Skimming, Forecasting, Simple Regression and Correlation Multiple Regression to forecast sales. Modeling Trend and Seasonality Ratio to Moving Average Method, Winter's Method.  |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| IV                         | <b>Business Intelligence &amp; Tableau:</b> Definition of BI – A Brief History of BI – The Architecture of BI. The origin and Drivers of BI. Successful BI Implementation – Analytics Overview – Descriptive, Predictive and Perspective Analytics. Business reporting and Visualization – components - A brief history of data visualization – Different types of charts and graphs                           |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| V                          | <b>Visualizations:</b> Using Tableau to Summarize Data, Slicing and Dicing Financial Data, Charts to Summarize Marketing Data. Functions to Summarize Data, Pricing Analytics, Risk based pricing, Fraud Detection and Prediction, Recovery Management, Loss Risk Forecasting, Risk Profiling, Portfolio Stress Testing.   |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| <b>Course Outcomes</b>     |  |              |   |   |   |   |         | <b>Programme Outcomes</b> |                              |       |  |
| CO                         | On completion of this course, students will  |              |   |   |   |   |         |                           |                              |       |  |
| CO1                        | Interpret and discuss the outputs of given financial models and create their own models.   |              |   |   |   |   |         |                           | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |

|                        |   |                              |
|------------------------|---|------------------------------|
| CO2                    | Design and create visualizations that clearly communicate financial data insights.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO3                    | Gain essential knowledge and hands-on experience in the data analysis process, including data scraping, manipulation, and exploratory data analysis.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO4                    | Be prepared for more advanced applied financial modeling courses.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5                    | Improve leadership, teamwork and critical thinking skills for financial decision making.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                              |
| 1                      | Analysis of Economic Data, Gary Koop, (4th Edition), Wiley.   |                              |
| 2                      | Statistics and Data Analysis for Financial Engineering: with R examples; David Ruppert, David S. Matteson, Springer                                   |                              |
| <b>Reference Books</b> |   |                              |
| 1.                     | Analyzing Financial Data and Implementing Financial Models Using „R“, Ang Clifford, Springer.   |                              |
| 2.                     | Microsoft Excel 2013: Data Analysis and Business Modeling, Wayne L. Winston, Microsoft Publishing   |                              |
| <b>Web Resources</b>   |   |                              |
| 1.                     | <a href="https://www.techtarget.com/searcherp/definition/financial-analytics">https://www.techtarget.com/searcherp/definition/financial-analytics</a> |                              |
| 2.                     | <a href="https://www.teradata.com/Glossary/What-is-Finance-Analytics">https://www.teradata.com/Glossary/What-is-Finance-Analytics</a>                 |                              |

**Mapping with Programme Outcomes:**

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 2     | 3     | 3     | 3     | 2     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 2     | 2     |
| CO 4   | 3     | 3     | 3     | 3     | 2     | 3     |
| CO 5   | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 15    | 15    | 15    | 12    | 14    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code               | Subject Name  | Category | L | T | P | S | Credits | Marks              |                              |       |  |
|----------------------------|---|----------|---|---|---|---|---------|--------------------|------------------------------|-------|--|
|                            |   |          |   |   |   |   |         | CIA                | External                     | Total |  |
|                            | <b>CRYPTOGRAPHY</b>   | Elect    | 4 | - | - | - | 3       | 25                 | 75                           | 100   |  |
| <b>Learning Objectives</b> |   |          |   |   |   |   |         |                    |                              |       |  |
| LO1                        | To understand the fundamentals of Cryptography  |          |   |   |   |   |         |                    |                              |       |  |
| LO2                        | To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.  |          |   |   |   |   |         |                    |                              |       |  |
| LO3                        | To understand the various key distribution and management schemes.  |          |   |   |   |   |         |                    |                              |       |  |
| LO4                        | To understand how to deploy encryption techniques to secure data in transit across data networks  |          |   |   |   |   |         |                    |                              |       |  |
| LO5                        | To design security applications in the field of Information technology  |          |   |   |   |   |         |                    |                              |       |  |
| UNIT                       | Contents  |          |   |   |   |   |         |                    | No. Of. Hours                |       |  |
| I                          | <b>Introduction:</b> The OSI security Architecture – Security Attacks – Security Mechanisms – Security Services – A model for network Security.   |          |   |   |   |   |         |                    | 12                           |       |  |
| II                         | <b>Classical Encryption Techniques:</b> Symmetric cipher model – <b>Substitution Techniques:</b> Caesar Cipher – Monoalphabetic cipher – Play fair cipher – Poly Alphabetic Cipher – Transposition techniques – Stenography |          |   |   |   |   |         |                    | 12                           |       |  |
| III                        | <b>Block Cipher and DES:</b> Block Cipher Principles – DES – The Strength of DES – <b>RSA:</b> The RSA algorithm.   |          |   |   |   |   |         |                    | 12                           |       |  |
| IV                         | <b>Network Security Practices:</b> IP Security overview - IP Security architecture – Authentication Header. <b>Web Security:</b> SecureSocket Layer and Transport Layer Security – Secure Electronic Transaction.           |          |   |   |   |   |         |                    | 12                           |       |  |
| V                          | Intruders – Malicious software – Firewalls.   |          |   |   |   |   |         |                    | 12                           |       |  |
| <b>TOTAL HOURS</b>         |   |          |   |   |   |   |         | <b>60</b>          |                              |       |  |
| Course Outcomes            |   |          |   |   |   |   |         | Programme Outcomes |                              |       |  |
| CO                         | On completion of this course, students will   |          |   |   |   |   |         |                    |                              |       |  |
| CO1                        | Analyze the vulnerabilities in any computing system and hence be able to design a security solution.  |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO2                        | Apply the different cryptographic operations of symmetric cryptographic algorithms  |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO3                        | Apply the different cryptographic operations of public key cryptography   |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO4                        | Apply the various Authentication schemes to simulate different applications.  |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO5                        | Understand various Security practices and System security standards   |          |   |   |   |   |         |                    | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| <b>Textbooks</b>           |   |          |   |   |   |   |         |                    |                              |       |  |

|                        |   |
|------------------------|---|
| 1                      | <b>William Stallings</b> , “Cryptography and Network Security Principles and Practices”.  |
| 2                      | P.Rizwan Ahmed, Cryptography, Margham Publications, Chennai, 2017   |
| <b>Reference Books</b> |   |
| 1.                     | <b>Behrouz A. Foruzan</b> , “Cryptography and Network Security”, Tata McGraw-Hill, 2007.  |
| 2                      | <b>AtulKahate</b> , “ <i>Cryptography and Network Security</i> ”, Second Edition, 2003, TMH.  |
| 3                      | <b>M.V. Arun Kumar</b> , “ <i>Network Security</i> ”, 2011, First Edition, USP.   |
| <b>Web Resources</b>   |   |
| 1                      | <a href="https://www.tutorialspoint.com/cryptography/">https://www.tutorialspoint.com/cryptography/</a>   |
| 2                      | <a href="https://gpgtools.tenderapp.com/kb/how-to/introduction-to-cryptography">https://gpgtools.tenderapp.com/kb/how-to/introduction-to-cryptography</a> |

**Mapping with Programme Outcomes:**

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| <b>CO 1</b>  | 3     | 3     | 3     | 2     | 3     | 2     |
| <b>CO 2</b>  | 3     | 2     | 3     | 2     | 3     | 3     |
| <b>CO 3</b>  | 3     | 3     | 3     | 2     | 3     | 3     |
| <b>CO 4</b>  | 2     | 3     | 3     | 3     | 2     | 3     |
| <b>CO 5</b>  | 3     | 2     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 13    | 15    | 12    | 14    | 14    |

**S-Strong-3 M-Medium-2 L-Low-1**



| Subject Code               | Subject Name  | Category     | L | T | P | S | Credits | Marks |                    |                              |
|----------------------------|---|--------------|---|---|---|---|---------|-------|--------------------|------------------------------|
|                            |   |              |   |   |   |   |         | CIA   | External           | Total                        |
|                            | <b>OPERATING SYSTEM</b>   | <b>Elect</b> | 4 | - | - | - | 3       | 25    | 75                 | 100                          |
| <b>Learning Objectives</b> |   |              |   |   |   |   |         |       |                    |                              |
| LO1                        | To understand the fundamental concepts and role of Operating System.  |              |   |   |   |   |         |       |                    |                              |
| LO2                        | To learn the Process Management and Scheduling Algorithms.  |              |   |   |   |   |         |       |                    |                              |
| LO3                        | To understand the Memory Management policies.   |              |   |   |   |   |         |       |                    |                              |
| LO4                        | To gain insight on I/O and File management techniques.  |              |   |   |   |   |         |       |                    |                              |
| LO5                        | Analyze resource management techniques  |              |   |   |   |   |         |       |                    |                              |
| UNIT                       | Contents  |              |   |   |   |   |         |       |                    | No. Of. Hours                |
| I                          | <b>Introduction-</b> views and goals – Operating System Services - User and Operating System interface - System Call- Types of System Calls – Operating System Design and Implementation - Operating System Structure. <b>Process Management:</b> Process concept- Process Scheduling - Operations on Processes- Interprocess Communication. <b>Threads:</b> Types of threads |              |   |   |   |   |         |       |                    | <b>12</b>                    |
| II                         | <b>Process Scheduling:</b> Basic Concepts-Scheduling Criteria Scheduling Algorithm Multiple Processor Scheduling CPU Scheduling. <b>Synchronization:</b> The Critical-Section Problem Synchronization Hardware – Semaphores- Classic Problem of Synchronization.  |              |   |   |   |   |         |       |                    | <b>12</b>                    |
| III                        | <b>Deadlocks:</b> Deadlock Characterization - Methods for Handling Deadlocks-Deadlock Prevention- Deadlock Avoidance - Deadlock Detection- Recovery from Deadlock.  |              |   |   |   |   |         |       |                    | <b>12</b>                    |
| IV                         | <b>Memory-Management Strategies:</b> Swapping - Contiguous Memory Allocation Segmentation- Paging - Structure of the Page Table. <b>Virtual-Memory Management:</b> Demand Paging - Page Replacement - Allocation of Frames -Thrashing.  |              |   |   |   |   |         |       |                    | <b>12</b>                    |
| V                          | <b>Storage Management:</b> File System- File Concept - Access Methods-Directory and Disk Structure -File Sharing- Protection. Allocation Methods - Free- Space Management - Efficiency and Performance – Recovery.  |              |   |   |   |   |         |       |                    | <b>12</b>                    |
| <b>TOTAL HOURS</b>         |   |              |   |   |   |   |         |       | <b>60</b>          |                              |
| Course Outcomes            |   |              |   |   |   |   |         |       | Programme Outcomes |                              |
| CO                         | On completion of this course, students will   |              |   |   |   |   |         |       |                    |                              |
| CO1                        | Define OS with its view and goals and services rendered by it Design of Operating System with its structure. Message through Inter process communication.   |              |   |   |   |   |         |       |                    | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO2                        | Describe the allocation of process through scheduling algorithms. Define critical section problems and its usage. Prevention of multiple process executing through the concept of semaphores.   |              |   |   |   |   |         |       |                    | PO1, PO2, PO3, PO4, PO5, PO6 |

|                        |   |                              |
|------------------------|---|------------------------------|
| CO3                    | Describe the concept of Mutual exclusion, Deadlock detection and agreement protocols for deadlock prevention and its avoidance.               | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO4                    | Analyze the strategies of Memory management schemes and the usage of Virtual memory. Apply Replacement algorithms to avoid thrashing.         | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5                    | Brief study of storage management. Categorize the methods to allocate files for proper protection.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                              |
| 1                      | A. Silberschatz P.B.Galvin, Gange. "Operating System Concepts", Ninth Edition, 2013, Addison Wesley Publishing Co.                            |                              |
| 2                      | P.Rizwan Ahmed, Operating System, Margham Publications, Chennai.2018  |                              |
| <b>Reference Books</b> |   |                              |
| 1.                     | Anderw S Tanenbaum, Albert S. Woodhull, " Operating System Design and Impletation", prentice-Hall India Publication.                          |                              |
| 2.                     | William Stallings, "Operating Systems Internals and Design Principles", Pearson, 2018, 9th Edition.   |                              |
| 3.                     | Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition  |                              |
| 4.                     | Operating System Concepts (2nd Ed) by James L. Peterson, Abraham Silberschatz, Addison – Wesley.  |                              |
| 5.                     | Operating Systems Design & implementation Andrew S. Tanenbam, Albert S. Woodhull Pearson.   |                              |
| <b>Web Resources</b>   |   |                              |
| 1.                     | <a href="https://www.guru99.com/operating-system-tutorial.html">https://www.guru99.com/operating-system-tutorial.html</a>                     |                              |
| 2.                     | <a href="https://www.mygreatlearning.com/blog/what">https://www.mygreatlearning.com/blog/what</a>   |                              |
| 3.                     | <a href="https://en.wikipedia.org/wiki/Operating_system">https://en.wikipedia.org/wiki/Operating_system</a>                                   |                              |
| 4.                     | <a href="https://www.geeksforgeeks.org/what-is-an-operating-system/">https://www.geeksforgeeks.org/what-is-an-operating-system/</a>           |                              |
| 5.                     | <a href="http://www.cs.kent.edu/~farrell/osf03/oldnotes/2.th-edition.pdf">http://www.cs.kent.edu/~farrell/osf03/oldnotes/2.th-edition.pdf</a> |                              |

### Mapping with Programme Outcomes

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 2     | 3     | 3     | 3     | 2     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 2     | 2     |
| CO 4   | 3     | 3     | 3     | 3     | 2     | 3     |
| CO 5   | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 15    | 15    | 15    | 12    | 14    |

S-Strong-3 M-Medium-2 L-Low-1

| Subject Code | Subject Name                   | Category | L | T | P | S | Credits | Marks |          |       |
|--------------|--------------------------------|----------|---|---|---|---|---------|-------|----------|-------|
|              |                                |          |   |   |   |   |         | CIA   | External | Total |
|              | <b>SIMULATION AND MODELING</b> | SEC      | 2 | - | - | - | 3       | 25    | 75       | 100   |

**Learning Objectives:**(for teachers: what they have to do in the class/lab/field)

In this course, modeling and simulation (M&S) methodologies considering the theoretical aspects. A wide range of Modeling and Simulation concepts that will lead you to develop your own M&S applications. Students learn the methodologies and tools for simulation and modeling of a real time problem/ mathematical model.

**Course Outcomes:**(for students: To know what they are going to learn)

**CO1:** Introduction To Modeling & Simulation, Input Data Analysis and Modeling.

**CO2:** Random Variate and Number Generation. Analysis of Simulations and methods.

**CO3:** Comparing Systems via Simulation

**CO4:** Entity Body Modeling, Visualization, Animation.

**CO5:** Algorithms and Sensor Modeling.

| Units      | Contents   | Required Hours |
|------------|--|----------------|
| <b>I</b>   | Introduction To Modeling & Simulation – What is Modeling and Simulation? – Complexity Types – Model Types – Simulation Types – M&S Terms and Definitions Input Data Analysis – Simulation Input Modeling   | <b>6</b>       |
| <b>II</b>  | Random Variate Generation – Random Numbers – Random Number Generators – General principles – Inverse Transform Method – Acceptance Rejection Method – Composition Method – Relocate and Rescale Method - Specific distributions-Output Data Analysis                             | <b>6</b>       |
| <b>III</b> | Comparing Systems via Simulation – Introduction – Comparison Problems - Comparing Two Systems - Screening Problems - Selecting the Best - Comparison with a Standard - Comparison with a Fixed Performance Discrete Event Simulations – Introduction - Next-Event Time Advance - | <b>6</b>       |
| <b>IV</b>  | Entity Modeling – Entity Body Modeling – Entity Body Visualization – Entity Body Animation – Entity Interaction Modeling – Building Modeling Distributed Simulation – High Level Architecture (HLA) – Federation Development and Execution Process (FEDEP)                       | <b>6</b>       |
| <b>V</b>   | Optimization Algorithms – Genetic Algorithms – Simulated Annealing Examples: Sensor Systems Modeling – Human Eye Modeling – Optical Sensor Modeling – Radar Modeling.  | <b>6</b>       |

**Learning Resources:****Recommended Texts**

1. Jerry Banks, "Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practice", John Wiley & Sons, Inc., 1998.
2. George S. Fishman, "Discrete-Event Simulation: Modeling, Programming and Analysis", Springer-Verlag New York, Inc., 2001.

**Reference Books**

1. Andrew F. Seila, Vlatko Ceric, Pandu Tadikamalla, "Applied Simulation Modeling", Thomson Learning Inc., 2003.

| <b>MAPPING TABLE</b>                               |             |             |             |             |             |             |
|--|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO/PSO</b>                                      | <b>PSO1</b> | <b>PSO2</b> | <b>PSO3</b> | <b>PSO4</b> | <b>PSO5</b> | <b>PSO6</b> |
| <b>CO1</b>   | <b>3</b>    | <b>2</b>    | <b>3</b>    | <b>2</b>    | <b>2</b>    | <b>2</b>    |
| <b>CO2</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>2</b>    |
| <b>CO3</b>   | <b>3</b>    | <b>2</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CO4</b>   | <b>3</b>    | <b>2</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>CO5</b>   | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    | <b>3</b>    |
| <b>Weightage of course contributed to each PSO</b> | <b>15</b>   | <b>12</b>   | <b>15</b>   | <b>14</b>   | <b>14</b>   | <b>13</b>   |

| Subject Code   | Subject Name  | Cate<br>gory | L | T | P | S | Cr | Marks          |    |     |
|--|---|--------------|---|---|---|---|----|----------------|----|-----|
|  |   |              |   |   |   |   |    | O              | E  | T   |
|  | <b>QUANTITATIVE<br/>APTITUDE</b>  | <b>Elec</b>  | 2 | - | - | - | 3  | 25             | 75 | 100 |
| <b>Learning Objectives:</b> (for teachers: what they have to do in the class/lab/field) <ul style="list-style-type: none"> <li>To improve the quantitative skills of the students</li> <li>To prepare the students for various competitive exams</li> </ul>  |   |              |   |   |   |   |    |                |    |     |
| <b>Course Outcomes:</b> (for students: To know what they are going to learn) <p><b>CO1:</b>To gain knowledge on LCM and HCF and its related problems<br/> <b>CO2:</b>To get an idea of age, profit and loss related problem solving.<br/> <b>CO3:</b>Able to understand time series simple and compound interests<br/> <b>CO4:</b>Understanding the problem related to probability, and series<br/> <b>CO5:</b>Able to understand graphs, charts</p> |   |              |   |   |   |   |    |                |    |     |
| Units  | Contents  |              |   |   |   |   |    | Required Hours |    |     |
| <b>I</b>   | Numbers- HCF and LCM of numbers-Decimal fractions-Simplification- Square roots and cube roots- Average-problems on Number   |              |   |   |   |   |    | <b>6</b>       |    |     |
| <b>II</b>  | Problems on Ages - Surds and Indices - percentage - profits and loss - ratio and proportion-partnership- Chain rule.  |              |   |   |   |   |    | <b>6</b>       |    |     |
| <b>III</b>   | Time and work - pipes and cisterns - Time and Distance - problems on trains -Boats and streams - simple interest - compound interest - Logarithms - Area –Volume and surface area-races and Games of skill. |              |   |   |   |   |    | <b>6</b>       |    |     |
| <b>IV</b>  | Permutation and combination-probability-True Discount-Bankers Discount Height and Distances-Odd man out & Series.   |              |   |   |   |   |    | <b>6</b>       |    |     |
| <b>V</b>   | Calendar - Clocks - stocks and shares - Data representation - Tabulation – Bar Graphs- Pie charts-Line graphs   |              |   |   |   |   |    | <b>6</b>       |    |     |
| <b>Learning Resources:</b><br><b>Recommended Texts</b><br>1.“Quantitative Aptitude”, R.S.AGGARWAL.,S.Chand& Company Ltd.,<br><b>Web resources:</b> Authentic Web resources related to Competitive examinations   |   |              |   |   |   |   |    |                |    |     |

| MAPPING TABLE                               |      |      |      |      |      |      |
|---|------|------|------|------|------|------|
| CO/PSO                                      | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1   | 3    | 2    | 3    | 2    | 2    | 3    |
| CO2   | 3    | 3    | 3    | 3    | 3    | 3    |
| CO3   | 3    | 2    | 2    | 2    | 3    | 3    |
| CO4   | 3    | 3    | 2    | 3    | 3    | 3    |
| CO5   | 3    | 3    | 3    | 3    | 3    | 3    |
| Weightage of course contributed to each PSO | 15   | 13   | 13   | 13   | 14   | 15   |

| Subject Code               | Subject Name   | Category    | L | T | P | S | Credits | Marks |          |       |
|----------------------------|--|-------------|---|---|---|---|---------|-------|----------|-------|
|                            |  |             |   |   |   |   |         | CIA   | External | Total |
|                            | <b>Project with Viva voce</b>  | <b>CC12</b> | 4 | - | - |   | 4       | 25    | 75       | 100   |
| <b>Learning Objectives</b> |  |             |   |   |   |   |         |       |          |       |
| LO1                        | Advance from an intellectually curious student to a creator/maker and an industry professional   |             |   |   |   |   |         |       |          |       |
| LO2                        | Apply verbal and written communication skills to explain technical problem solving techniques and solutions to an increasingly diverse and global audience |             |   |   |   |   |         |       |          |       |
| LO3                        | Collaborate within and across disciplinary boundaries to solve problems  |             |   |   |   |   |         |       |          |       |
| LO4                        | Apply mathematical and/or statistical methods to facilitate problem solving.   |             |   |   |   |   |         |       |          |       |
| LO5                        | Exercise computational thinking over the entire software life cycle  |             |   |   |   |   |         |       |          |       |

### Project Work

| SL | Area of Work  | Maximum Marks |
|----|---|---------------|
|    | <b>PROJECT WORK:</b>  | 10            |
|    | (i) Project Proposal and Plan   |               |
| 1. | (ii) Execution of the Project Proposal and Plan / Collection of data, Documentation and Presentation of the report. | 40            |
| 2. | Viva Voce Examination   | 25            |
|    | <b>TOTAL</b>  | <b>75</b>     |

\* CIA Marks =25 marks (Project Review 1, Project Review2 and Project Review 3)

| Course Outcomes |   | Programme Outcomes           |
|-----------------|---|------------------------------|
| CO              | On successful completion of this course, students will be able to         |                              |
| 1               | show leadership skills and learn time management                          | PO1, PO2, PO3, PO4, PO5, PO6 |
| 2               | identify various tools to be applied to a specific problem                | PO1, PO2, PO3, PO4, PO5, PO6 |
| 3               | evaluate the reports  | PO1, PO2, PO3, PO4, PO5, PO6 |
| 4               | take part in a team as well as manage it to deliver stunning outcomes     | PO1, PO2, PO3, PO4, PO5, PO6 |
| 5               | assess and develop the individual skills to present and organize projects | PO1, PO2, PO3, PO4, PO5, PO6 |

**Mapping with Programme Outcomes:**

| CO/ PSO                                     | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|-------|-------|-------|-------|-------|-------|
| CO1   | 3     | 3     | 3     | 3     | 3     | 2     |
| CO2   | 3     | 3     | 3     | 2     | 2     | 3     |
| CO3   | 2     | 2     | 1     | 3     | 3     | 3     |
| CO4   | 3     | 3     | 3     | 3     | 3     | 2     |
| CO5   | 3     | 3     | 3     | 3     | 3     | 1     |
| Weightage of course contributed to each PSO | 14    | 14    | 13    | 14    | 14    | 11    |

### Annexure - I

(A typical Specimen of Cover Page & Title Page)

#### TITLE OF PROJECT

<Font Size 22><BOLD><Centralized>

#### A Project Report

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#### Submitted by:

<Font Size 14><Italic>><BOLD><Centralized>

#### NAME OF THE STUDENT (<University Roll Number>)

<Font Size 16>><BOLD><Centralized>

in partial fulfillment for the award of the degree

of

<Font Size 14><1.5 line spacing><Italic><BOLD><Centralized>

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#### BACHELOR OF SCIENCE

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IN

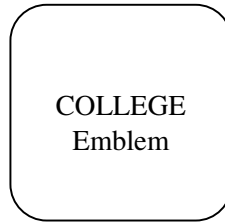
#### DATA SCIENCE

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*Under the Supervision of*

**<NAME OF THE SUPERVISOR(s)>**

**<Font Size 14><BOLD><Centralized>**



**COLLEGE NAME**

**DEPARTMENT NAME**

**MONTH & YEAR**

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**Annexure - 2**

**CANDIDATE'S DECLARATION**

I hereby certify that the project entitled “ \_\_\_\_\_ ”  
submitted by \_\_\_\_\_ (Student name) & (University Roll no) in partial fulfillment of  
the requirement for the award of degree of the B. Sc. (Data Science) submitted at  
\_\_\_\_\_ (College Name) is an authentic record of my own work carried  
out during a period from \_\_\_\_\_ to \_\_\_\_\_ under the guidance of  
Mr./Dr. \_\_\_\_\_ (Guide name, Designation, Department of Data Science).  
The matter presented in this project has not formed the basis for the award of any other degree,  
diploma, fellowship or any other similar titles.

Signature of the Student

Place:

Date:

**Annexure – 3**

**CERTIFICATE**

This is to certify that the project titled “ \_\_\_\_\_ ” is the bona fide



work carried out by (Student name) & (University Roll no) in partial fulfillment of the requirement for the award of degree of the B.Sc. (Data Science) submitted at \_\_\_\_\_ (College Name) is an authentic record his/her work carried out during a period from \_\_\_\_\_ to \_\_\_\_\_ under the guidance of Mr./Dr. \_\_\_\_\_ Guide name, Designation, Department of Data Science . The Major Project Viva-Voce Examination has been held on \_\_\_\_\_ (DD/MM/YYYY).

**Signature of the Guide**

**Signature of the HoD**

**Internal Examiner**

**External Examiner**

|                            | Subject Name   | Category | L | T | P | S | Credits | Marks |          |       |
|----------------------------|--|----------|---|---|---|---|---------|-------|----------|-------|
|                            |  |          |   |   |   |   |         | CIA   | External | Total |
|                            | Internship / Industrial Training   | -        | - | - | - |   | 2       | 25    | 75       | 100   |
| <b>Learning Objectives</b> |  |          |   |   |   |   |         |       |          |       |
| LO1                        | Advance from an intellectually curious student to a creator/maker and an industry professional   |          |   |   |   |   |         |       |          |       |
| LO2                        | Apply verbal and written communication skills to explain technical problem solving techniques and solutions to an increasingly diverse and global audience |          |   |   |   |   |         |       |          |       |
| LO3                        | Collaborate within and across disciplinary boundaries to solve problems  |          |   |   |   |   |         |       |          |       |
| LO4                        | Apply mathematical and/or statistical methods to facilitate problem solving.   |          |   |   |   |   |         |       |          |       |
| LO5                        | Exercise computational thinking over the entire software life cycle  |          |   |   |   |   |         |       |          |       |

### Internship / Industrial Training:

The students to undergo 2 weeks of Internship / Industrial Training in the Industry

| Sl.No | Area of Work  | Maximum Marks |
|-------|---|---------------|
|       | a) Work Related performance – Work Attitude/ Academic preparation/ problem solving ability/ Adaptability / Overall Attendance / Progress towards learning goals         | 10            |
|       | b) Organizational skills – Time management skills / Planning skills/ communication skills   | 20            |
|       | c) Relationship with others – Willingness to cooperate with co-works/ Ability to work with supervisor / Acceptance of constructive comments / Ability to take direction | 20            |
|       | Internship Report / Viva Voce Examination   | 25            |
|       | <b>Total</b>  | 75            |

\* CIA Marks =25 marks (Internship Review 1, Review2 and Review 3)

| Course Outcomes |   | Programme Outcomes           |
|-----------------|---|------------------------------|
| CO              | On successful completion of this course , students will be able to            |                              |
| 1               | Find their specific areas of interest , refine their skills and abilities     | PO1, PO2, PO3, PO4, PO5, PO6 |
| 2               | Show a greater sense of self-awareness and appreciation for others            | PO1, PO2, PO3, PO4, PO5, PO6 |
| 3               | Apply problem solving and critical thinking skills to solve real time problem | PO1, PO2, PO3, PO4, PO5, PO6 |
| 4               | Design various solution approaches for addressing IT business needs.          | PO1, PO2, PO3, PO4, PO5, PO6 |

|   |  |                              |
|---|--|------------------------------|
| 5 | Apply best practices of IT industries by working in the Product or service domain. | PO1, PO2, PO3, PO4, PO5, PO6 |
|---|--|------------------------------|

**Mapping with Programme Outcomes:**

| <b>MAPPING TABLE</b>                        |              |              |              |              |              |              |
|---|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>CO/ PSO</b>                              | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> | <b>PSO 4</b> | <b>PSO 5</b> | <b>PSO 6</b> |
| CO1   | 3            | 1            | 2            | 2            | 2            | 2            |
| CO2   | 2            | 3            | 2            | 3            | 3            | 1            |
| CO3   | 3            | 2            | 2            | 3            | 3            | 2            |
| CO4   | 3            | 3            | 1            | 3            | 3            | 2            |
| CO5   | 3            | 3            | 2            | 3            | 3            | 3            |
| Weightage of course contributed to each PSO | 14           | 12           | 9            | 14           | 14           | 10           |

**Strong-3      M-Medium-2      L-Low-1**

**Guidelines for internship**

- Internship should be of 2 weeks duration.
- A student is expected to find internship by himself or herself. However, the institution should assist their students in getting internship in good organizations.
- The home institution cannot be taken as the place of internship.
- Internship can be on any topic covered in the syllabus mentioned in the syllabus, not restricted to the specialization.
- Internship can be done, in one of the following, but not restricted to, types of organizations:
  - Software development firms
  - Hardware/ manufacturing firms
  - Any small scale industries, service providers like banks
  - Clinics/ NGOs/professional institutions like that of CA, Advocate etc
  - Civic Depts like Ward office/post office/police station/ punchayat.

## **Guidelines for making Internship Report**

A student is expected to make a report based on the internship he or she has done in an organization. It should contain the following:

- Certificate: A certificate in the prescribed Performa (given in appendix 1) from the organization where the internship done.
- Evaluation form: The form filled by the supervisor or to whom the intern was reporting, in the prescribed Performa (given in appendix 2).
- Title: A suitable title giving the idea about what work the student has performed during the internship.
- Description of the organization: A small description of 1 to 2 pages on the organization where the student has interned
- Description about the activities done by the section where the intern has worked: A description of 2 to 4 pages about the section or cell of the organization where the intern actually worked. This should give an idea about the type of activity a new employee is expected to do in that section of the organization.
- Description of work allotted and actually done by the intern: A detailed description of the work allotted and actual work performed by the intern during the internship period. Intern may give a weekly report of the work by him or her if needed. It shall be of around 7 to 10 pages.
- Self assessment: A self assessment by the intern on what he or she has learnt during the internship period. It shall contain both technical as well as interpersonal skills learned in the process. It shall be of around 2 to 3 pages.

The internship report may be around 20 to 30 pages and this needs to be submitted to the external examiner at the time of University examination.

### ***Appendix 1***

(Proforma for the certificate for internship in official letter head)

This is to certify that Mr/Ms \_\_\_\_\_  
of \_\_\_\_\_ College/Institution worked as an intern as part of her B.Sc. course in

Data Science of Thiruvalluvar University. The particulars of internship are given below:

Internship starting date:

Internship ending date:

Actual number of days worked:

Tentative number of hours worked:                      Hours

Broad area of work:

A small description of work done by the intern during the period:

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Signature:

Name:

Designation:

Contact number:

Email:

(Seal of the organization)

## **Appendix 2**

(Proforma for the Evaluation of the intern by the supervisor/to whom the intern was reporting  
in the organization)

### **Professional Evaluation of intern**

Name of intern:

College/institution:

[Note: Give a score in the 1-5 scale by putting  $\surd$  in the respective cells]

| <b>S. No</b> | <b>Particular</b>                     | <b>Excellent</b> | <b>Very Good</b> | <b>Good</b> | <b>Moderate</b> | <b>Satisfactory</b> |
|--------------|---------------------------------------|------------------|------------------|-------------|-----------------|---------------------|
| 1            | Attendance                            |                  |                  |             |                 |                     |
| 2            | Punctuality                           |                  |                  |             |                 |                     |
| 3            | Adaptability                          |                  |                  |             |                 |                     |
| 4            | Ability to shoulder responsibility    |                  |                  |             |                 |                     |
| 5            | Ability to work in a team             |                  |                  |             |                 |                     |
| 6            | Written and oral communication skills |                  |                  |             |                 |                     |
| 7            | Problem solving skills                |                  |                  |             |                 |                     |
| 8            | Ability to grasp new concepts         |                  |                  |             |                 |                     |
| 9            | Ability to complete task              |                  |                  |             |                 |                     |
| 10           | Quality of work done                  |                  |                  |             |                 |                     |

Comments:

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Signature:

Name:

Designation:

Contact number:

Email:

(Seal of the organization)

## SEMESTER –VI

| Subject Code               | Subject Name   | Category    | L | T | P | S  | Credits | Marks |          |               |
|----------------------------|--|-------------|---|---|---|----|---------|-------|----------|---------------|
|                            |  |             |   |   |   |    |         | CIA   | External | Total         |
|                            | <b>IOT AND CLOUD TECHNOLOGIES</b>  | <b>CC13</b> | 6 | - | - | VI | 4       | 25    | 75       | 100           |
| <b>Learning Objectives</b> |  |             |   |   |   |    |         |       |          |               |
| LO1                        | Learn basic concepts of Cloud Computing.   |             |   |   |   |    |         |       |          |               |
| LO2                        | To get an overview of Map Reduce Concepts.   |             |   |   |   |    |         |       |          |               |
| LO3                        | To learn about infrastructure security, Data Security and Privacy.   |             |   |   |   |    |         |       |          |               |
| LO4                        | To understand access based on access management in data security   |             |   |   |   |    |         |       |          |               |
| LO5                        | To generate security and privacy access for the end user   |             |   |   |   |    |         |       |          |               |
| UNIT                       | Contents   |             |   |   |   |    |         |       |          | No. Of. Hours |
| I                          | <b>IoT Introduction:</b> Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU - Protocols for IoT.  |             |   |   |   |    |         |       |          | <b>18</b>     |
| II                         | <b>Introduction to Cloud Computing</b> Cloud Computing – Definition – SPI Framework – Software Model – Cloud Services Delivery Model – Deployment Models – Key drivers – Impact on Users – Governance in the cloud – Barriers to Cloud Computing Adoption in the enterprise. Examples of Cloud Service Providers: Amazon Web services – Google – Microsoft Azure Services Platform – Sun Open Cloud Platform.  |             |   |   |   |    |         |       |          | <b>18</b>     |
| III                        | <b>Virtual Machines Provisioning and Migration Services</b> Introduction and Inspiration -Background and Related Work- Virtual Machines Provisioning and Manageability-Virtual Machine Migration Services- VM Provisioning and Migration in Action -Provisioning in the Cloud Context - Future Research Directions- The Anatomy of Cloud Infrastructures -Distributed Management of Virtual Infrastructures- Scheduling Techniques for Advance Reservation of Capacity- Capacity Management to meet SLA Commitments. |             |   |   |   |    |         |       |          | <b>18</b>     |
| IV                         | <b>Data Security, Identity and Access Management</b> <b>Data security and storage:</b> Aspects of Data Security -Data Security Mitigation -Provider Data and Its Security. Identity and Access Management: Trust Boundaries and IAM -Why IAM? - IAM Challenges- IAM Definitions- IAM Architecture and Practice-Getting Ready for the Cloud - Relevant IAM Standards and Protocols for Cloud Services - IAM Practices in the Cloud-Cloud Authorization Management-Cloud Service Provider IAM Practice.                |             |   |   |   |    |         |       |          | <b>18</b>     |
| V                          | <b>Security and Privacy</b> <b>Security Management: Standards</b> – Security Management in the Cloud – Availability Management – Access Control. Privacy: What is Privacy – Data Life Cycle – Key Privacy Concerns – Who is responsible for protecting Privacy – Privacy Risk Management – Legal and Regulatory Implications. IoT and Cloud Integration: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment.                                |             |   |   |   |    |         |       |          | <b>18</b>     |



|                        |   | <b>TOTAL HOURS</b>           | <b>90</b> |
|------------------------|---|------------------------------|-----------|
| <b>Course Outcomes</b> |   | <b>Programme Outcomes</b>    |           |
| CO                     | On completion of this course, students will   |                              |           |
| CO1                    | Design an IoT system with cloud infrastructure.   | PO1, PO2, PO3, PO4, PO5, PO6 |           |
| CO2                    | Implement the M2M Communication protocols in a prototype  | PO1, PO2, PO3, PO4, PO5, PO6 |           |
| CO3                    | Understand the basic concepts of the main sensors used in electromechanical systems   | PO1, PO2, PO3, PO4, PO5, PO6 |           |
| CO4                    | Understand/implement computer models of common engineering information types.   | PO1, PO2, PO3, PO4, PO5, PO6 |           |
| CO5                    | Understand storage mechanisms / analysis algorithms for data management in distributed & data intensive applications                        | PO1, PO2, PO3, PO4, PO5, PO6 |           |
| <b>Textbooks</b>       |   |                              |           |
| 1                      | "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press.                  |                              |           |
| 2                      | P.Rizwan Ahmed, Internet of Things, Margham Publications, Chennai, 2017   |                              |           |
| 3                      | Tim Mather, Subra Kumaraswamy, ShahedLatif (2010), Cloud Security and Privacy, OREILLY Media.   |                              |           |
| 4                      | Adrian McEwen, Designing the Internet of Things, Wiley, 2013.   |                              |           |
| <b>Reference Books</b> |   |                              |           |
| 1.                     | Ronald L. Krutz and Russell Dean Vines(2010), Cloud Security, Wiley – India   |                              |           |
| 2                      | RajkumarBuyya, James Broberg, AndrzejGoscinski(2011),CLOUD COMPUTING Principles and Paradigms, John Wiley & Sons, Inc., Hoboken, New Jersey |                              |           |

#### Mapping with Programme Outcomes:

| <b>CO/PSO</b>                                      | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> | <b>PSO 4</b> | <b>PSO 5</b> | <b>PSO 6</b> |
|--|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>CO 1</b>  | 3            | 3            | 3            | 3            | 3            | 2            |
| <b>CO 2</b>  | 3            | 3            | 3            | 3            | 3            | 3            |
| <b>CO 3</b>  | 3            | 3            | 3            | 3            | 3            | 3            |
| <b>CO 4</b>  | 3            | 3            | 3            | 3            | 2            | 3            |
| <b>CO 5</b>  | 3            | 2            | 3            | 3            | 3            | 3            |
| <b>Weightage of course contributed to each PSO</b> | 15           | 14           | 15           | 15           | 14           | 14           |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code | Subject Name                          | Category     | L | T | P | S  | Credits | Marks |          |       |
|--------------|---------------------------------------|--------------|---|---|---|----|---------|-------|----------|-------|
|              |                                       |              |   |   |   |    |         | CIA   | External | Total |
|              | <b>IOT AND CLOUD TECHNOLOGIES LAB</b> | <b>CC 14</b> | - | - | 5 | VI | 4       | 25    | 75       | 100   |

### Objectives

To improve efficiency and bringing important information to the surface more quickly than a system depending on human intervention, provide easy, scalable access to computing resources and IT services.

### LIST OF PROGRAMS

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when "1"/"0" is received from smart phone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

### Course Outcomes

| CO  | On completion of this course, students will   |
|-----|---|
| CO1 | Design an IoT system with cloud infrastructure.                                     |
| CO2 | Implement the M2M Communication protocols in a prototype                            |
| CO3 | Understand the basic concepts of the main sensors used in electromechanical systems |

|     |  |
|-----|--|
| CO4 | Understand/implement computer models of common engineering information types.  |
| CO5 | Understand storage mechanisms / analysis algorithms for data management in distributed & data intensive applications |

**Mapping with Programme Outcomes:**

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 3     | 3     | 3     | 2     | 3     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 4   | 3     | 3     | 2     | 2     | 2     | 3     |
| CO 5   | 3     | 2     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 15    | 14    | 14    | 13    | 14    | 15    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code               | Subject Name   | Category    | L | T | P | S  | Credits | Marks                     |                              |       |  |
|----------------------------|--|-------------|---|---|---|----|---------|---------------------------|------------------------------|-------|--|
|                            |  |             |   |   |   |    |         | CIA                       | External                     | Total |  |
|                            | <b>ARTIFICIAL INTELLIGENCE</b>   | <b>CC15</b> | 5 | - | - | VI | 4       | 25                        | 75                           | 100   |  |
| <b>Learning Objectives</b> |  |             |   |   |   |    |         |                           |                              |       |  |
| <b>LO1</b>                 | Describe the concepts of Artificial Intelligence   |             |   |   |   |    |         |                           |                              |       |  |
| <b>LO2</b>                 | Understand the method of solving problems using Artificial Intelligence  |             |   |   |   |    |         |                           |                              |       |  |
| <b>LO3</b>                 | Understand Knowledge Representation  |             |   |   |   |    |         |                           |                              |       |  |
| <b>LO4</b>                 | Introduce the concept of Software Agents   |             |   |   |   |    |         |                           |                              |       |  |
| <b>LO5</b>                 | Understand about AI applications   |             |   |   |   |    |         |                           |                              |       |  |
| <b>UNIT</b>                | <b>Contents</b>  |             |   |   |   |    |         |                           | <b>No. Of. Hours</b>         |       |  |
| I                          | <b>INTRODUCTION</b> : Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.   |             |   |   |   |    |         |                           | <b>15</b>                    |       |  |
| II                         | <b>PROBLEM SOLVING METHODS</b> Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games |             |   |   |   |    |         |                           | <b>15</b>                    |       |  |
| III                        | <b>KNOWLEDGE REPRESENTATION</b> First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information                                 |             |   |   |   |    |         |                           | <b>15</b>                    |       |  |
| IV                         | <b>SOFTWARE AGENTS</b> Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.  |             |   |   |   |    |         |                           | <b>15</b>                    |       |  |
| V                          | <b>APPLICATIONS</b> AI applications – Language Models – Information Retrieval-Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving  |             |   |   |   |    |         |                           | <b>15</b>                    |       |  |
| <b>TOTAL HOURS</b>         |  |             |   |   |   |    |         | <b>75</b>                 |                              |       |  |
| <b>Course Outcomes</b>     |  |             |   |   |   |    |         | <b>Programme Outcomes</b> |                              |       |  |
| <b>CO</b>                  | On completion of this course, students will  |             |   |   |   |    |         |                           |                              |       |  |
| CO1                        | Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents.  |             |   |   |   |    |         |                           | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO2                        | Understand search techniques and gaming theory   |             |   |   |   |    |         |                           | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO3                        | The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.  |             |   |   |   |    |         |                           | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO4                        | Student should be aware of techniques used for classification and clustering.  |             |   |   |   |    |         |                           | PO1, PO2, PO3,               |       |  |

|                        |   |                                 |
|------------------------|---|---------------------------------|
|                        |   | PO4, PO5, PO6                   |
| CO5                    | Student should aware of basics of pattern recognition and steps required for it.  | PO1, PO2, PO3,<br>PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                                 |
| 1                      | Elaine Rich, Kevin Knight (2008), Shivsankar B Nair, Artificial Intelligence, Third Edition, Tata McGraw Hill Publication |                                 |
| 2                      | P.Rizwan Ahmed, Artificial Intelligence, Margham Publications, Chennai, 2012  |                                 |
| <b>Reference Books</b> |   |                                 |
| 1.                     | Russel S, Norvig P (2010), Artificial Intelligence : A Modern approach,Third Edition, Pearson Education                   |                                 |
| 2.                     | Dan W Patterson (2007), Introduction to Artificial Intelligence and Expert System, Second Edition, Pearson Education Inc. |                                 |
| 3.                     | Jones M(2006), Artificial Intelligence application Programming, Second Edition, Dreamtech Press                           |                                 |
| 4.                     | Nilsson (2000), Artificial Intelligence : A new synthesis, Nils J Harcourt Asia Pvt Ltd.                                  |                                 |

#### Mapping with Programme Outcomes:

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 3     | 2     | 3     | 3     | 3     | 3     |
| CO 3   | 3     | 3     | 2     | 3     | 3     | 3     |
| CO 4   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 5   | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 15    | 14    | 14    | 15    | 15    | 15    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code  | Subject Name  | Category | L | T | P | S  | Credits | Marks |          |               |
|---|---|----------|---|---|---|----|---------|-------|----------|---------------|
|   |   |          |   |   |   |    |         | CIA   | External | Total         |
|   | <b>INTRODUCTION TO LINEAR ALGEBRA</b>   | Elec.    | 5 | - | - | VI | 3       | 25    | 75       | 100           |
| <b>Learning Objectives</b>  |   |          |   |   |   |    |         |       |          |               |
| <ul style="list-style-type: none"> <li>• Vector Spaces, linear dependence and independence of vectors . Dual spaces, Inner product and norm – orthogonalization process.</li> <li>• Linear transformations. Various operators on vector spaces</li> </ul> |   |          |   |   |   |    |         |       |          |               |
| UNIT  | Contents  |          |   |   |   |    |         |       |          | No. Of. Hours |
| <b>I</b>  | Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced -Echelon form.  |          |   |   |   |    |         |       |          | 12            |
| <b>II</b>   | Linear Dependence and Linear independence – Bases – Dimensions  |          |   |   |   |    |         |       |          | 12            |
| <b>III</b>  | Linear transformations, null spaces and ranges – Matrix representation of a linear transformation –invertibility and isomorphisms – dual spaces   |          |   |   |   |    |         |       |          | 12            |
| <b>IV</b>   | Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem   |          |   |   |   |    |         |       |          | 12            |
| <b>V</b>  | Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements  |          |   |   |   |    |         |       |          | 12            |
| <b>Recommended Text</b>   |   |          |   |   |   |    |         |       |          |               |
| <b>1</b>  | Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5 <sup>th</sup> edition (2018) Pearson  |          |   |   |   |    |         |       |          |               |
| <b>Reference Books</b>  |   |          |   |   |   |    |         |       |          |               |
|   | <ol style="list-style-type: none"> <li>1. I.N.Herstein, Topics in Algebra, Wiley EasternLtd. Second Edition, 2006.</li> <li>2. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd.</li> <li>3. John B.Fraleigh, First course in Algebra, Addison Wesley.</li> <li>4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.</li> <li>5. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.</li> <li>6. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.</li> </ol> |          |   |   |   |    |         |       |          |               |
| <b>Website and e-Learning Source</b>  |   |          |   |   |   |    |         |       |          |               |
| 1   | <a href="https://nptel.ac.in">https://nptel.ac.in</a>   |          |   |   |   |    |         |       |          |               |

### Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

**CLO 1:** Acquire a detailed knowledge about vector spaces and subspaces

**CLO 2:** Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis

**CLO 3:** Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces

**CLO 4:** Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation

**CLO5:** Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to

problems on inner product spaces

**Mapping with Programme Outcomes:**

| <b>CO/PSO</b>  | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> | <b>PSO 4</b> | <b>PSO 5</b> | <b>PSO 6</b> |
|--|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>CO 1</b>  | 3            | 3            | 3            | 3            | 3            | 3            |
| <b>CO 2</b>  | 3            | 2            | 3            | 3            | 3            | 3            |
| <b>CO 3</b>  | 3            | 3            | 2            | 3            | 3            | 3            |
| <b>CO 4</b>  | 3            | 3            | 3            | 3            | 3            | 3            |
| <b>CO 5</b>  | 3            | 3            | 3            | 3            | 3            | 3            |
| <b>Weightage of course<br/>contributed to each<br/>PSO</b> | 15           | 14           | 14           | 15           | 15           | 15           |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code | Subject Name                     | Category     | L | T | P | S | Credits | Marks |          |       |
|--------------|----------------------------------|--------------|---|---|---|---|---------|-------|----------|-------|
|              |                                  |              |   |   |   |   |         | CIA   | External | Total |
|              | <b>ARTIFICIAL NEURAL NETWORK</b> | <b>Elect</b> | 4 | - | - | - | 3       | 25    | 75       | 100   |

**Learning Objectives:**

The objective of this course is to teach the basics of artificial neural networks, learning process, single layer and multi-layer perceptron networks.

**Course Outcomes:**

**CO1:** Understand the basics of artificial neural networks and its architecture.

**CO2:** Understand the various learning algorithms and their applications.

**CO3:** Identify the appropriate neural network model to a particular application.

**CO4:** Apply the selected neural network model to a particular application.

**CO5:** Analyze the performance of the selected neural network.

| Units      | Contents   | Required Hours |
|------------|--|----------------|
| <b>I</b>   | Artificial Neural Model- Activation functions- Feed forward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem - Multilayer Networks. Learning Algorithms- Error correction - Gradient Descent Rules, Perceptron Learning Algorithm, Perceptron Convergence Theorem. | <b>12</b>      |
| <b>II</b>  | Introduction, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning, Boltzmann learning, credit assignment problem, Learning with and without teacher, learning tasks, Memory and Adaptation  | <b>12</b>      |
| <b>III</b> | Single layer Perception: Introduction, Pattern Recognition, Linear classifier, Simple perception, Perception learning algorithm, Modified Perception learning algorithm, Adaptive linear combiner, Continuous perception, learning in continuous perception, Limitation of Perception.                         | <b>12</b>      |
| <b>IV</b>  | Multi-Layer Perceptron Networks: Introduction, MLP with 2 hidden layers, Simple layer of a MLP, Delta learning rule of the output layer, Multilayer feed forward neural network with continuous perceptions, Generalized delta learning rule, Back propagation algorithm                                       | <b>12</b>      |
| <b>V</b>   | Deep learning- Introduction- Neuro architectures building blocks for the DL techniques, Deep Learning and Neo cognitron, Deep Convolutional Neural Networks, Recurrent Neural Networks (RNN), feature extraction, Deep Belief Networks, Restricted Boltzmann Machines, Training of DNN and Applications        | <b>12</b>      |



**Learning Resources:**

- **Recommended Texts**

1. Neural Networks A Classroom Approach- Satish Kumar, McGraw Hill- Second Edition.
2. “Neural Network- A Comprehensive Foundation”- Simon Haykins, Pearson Prentice Hall, 2nd Edition, 1999.

- **Reference Books**

1. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.

**Mapping with Programme Outcomes:**

| <b>CO/PSO</b>  | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> | <b>PSO 4</b> | <b>PSO 5</b> | <b>PSO 6</b> |
|--|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>CO 1</b>  | 3            | 3            | 3            | 2            | 3            | 2            |
| <b>CO 2</b>  | 3            | 2            | 3            | 2            | 3            | 3            |
| <b>CO 3</b>  | 3            | 3            | 2            | 2            | 3            | 3            |
| <b>CO 4</b>  | 2            | 3            | 3            | 3            | 2            | 3            |
| <b>CO 5</b>  | 3            | 2            | 3            | 3            | 3            | 3            |
| <b>Weightage of course<br/>contributed to each<br/>PSO</b> | 14           | 13           | 14           | 12           | 14           | 14           |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code               | Subject Name   | Category | L | T | P | S | Credits | Marks                        |                    |               |
|----------------------------|--|----------|---|---|---|---|---------|------------------------------|--------------------|---------------|
|                            |  |          |   |   |   |   |         | CIA                          | External           | Total         |
|                            | <b>ANALYTICS FOR SERVICE INDUSTRY</b>  | Elect    | 4 | - | - | - | 3       | 25                           | 75                 | 100           |
| <b>Learning Objectives</b> |  |          |   |   |   |   |         |                              |                    |               |
| <b>LO1</b>                 | Recognize challenges in dealing with data sets in service industry.  |          |   |   |   |   |         |                              |                    |               |
| <b>LO2</b>                 | Identify and apply appropriate algorithms for analyzing the healthcare, Human resource, hospitality and tourism data.  |          |   |   |   |   |         |                              |                    |               |
| <b>LO3</b>                 | Make choices for a model for new machine learning tasks.   |          |   |   |   |   |         |                              |                    |               |
| <b>LO4</b>                 | To identify employees with high attrition risk.  |          |   |   |   |   |         |                              |                    |               |
| <b>LO5</b>                 | To Prioritizing various talent management initiatives for your organization.   |          |   |   |   |   |         |                              |                    |               |
| UNIT                       | Contents   |          |   |   |   |   |         |                              |                    | No. Of. Hours |
| I                          | <b>Healthcare Analytics :</b> Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges-Phenotyping Algorithms. Biomedical Image Analysis and Signal Analysis- Genomic Data Analysis for Personalized Medicine. Review of Clinical Prediction Models. |          |   |   |   |   |         |                              |                    | 12            |
| II                         | <b>Healthcare Analytics Applications :</b> Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer- Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data. |          |   |   |   |   |         |                              |                    | 12            |
| III                        | <b>HR Analytics:</b> Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics, Evolution of HR Analytics; HR Metrics and HR Analytics; Intuition versus analytical thinking; HRMS/HRIS and data sources; Analytics frameworks like LAMP, HCM:21(r) Model.  |          |   |   |   |   |         |                              |                    | 12            |
| IV                         | <b>Performance Analysis:</b> Predicting employee performance, Training requirements, evaluating training and development, Optimizing selection and promotion decisions.  |          |   |   |   |   |         |                              |                    | 12            |
| V                          | <b>Tourism and Hospitality Analytics:</b> Guest Analytics – Loyalty Analytics – Customer Satisfaction – Dynamic Pricing – optimized disruption management – Fraud detection in payments.   |          |   |   |   |   |         |                              |                    | 12            |
| <b>TOTAL HOURS</b>         |  |          |   |   |   |   |         |                              | <b>60</b>          |               |
| Course Outcomes            |  |          |   |   |   |   |         |                              | Programme Outcomes |               |
| CO                         | On completion of this course, students will  |          |   |   |   |   |         |                              |                    |               |
| CO1                        | Understand and critically apply the concepts and methods of business analytics   |          |   |   |   |   |         | PO1, PO2, PO3, PO4, PO5, PO6 |                    |               |
| CO2                        | Identify, model and solve decision problems in different settings.   |          |   |   |   |   |         | PO1, PO2, PO3, PO4, PO5, PO6 |                    |               |

|                        |   |                              |
|------------------------|---|------------------------------|
| CO3                    | Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO4                    | Create viable solutions to decision making problems.  | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5                    | Instill a sense of ethical decision-making and a commitment to the long-run welfare of both organizations and the communities they serve.   | PO1, PO2, PO3, PO4, PO5, PO6 |
| <b>Textbooks</b>       |   |                              |
| 1                      | Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015.   |                              |
| 2                      | Edwards Martin R, Edwards Kirsten (2016), "Predictive HR Analytics: Mastering the HR Metric", Kogan Page Publishers, ISBN-0749473924  |                              |
| 3                      | Fitz-enzJac (2010), "The new HR analytics: predicting the economic value of your company's human capital investments", AMACOM, ISBN-13: 978-0-8144-1643-3   |                              |
| 4                      | RajendraSahu, Manoj Dash and Anil Kumar. Applying Predictive Analytics Within the Service Sector.   |                              |
| <b>Reference Books</b> |   |                              |
| 1.                     | Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016   |                              |
| 2.                     | Fitz-enzJac, Mattox II John (2014), "Predictive Analytics for Human Resources", Wiley, ISBN- 1118940709.  |                              |
| <b>Web Resources</b>   |   |                              |
| 1.                     | <a href="https://www.ukessays.com/essays/marketing/contemporary-issues-in-marketing-marketing-essay.php">https://www.ukessays.com/essays/marketing/contemporary-issues-in-marketing-marketing-essay.php</a> |                              |
| 2.                     | <a href="https://yourbusiness.azcentral.com/examples-contemporary-issues-marketing-field-26524.html">https://yourbusiness.azcentral.com/examples-contemporary-issues-marketing-field-26524.html</a>         |                              |

#### Mapping with Programme Outcomes:

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 2     | 3     | 3     | 3     | 3     | 3     |
| CO 3   | 3     | 3     | 2     | 3     | 3     | 2     |
| CO 4   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 5   | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 15    | 14    | 15    | 15    | 14    |

S-Strong-3 M-Medium-2 L-Low-1

| Subject Code | Subject Name                  | Category     | L | T | P | S | Credits | Marks |          |       |
|--------------|-------------------------------|--------------|---|---|---|---|---------|-------|----------|-------|
|              |                               |              |   |   |   |   |         | CIA   | External | Total |
|              | <b>COMPUTING INTELLIGENCE</b> | <b>Elect</b> | 4 | - | - | - | 3       | 25    | 75       | 100   |

**Learning Objectives:**

- To provide strong foundation on fundamental concepts in Computing Intelligence
- To apply basic principles of Artificial Intelligence and solutions that require problem solving, influence, perception, knowledge representation and learning

**Course Outcomes:**

**CO1:** Describe the fundamentals of artificial intelligence concepts and searching techniques.

**CO2:** Develop the fuzzy logic sets and membership function and defuzzification techniques.

**CO3:** Understand the concepts of Neural Network and analyze and apply the learning techniques

**CO4:** Understand the artificial neural networks and its applications

**CO5:** Understand the concept of Genetic Algorithm and Analyze the optimization problems using GAs.

| Units      | Contents  | Required Hours |
|------------|---|----------------|
| <b>I</b>   | Introduction to AI: Problem formulation – AI Applications – Problems – State Space and Search – Production Systems – Breadth First and Depth First – Travelling Salesman Problem – Heuristic search techniques: Generate and Test – Types of Hill Climbing.   | <b>12</b>      |
| <b>II</b>  | Fuzzy Logic Systems: Notion of fuzziness – Operations on fuzzy sets – T-norms and other aggregation operators – Basics of Approximate Reasoning – Compositional Rule of Inference – Fuzzy Rule Based Systems – Schemes of Fuzzification – Inferencing – Defuzzification – Fuzzy Clustering – fuzzy rule-based classifier.   | <b>12</b>      |
| <b>III</b> | Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptions, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Back propagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications. | <b>12</b>      |
| <b>IV</b>  | <b>Artificial Neural Networks:</b> Fundamental Concepts – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron – Linear Separability – Hebb Network.   | <b>12</b>      |
| <b>V</b>   | <b>Genetic Algorithm:</b> Introduction – Biological Background – Genetic Algorithm Vs Traditional Algorithm – Basic Terminologies in Genetic Algorithm – Simple GA – General Genetic Algorithm – Operators in Genetic Algorithm.  | <b>12</b>      |

**Learning Resources:****Recommended Texts**

1. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", 2<sup>nd</sup> Edition, Wiley India Pvt. Ltd.
2. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 2<sup>nd</sup> Edition, Pearson Education in Asia.
3. S. Rajasekaran, G. A. Vijayalakshmi, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications", PHI.

**Reference Books**

1. F. Martin, Mc neill, and Ellen Thro, "Fuzzy Logic: A Practical approach", AP Professional, 2000. Chin Teng Lin, C. S. George Lee," Neuro-Fuzzy Systems", PHI.
2. Chin Teng Lin, C. S. George Lee," Neuro-Fuzzy Systems", PHI.

**Mapping with Programme Outcomes:**

| CO/PSO                                      | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|-------|-------|-------|-------|-------|-------|
| CO 1  | 3     | 3     | 3     | 2     | 3     | 2     |
| CO 2  | 3     | 2     | 3     | 2     | 3     | 3     |
| CO 3  | 3     | 3     | 3     | 2     | 3     | 3     |
| CO 4  | 3     | 3     | 3     | 3     | 2     | 3     |
| CO 5  | 3     | 3     | 3     | 2     | 3     | 3     |
| Weightage of course contributed to each PSO | 15    | 14    | 15    | 11    | 14    | 14    |

S-Strong-3 M-Medium-2 L-Low-1

| Subject Code            | Subject Name   | Category | L | T | P | S | Credits      | Inst. Hours | Marks |          |       |
|-------------------------|--|----------|---|---|---|---|--------------|-------------|-------|----------|-------|
|                         |  |          |   |   |   |   |              |             | CIA   | External | Total |
| CC16                    | Data Analytics using R Programming   | Elective | 5 | - | - | - | 3            | 5           | 25    | 75       | 100   |
| <b>Course Objective</b> |  |          |   |   |   |   |              |             |       |          |       |
| C1                      | To understand the problem solving approaches   |          |   |   |   |   |              |             |       |          |       |
| C2                      | To learn the basic programming constructs in R Programming   |          |   |   |   |   |              |             |       |          |       |
| C3                      | To learn the basic programming constructs in R Programming   |          |   |   |   |   |              |             |       |          |       |
| C4                      | To use R Programming data structures - lists, tuples, and dictionaries.  |          |   |   |   |   |              |             |       |          |       |
| C5                      | To do input/output with files in R Programming.  |          |   |   |   |   |              |             |       |          |       |
| UNIT                    | Contents   |          |   |   |   |   | No. of Hours |             |       |          |       |
| I                       | Evolution of Big data — Best Practices for Big data Analytics — Big data characteristics — Validating — The Promotion of the Value of Big Data — Big Data Use Cases- Characteristics of Big Data Applications — Perception and Quantification of Value -Understanding Big Data Storage — A General Overview of High-Performance Architecture — HDFS — MapReduce and YARN — Map Reduce Programming Model  |          |   |   |   |   | 15           |             |       |          |       |
| II                      | CONTROL STRUCTURES AND VECTORS -Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations |          |   |   |   |   | 15           |             |       |          |       |
| III                     | LISTS- Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations  |          |   |   |   |   | 15           |             |       |          |       |

|                        |  |                           |
|------------------------|--|---------------------------|
| IV                     | FACTORS AND TABLES - Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions R PROGRAMMING . | 15                        |
| V                      | OBJECT-ORIENTED PROGRAMMING S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation   | 15                        |
| <b>Total</b>           |  | <b>75</b>                 |
| <b>Course Outcomes</b> |  | <b>Programme Outcomes</b> |
| CO                     | On completion of this course, students will  |                           |
| 1                      | Work with big data tools and its analysis techniques.  | PO1                       |
| 2                      | Analyze data by utilizing clustering and classification algorithms.  | PO1, PO3                  |
| 3                      | Learn and apply different mining algorithms and recommendation systems for large volumes of data.  | PO2, PO6                  |
| 4                      | Perform analytics on data streams.   | PO4, PO5, PO6             |
| 5                      | Learn NoSQL databases and management.  | PO5, PO6                  |
| <b>Text Book</b>       |  |                           |
| 1                      | Roger D. Peng,” R Programming for Data Science “, 2012   |                           |
| 2                      | Norman Matloff,”The Art of R Programming- A Tour of Statistical Software Design”, 2011   |                           |
| <b>Reference Books</b> |  |                           |
| 1.                     | Garrett Golemund, Hadley Wickham,”Hands-On Programming with R: Write Your Own Functions and Simulations” , 1st Edition, 2014   |                           |
| 2.                     | Venables ,W.N.,andRipley,”S programming“, Springer, 2000.  |                           |
| <b>Web Resources</b>   |  |                           |
| 1.                     | <a href="https://www.simplilearn.com">https://www.simplilearn.com</a>  |                           |

**Mapping with Programme Outcomes:**

|        |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|
| CO/PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--------|-------|-------|-------|-------|-------|-------|

|   |    |    |    |    |    |    |
|---|----|----|----|----|----|----|
| CO1   | 3  | 3  | 3  | 3  | 3  | 3  |
| CO2   | 3  | 3  | 2  | 3  | 2  | 2  |
| CO3   | 3  | 2  | 3  | 3  | 3  | 2  |
| CO4   | 3  | 2  | 3  | 2  | 3  | 3  |
| CO5   | 2  | 3  | 3  | 3  | 3  | 3  |
| Weightageof<br>coursecontributed<br>toeach<br>PSO | 14 | 13 | 14 | 14 | 14 | 13 |

**S-Strong-3 M-Medium-2 L-Low-1**



| Subject Code               | Subject Name  | Category     | L | T | P | S | Credits | Marks                     |                              |       |  |
|----------------------------|---|--------------|---|---|---|---|---------|---------------------------|------------------------------|-------|--|
|                            |   |              |   |   |   |   |         | CIA                       | External                     | Total |  |
|                            | <b>NATURAL LANGUAGE PROCESSING</b>  | <b>Elect</b> | 4 | - | - | - | 3       | 25                        | 75                           | 100   |  |
| <b>Learning Objectives</b> |   |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO1</b>                 | To understand approaches to syntax and semantics in NLP.  |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO2</b>                 | To learn natural language processing and to learn how to apply basic algorithms in this field.  |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO3</b>                 | To understand approaches to discourse, generation, dialogue and summarization within NLP.   |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO4</b>                 | To get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, pragmatics etc.  |              |   |   |   |   |         |                           |                              |       |  |
| <b>LO5</b>                 | To understand current methods for statistical approaches to machine translation.  |              |   |   |   |   |         |                           |                              |       |  |
| <b>UNIT</b>                | <b>Contents</b>   |              |   |   |   |   |         |                           | <b>No. Of. Hours</b>         |       |  |
| I                          | <b>Introduction :</b> Natural Language Processing tasks in syntax, semantics, and pragmatics – Issue- Applications – The role of machine learning – Probability Basics –Information theory – Collocations -N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.       |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| II                         | <b>Word level and Syntactic Analysis:</b> Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing. |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| III                        | <b>Semantic analysis and Discourse Processing:</b> Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.  |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| IV                         | <b>Natural Language Generation:</b> Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation. Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.                |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| V                          | <b>Information retrieval and lexical resources:</b> Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame Net Stemmers- POS Tagger- Research Corpora SSAS.            |              |   |   |   |   |         |                           | <b>12</b>                    |       |  |
| <b>Course Outcomes</b>     |   |              |   |   |   |   |         | <b>Programme Outcomes</b> |                              |       |  |
| CO                         | On completion of this course, students will   |              |   |   |   |   |         |                           |                              |       |  |
| CO1                        | Describe the fundamental concepts and techniques of natural language processing.<br>Explain the advantages and disadvantages of different NLP technologies and their applicability in different business situations.  |              |   |   |   |   |         |                           | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |
| CO2                        | Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each<br>Use NLP technologies to explore and gain a broad understanding  |              |   |   |   |   |         |                           | PO1, PO2, PO3, PO4, PO5, PO6 |       |  |

|                        |  |                                 |
|------------------------|--|---------------------------------|
|                        | of text data.  |                                 |
| CO3                    | Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.<br>Use NLP methods to analyse sentiment of a text document.  | PO1, PO2, PO3,<br>PO4, PO5, PO6 |
| CO4                    | Analyze large volume text data generated from a range of real-world applications.<br>Use NLP methods to perform topic modelling.   | PO1, PO2, PO3,<br>PO4, PO5, PO6 |
| CO5                    | Develop robotic process automation to manage business processes and to increase and monitor their efficiency and effectiveness.<br>Determine the framework in which artificial intelligence and the Internet of things may function, including interactions with people, enterprise functions, and environments. | PO1, PO2, PO3,<br>PO4, PO5, PO6 |
| <b>Textbooks</b>       |  |                                 |
| 1                      | Daniel Jurafsky, James H. Martin, “Speech & language processing”, Pearson publications.  |                                 |
| 2                      | Allen, James. Natural language understanding. Pearson, 1995.   |                                 |
| <b>Reference Books</b> |  |                                 |
| 1.                     | Pierre M. Nugues, “An Introduction to Language Processing with Perl and Prolog”, Springer  |                                 |
| <b>Web Resources</b>   |  |                                 |
| 1.                     | <a href="https://en.wikipedia.org/wiki/Natural_language_processing">https://en.wikipedia.org/wiki/Natural_language_processing</a>  |                                 |
| 2.                     | <a href="https://www.techtarget.com/searchenterpriseai/definition/natural-language-processing-NLP">https://www.techtarget.com/searchenterpriseai/definition/natural-language-processing-NLP</a>  |                                 |

#### Mapping with Programme Outcomes:

| CO/PSO   | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|--|-------|-------|-------|-------|-------|-------|
| CO 1   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 2   | 2     | 3     | 3     | 3     | 2     | 3     |
| CO 3   | 3     | 3     | 3     | 3     | 3     | 3     |
| CO 4   | 3     | 2     | 3     | 3     | 2     | 3     |
| CO 5   | 3     | 3     | 3     | 3     | 3     | 3     |
| <b>Weightage of course contributed to each PSO</b> | 14    | 14    | 15    | 15    | 13    | 15    |

**S-Strong-3 M-Medium-2 L-Low-1**

| Subject Code | Subject Name           | Category    | L | T | P | S | Credits | Marks |          |       |
|--------------|------------------------|-------------|---|---|---|---|---------|-------|----------|-------|
|              |                        |             |   |   |   |   |         | CIA   | External | Total |
|              | <b>CYBER FORENSICS</b> | <b>SEC8</b> | 2 | - | - | - | 2       | 25    | 75       | 100   |

**Learning Objectives:**

- To correctly define and cite appropriate instances for the application of computer forensics.
- To Correctly collect and analyze computer forensic evidence and data seizure. Identify the essential and up-to-date concepts, algorithms, protocols, tools, and methodology of Computer Forensics.

**Course Outcomes:**

**CO1:** Understand the definition of computer forensics fundamentals.

**CO2:** Evaluate the different types of computer forensics technology.

**CO3:** Analyze various computer forensics systems.

**CO4:** Apply the methods for data recovery, evidence collection and data seizure.

**CO5:** Gain your knowledge of duplication and preservation of digital evidence.

| Units      | Contents   | Required Hours |
|------------|--|----------------|
| <b>I</b>   | <b>Overview of Computer Forensics Technology:</b> Computer Forensics Fundamentals: What is Computer Forensics Use of Computer Forensics in Law Enforcement, Computer Forensics Services,. Types of Computer Forensics Technology: Types of Business Computer Forensic, Technology–Types of Military Computer Forensic Technology–Types of Law Enforcement–Computer Forensic. | <b>6</b>       |
| <b>II</b>  | <b>Computer Forensics Evidence and capture:</b> Data Recovery: Data Recovery Defined, Data Back–up and Recovery, The Role of Back –up in Data Recovery, The Data –Recovery Solution. Evidence Collection and Data Seizure: Collection Options, Obstacles, Types of Evidence.   | <b>6</b>       |
| <b>III</b> | <b>Duplication and Preservation of Digital Evidence:</b> Processing steps, Legal Aspects of collecting and Preserving Computer forensic Evidence. Computer image Verification and Authentication: Special needs of Evidential Authentication.  | <b>6</b>       |
| <b>IV</b>  | <b>Computer Forensics Analysis:</b> Discovery of Electronic Evidence: Electronic Document Discovery: A Powerful New Litigation Tool. Identification of Data: Time Travel, Forensic Identification and Analysis of Technical  | <b>6</b>       |
| <b>V</b>   | <b>Reconstructing Past Events:</b> How to Become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files. Networks: Network Forensics Scenario, a technical approach, Destruction of E–Mail, Damaging Computer Evidence.  | <b>6</b>       |

**Learning Resources:****Recommended Texts**

1. John R. Vacca, "Computer Forensics: Computer Crime Investigation", 3/E, Firewall Media, New Delhi, 2002.

**Reference Books**

1. Nelson, Phillips Enfinger, Steuart, "Computer Forensics and Investigations" Enfinger, Steuart, CENGAGE Learning, 2004.
2. Anthony Sammes and Brian Jenkinson, "Forensic Computing: A Practitioner's Guide", Second Edition, Springer-Verlag London Limited, 2007.
3. Robert M. Slade, "Software Forensics Collecting Evidence from the Scene of a Digital Crime", TMH 2005.

**MAPPING TABLE**

| <b>CO/PSO</b>                               | <b>PSO1</b> | <b>PSO2</b> | <b>PSO3</b> | <b>PSO4</b> | <b>PSO5</b> | <b>PSO6</b> |
|---|-------------|-------------|-------------|-------------|-------------|-------------|
| CO1   | 3           | 3           | 3           | 2           | 2           | 2           |
| CO2   | 2           | 3           | 3           | 3           | 3           | 2           |
| CO3   | 3           | 2           | 3           | 3           | 3           | 3           |
| CO4   | 3           | 2           | 2           | 3           | 3           | 3           |
| CO5   | 3           | 3           | 3           | 3           | 3           | 3           |
| Weightage of course contributed to each PSO | 14          | 13          | 14          | 14          | 14          | 13          |