## 

**M.Sc., Artificial Intelligence**

Syllabus

UNIVERSITY DEPARTMENT

**Program Code: CSER**

**2025 – 2026 onwards**



**BHARATHIAR UNIVERSITY**

**(A State University, Accredited with “A++” Grade by NAAC,**

**Ranked 21st among Indian Universities by MHRD-NIRF)**

**Coimbatore - 641 046, Tamil Nadu, India**

**BHARATHIAR UNIVERSITY :: COIMBATORE - 641046**

**DEPARTMENT OF COMPUTER SCIENCE**

**(Effective from the academic Year 2025-2026)**

**MISSION**

* Creating and disseminating world-class knowledge in the global context
* Equip students with knowledge of up-to-date technological developments to take part in the global software industry
* Promote state of art interdisciplinary research in computer science
* Imbibe entrepreneurial culture through curriculum, pedagogy, research, and mentoring

**1. Eligibility for Admission to the Programme**

Candidates for admission to the first-year programme leading to the Degree of Master of Science in Artificial Intelligence (M.Sc., AI) will be required to possess:

A pass in B.Sc. Computer Science/ Information Technology/ Computer Applications or its equivalents.

**2. Duration of the Programme**

The programme shall be offered on a full-time basis. The programme will consist of three semesters of coursework and laboratory work and the fourth semester consists of project work.

**3. Regulations**

The general Regulations of the Bharathiar University Choice-Based Credit System Programme apply to this programme.

**4. The Medium of Instruction and Examinations**

The medium of instruction and Examinations shall be in English.

**5. Submission of Record Notebooks for Practical Examinations & Project Viva-Voce**

Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Examinations. Otherwise, the candidates will not be permitted to take the Practical Examinations.

Candidates taking the Project Viva Examination should submit the Project Report prescribed for the Examinations. Otherwise, the candidates will not be permitted to take the Project Viva-voce Examination.

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| **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)** | |
| **The M.Sc. Artificial Intelligence programme describes accomplishments that graduates are expected to attain within five to seven years after graduation** | |
| **PEO1** | Graduates will have developed advanced technical expertise in artificial intelligence, machine learning, and data science. |
| **PEO2** | Graduates will demonstrate leadership and innovation in their professional roles, driving advancements in AI technologies and applications. |
| **PEO3** | Graduates will engage in continuous professional development and lifelong learning, staying current with the latest trends, technologies, and research in artificial intelligence. |
| **PEO4** | Graduates will exhibit ethical and social responsibility in their professional practices, understanding the societal impacts of AI technologies. |
| **PEO5** | Graduates will effectively collaborate and communicate with professionals from diverse disciplines, leveraging their AI expertise to solve complex problems. |

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| **PROGRAMME SPECIFIC OUTCOMES (PSOs)** | |
| **After the successful completion of M.Sc. Artificial Intelligence programme, the students are expected to** | |
| **PSO1** | Students will be able to apply fundamental and advanced AI techniques to develop innovative solutions for real-world problems across various domains. |
| **PSO2** | Students will demonstrate proficiency in using state-of-the-art AI tools, frameworks, and programming languages to design, implement, and optimize AI models and systems. |
| **PSO3** | Students will be equipped to conduct independent research, contributing to the advancement of the AI field by developing novel algorithms and methodologies. |
| **PSO4** | Students will understand and incorporate ethical considerations in the development and deployment of AI systems |
| **PSO5** | Students will be adept at collaborating with professionals from various disciplines to address complex challenges and provide inventive solutions |

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| **PROGRAMME OUTCOMES (POs)** | |
| On successful completion of the **M.Sc. Artificial Intelligence programme** | |
| **PO1** | Demonstrate comprehensive knowledge of artificial intelligence theories, principles, and techniques, and their applications in solving complex problems. |
| **PO2** | Exhibit technical proficiency in using AI tools, frameworks, and programming languages to develop and implement AI solutions. |
| **PO3** | Apply critical thinking and problem-solving skills to analyze, design, and optimize AI models and systems for various applications.. |
| **PO4** | Conduct independent research in AI, contributing to the body of knowledge with innovative findings. |
| **PO5** | Understand and apply ethical principles in the development and deployment of AI technologies. |
| **PO6** | Collaborate effectively with professionals from diverse fields to integrate AI solutions in multidisciplinary projects and initiatives. |
| **PO7** | Demonstrate strong communication skills, both written and verbal, to convey complex AI concepts and findings to technical and non-technical audiences. |
| **PO8** | Engage in lifelong learning and professional development to stay current with advancements in AI and related fields. |
| **PO9** | Manage AI projects effectively, utilizing project management principles to ensure successful project planning, execution, and delivery. |
| **PO10** | Exhibit innovation and entrepreneurial skills to identify opportunities for AI applications and create new AI-based products or services. |

**BHARATHIAR UNIVERSITY :: COIMBATORE 641 046**

**M.Sc. Artificial Intelligence Curriculum (University Department)**

*(For the students admitted during the academic year 2025– 2026 onwards)*

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| **Course Code** | **Title of the Course** | **Credits** | **Hours** | | **Maximum Marks** | | |
| **Theory** | **Practical** | **CIA** | **ESE** | **Total** |
| **First Semester** | | | | | | | |
| 25AI1C1 | Advanced Data Structures and Algorithms | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI1C2 | Foundations in Statistics & Mathematics for AI | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI1C3 | Foundations of AI | 4 | 4 | - | 25 | 75 | 100 |
| 25AI1C4 | Machine Learning and its Applications | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI1C5 | Foundations of Data Science | 4 | 4 | - | 25 | 75 | 100 |
| 25AI1EX | Elective I | 4 | 4 | - | 25 | 75 | 100 |
| 1GS | General Supportive - I | 2 | 2 | - | 12 | 38 | 50 |
| PDC | Industry Literacy | 1 | - | - | 25 | - | 25 |
| 25AI1JOC1 | Job-Oriented Course | 2 | - | - | - | - | 50 |
| **Total** | | **29** |  |  |  |  | **725** |
| **Second Semester** | | | | | | | |
| 25AI2C1 | Computational Intelligence | 4 | 4 | - | 25 | 75 | 100 |
| 25AI2C2 | Deep Learning Techniques | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI2C3 | Data Engineering | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI2C4 | Probabilistic Graphical Model | 4 | 4 | - | 25 | 75 | 100 |
| 25AI2C5 | Cloud and Big Data Analytics | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI2EX | Elective II | 4 | 4 | - | 25 | 75 | 100 |
| 25AI2MP | Mini Project - I | 2 | - | - | 50 | - | 50 |
| 2GS | General Supportive - II | 2 | 2 | - | 12 | 38 | 50 |
| 25AI2VAC1 | Value Added Course | 2 | - | - | - | - | 50 |
| **Total** | | **30** |  |  |  |  | **750** |
| **Third Semester** | | | | | | | |
| 25AI3C1 | Introduction to Speech Processing | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI3C2 | Natural Language Processing | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI3C3 | Reinforcement Learning | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI3C4 | Multi-Agent Systems | 4 | 2 | 4 | 25 | 75 | 100 |
| 25AI3EX | Elective III | 4 | 4 | - | 25 | 75 | 100 |
| 25AI3MP | Mini Project - II | 4 | - | - | 25 | 75 | 100 |
| 3GS | General Supportive - III | 2 | 2 | - | 12 | 38 | 50 |
| PDC | Research Review Analysis | 1 | - | - | 25 | - | 25 |
| General | Value Added Course(Health & Wellness) | 2 | - | - | - | - | 50 |
| **Total** | | **29** |  |  |  |  | **725** |
| **Fourth Semester** | | | | | | | |
| 25AI4PW | Project work | 12 | - | - | 180 | 120 | 300 |
| **Total** | | **12** |  |  |  |  | **300** |
| **Grand Total** | | **100** |  |  |  |  | **2500** |

**Note: Students must mandatorily publish or present their Research Review Analysis work in an international journal/conference before attending the viva-voce**

**Online Course**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | SWAYAM – MOOC Course\* | 2 |  |  |  |  |  |

\*Swayam – Mooc online course shall be for at least 4 weeks with at least 2 credits.

The course shall be mandatory and shall be completed within the third semester (i.e., before the beginning of the fourth semester)

**Elective Papers**

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| --- | --- | --- | --- | --- |
| **Sem** | **Elective** | **Suggested Code** | **Title of the Paper** | **No. of Credits** |
| I | Elective – I | 25AI1E1 | Representation Learning | 4 |
| 25AI1E2 | Data Visualization | 4 |
| 25AI1E3 | AI in IoT | 4 |
| II | Elective – II | 25AI2E1 | AI for Robotics | 4 |
| 25AI2E2 | AI in Healthcare | 4 |
| 25AI2E3 | Machine Learning for Big Data | 4 |
| III | Elective – III | 25AI3E1 | Computer Vision | 4 |
| 25AI3E2 | Quantum AI | 4 |
| 25AI3E3 | Applied Prediction Analytics | 4 |

**List of Job-Oriented Courses**

1. Data Analysis using Excel

2. Power BI for Data Analytics

3. Mobile Application Development

4. Smart Applications with the Internet of Things

5. DevOps

**List of Value-Added Courses**

1. Software Testing Tools

2. Cyber Security and Digital Forensics

3. Remote Sensing and GIS

4. Digital Marketing

SEMESTER - I

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| **Course Code** | | | | | **25AI1C1** | **ADVANCED DATA STRUCTURES AND ALGORITHMS** | | **L** | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **CORE** | | **2** | | | **0** | **4** | **4** |
| **Pre-requisite** | | | | | | **BASIC DATA STRUCTURES AND FUNDAMENTALS ALGORITHMS** | | **Syllabus**  **Version** | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | | |
| * This course builds upon the fundamental data structures and algorithms. * Its goal is to empower students to design data structures and algorithms to solve intricate problems, especially within the AI domain * The primary focus will be on concrete implementations of diverse data structures and their application in sophisticated algorithms with thorough analysis. | | | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | | | |
| 1 | | 1. Provide an insight into Data structures and algorithms in real-life domain scenarios. | | | | | | | | | K2/K3 | | |
| 2 | | Solve complex problems by applying appropriate Data structures and algorithms | | | | | | | | | K1/K3 | | |
| 3 | | Critically analyse the complexity of various algorithms and provide an understanding of efficiency and performance characteristics | | | | | | | | | K2/K5 | | |
| 4 | | To select suitable design strategies to solve real-world problems within the AI domain | | | | | | | | | K6 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | |
| **Unit 1** | | | | **Algorithm Analysis and Number Theory Fundamentals** | | | | | **9 hours** | | | | |
| Algorithm Analysis - Methodologies for Analysing Algorithms, Asymptotic growth rates, Amortized Analysis. Number Theory: Preliminaries, FLT, Euclid’s algorithm (extended), Totient function, Sieve for primes, Modular exponentiation  Sieve for primes, Modular exponentiation | | | | | | | | | | | | | |
| **Unit 2** | | | | **Advanced Algorithms and Problem-Solving Techniques** | | | | | **12 hours** | | | | |
| Graph terminology and representation Applications of graph algorithms: Topological sort, connected components, Bi-connected Components, Bridges, Articulation points, All Pairs Shortest Paths, Single Source Shortest Paths. Applications of Divide-and-Conquer | | | | | | | | | | | | | |
| **Unit 3** | | | | **Advanced Algorithmic Techniques** | | | | | | **11 hours** | | | |
| Greedy and Dynamic programming techniques - Knapsack, Median finding, Scheduling algorithms, Party planning, bitonic TSP. String matching algorithms: the Boyer- Moore, KMP algorithm, Hash-based lexicon matching | | | | | | | | | | | | | |
| **Unit 4** | | | | **Advanced-Data Structures & Network Flow Algorithms** | | | | | | **12 hours** | | | |
| Universal hashing, consistent hashing, load balancing, power of two choices, B-trees, Suffix trees, Segment trees, Flow Networks: Ford-Fulkerson algorithm, Edmonds Karp algorithm | | | | | | | | | | | | | |
| **Unit 5** | | | | **NP-Completeness and Approximation Algorithms** | | | | | | **14 hours** | | | |
| Applications of maximum flows - Maximum bipartite matching, minimum cost matching, NP-Completeness: Important NP-Complete Problems, Polynomial-time reductions, Approximation algorithms. | | | | | | | | | | | | | |
|  | | | **Total Lecture hours** | | | | **58 hours** | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | |
| 1 | Cormen T H, Leiserson CE, Rivest R L, and Stein C,” Introduction to Algorithms”, Prentice-Hall of India Private Limited. Third Edition 2009. | | | | | | | | | | | | |
| 2 | Michael T Goodrich and Roberto Tamassia,” Algorithm Design and Applications”, Wiley, - first edition 2014 | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | |
| 1 | Rajeev Motwani and Prabhakar Raghavan, ”Randomized Algorithms”, Cambridge University Press- First edition, 1995. | | | | | | | | | | | | |
| 2 | Vijay V. Vazirani,” Approximation Algorithm”, Springer Science and Business Media – Second edition 2003 | | | | | | | | | | | | |
| Course Designed by: **Dr. D. RAMYACHITRA** | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | L | L | L | M | M | M | L | M |
| **CO2** | L | S | S | L | M | L | L | L | M | M |
| **CO3** | L | L | S | M | M | L | L | M | M | L |
| **CO4** | S | M | M | M | L | M | L | M | M | S |

\*S-Strong; M-Medium; L-Low

**Advanced Data Structures and Algorithms – LAB**

**List of Programs**

1. Generation of Graph
2. Topological Sorting
3. All Pairs Shortest Path
4. Single Source Shortest Path
5. Implementation of Knapsack problem
6. Travelling Salesman Problem
7. B Tree
8. Ford Fulkerson Algorithm
9. KMP algorithm for pattern matching

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| **Course Code** | | **25AI1C2** | **FOUNDATIONS IN STATISTICS AND MATHEMATICS FOR AI** | | **L** | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | **CORE** | | **3** | **1** | **0** | **4** | |
| **Pre-Requisite** | | | | **Mathematics and Statistics** | | **Syllabus Version** | | **2025- 2026** | | |
| **Course Objective:** | | | | | | | | | | | |
| The main objectives of this course are:   * To express various matrix techniques and illustrate the matrix's nature. * To gather the techniques in matrix algebra and the concepts of basis and dimension in vector spaces. * To discuss general inner product spaces with associated norms and matrix decompositions. * To provide knowledge of different distributions * To explore the parameter estimation | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | |
| On the successful completion of the course, students will able to: | | | | | | | | | | | |
| 1 | Demonstrate the matrix techniques in solving problems. | | | | | | | K1/K2 | | | |
| 2 | Apply the concepts of basis and dimension in vector spaces. | | | | | | | K2/K4 | | | |
| 3 | Interpret the inner product spaces. | | | | | | | K2/K4 | | | |
| 4 | Perform different kinds of statistical distributions | | | | | | | K2/K4 | | | |
| 5 | Understand the concepts of parameter estimation and the relevant problems | | | | | | | K2/K3/K6 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit: 1** | **MATRICES AND QUADRATIC FORMS** | | | | | | | **12 Hours** | | | |
| Matrices: Types - Symmetric and Skew – symmetric matrices, Hermitian matrix, Unitary matrix and Orthogonal matrices – Rank, Inverse, and Trace of a matrix - Eigenvalues and eigenvectors- Diagonalization of matrices using orthogonal transformation - Quadratic forms - Reduction to canonical form using orthogonal transformation | | | | | | | | | | | |
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| **Unit: 2** | **VECTOR SPACES** | | | | | | | **12 Hours** | | | |
| Vector spaces – Subspaces – Linear combinations and system of Linear equations – Linear independence and Linear dependence – Bases and Dimensions – Linear Transformation – Matrix representation of Linear Transformation - Null space, Range space, and dimension theorem (without proof). | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit: 3** | **INNER PRODUCT SPACES** | | | | | | | **12 Hours** | | | |
| Inner product and norms – Gram-Schmidt orthonormalization process - QR Factorization-Singular value decomposition -Principal component analysis. | | | | | | | | | | | |
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| **Unit: 4** | **PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE** | | | | | | | **11 Hours** | | | |
| Probability – Probability and Conditional Probability-Addition and Multiplication Theorems – Baye’s Theorem and its applications– Random variables – Expectation and Variance – Covariance – Discrete and Continuous Distributions- Binomial, and Poisson distributions, Uniform, Normal and Rayleigh distributions- Moment-generating and characteristic functions and their Applications -– Central Limit Theorems(Statement only) | | | | | | | | | | | |
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| **Unit: 5** | **PARAMETER ESTIMATION and TESTING OF HYPOTHESIS** | | | | | | | **11 Hours** | | | |
| Elements of estimation theory: Point and interval estimation- Properties of a good estimator-Various methods of estimation- Basic concepts of testing of hypothesis – Large sample tests. | | | | | | | | | | | |
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| **Unit: 6** | **CONTEMPORARY ISSUES** | | | | | | | **2 Hours** | | | |
| Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops | | | | | | | | | | | |
| **Total Lectures** | | | | | | | | **60 Hours** | | | |
| **Text Books** | | | | | | | | | | | |
| 1 | T Veerarajan , Linear Algebra, and Partial Differential Equations, Mc Graw Hill Education,2019. | | | | | | | | | | |
| 2 | T Veerarajan, Engineering Mathematics –I , Mc Graw Hill Education, 2018 | | | | | | | | | | |
| 3 | David Forsyth, “Probability and Statistics for Computer Science”, Springer international publishing, 2018 | | | | | | | | | | |
| 4 | Ernest Davis, “Linear Algebra and Probability for Computer Science Applications”, CRC Press, 2012 | | | | | | | | | | |
| 5 | Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014. | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | |
| 1 | Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt.Ltd, New Delhi, 2016. | | | | | | | | | | |
| 2 | Friedberg, A.H., Insel, A.J. and Spence, L., ―Linear Algebra‖, Prentice - Hall of India, New Delhi, 2004. | | | | | | | | | | |
| 3 | Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016. | | | | | | | | | | |
| 4 | Douglas C. Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers”, Seventh Edition, John Wiley & Sons Inc., 2018. | | | | | | | | | | |
| 5 | Ronald E. Walpole, Raymond H Myres, Sharon.L. Myres and Kying Ye, “Probability and Statistics for Engineers and Scientists”, Ninth Edition, Pearson Education, 2021. | | | | | | | | | | |
| 6 | A. Papoulis and UnnikrishnaPillai, “Probability, Random Variables and Stochastic Processes”, Fourth Edition, McGraw Hill, 2019. | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | |
| 1 | https://www.udemy.com/course/mathematical-foundation-for-machine-learning-and-ai/ | | | | | | | | | | |
| 2 | <https://www.coursera.org/learn/machine-learning-probability-and-statistics> | | | | | | | | | | |
| 3 | <https://www.coursera.org/learn/math-for-ai-beginner-part-1-linear-algebra> | | | | | | | | | | |
| **Course Designed by:** | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | M | L | S | L | M | M | M |
| **CO2** | M | S | S | M | L | M | L | S | S | S |
| **CO3** | S | S | S | S | M | M | L | S | S | S |
| **CO4** | S | S | S | S | M | M | L | M | S | M |
| **CO5** | S | M | M | S | M | M | L | M | S | S |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | **25AI1C3** | **FOUNDATION OF AI** | | | **L** | | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **CORE** | | | **4** | | | | **0** | **0** | **4** |
| **Pre-requisite** | | | | |  | | | **Syllabus Version** | | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | | | | |
| The main objectives of this course are:   * To understand the basic principles of Artificial Intelligence. * To learn and design intelligent agents. * To understand the basic areas of artificial intelligence including problem-solving, knowledge representation, reasoning, and expert systems. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | | | | | |
| 1 | | | Apply basic principles of AI for inference, perception, problem-solving, and knowledge representation. | | | | | | | | K2 | | | | |
| 2 | | | Design and develop systems that process data automatically using AI framework and patterns. | | | | | | | | K2/K4 | | | | |
| 3 | | | Apply real-life problems in a state space representation to solve using state space representation. | | | | | | | | K4/K5 | | | | |
| 4 | | | Formulate valid solutions for the problems involved. | | | | | | | | K4 | | | | |
| 5 | | | Understand the fundamental principles of expert systems, and their applications and understand the other methods of programming. | | | | | | | | K1 /K2 | | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create | | | | | | | | | | | | | | | |
| **Unit:1** | | | |  | | | | | | **10 hours** | | | | | |
| AI problems, the foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. | | | | | | | | | | | | | | | |
| **Unit:2** | | | |  | | | | | **12 hours** | | | | | | |
| Searching- Searching for solutions, uniformed search strategies – Breadth-first search, depth-first Search. Search with partial information (Heuristic search) Hill climbing, A\*, AO\* Algorithms, Problem reduction, Game Playing - Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions. | | | | | | | | | | | | | | | |
| **Unit:3** | | | |  | | | **15 hours** | | | | | | | | |
| Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Baye’s probabilistic interferences and dempstershafer theory. | | | | | | | | | | | | | | | |
| **Unit:4** | | | |  | | | **11 hours** | | | | | | | | |
| First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning. | | | | | | | | | | | | | | | |
| **Unit:5** | | | |  | | **10 hours** | | | | | | | | | |
| Expert Systems: Introduction – Advantages – General concepts – Characteristics – Development of experts system technology – Expert system application and domains – Elements of expert systems – Production Systems – Procedural paradigms – Non procedural paradigms. | | | | | | | | | | | | | | | |
| **Unit:6** | | | |  | | **2 hours** | | | | | | | | | |
| Discussion on case study - Expert lectures - Online seminars – Webinars - Workshops | | | | | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | **60 hours** | | | | | | | | | |
| **Text Books** | | | | | | | | | | | | | | | |
| 1 | S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Prentice Hall, 2022. | | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | | |
| 1 | J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers,1998. | | | | | | | | | | | | | | |
| 2 | David Poole, Alan Mackworth, Randy Goebel, ”Computational Intelligence: a logical approach”, Oxford University Press, 1998. | | | | | | | | | | | | | | |
| 3 | G. Luger, “Artificial Intelligence: Structures and Strategies for Complex Problem Solving”, Sixth Edition, Pearson Education. | | | | | | | | | | | | | | |
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| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | | | | |
| 1 | | https://www.sci.brooklyn.cuny.edu/~dzhu/cis718/preview01.pdf | | | | | | | | | | | | | |
| 2 | | https://onlinecourses.nptel.ac.in/noc21\_ge20/ | | | | | | | | | | | | | |
| Course Designed by: **Dr. P. B. Pankajavalli** | | | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | M | L | S | L | M | M | M |
| **CO2** | M | S | S | M | L | M | L | S | S | S |
| **CO3** | S | S | S | S | M | M | L | S | S | S |
| **CO4** | S | S | S | S | M | M | L | M | S | M |
| **CO5** | S | M | M | S | M | M | L | M | S | S |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | **25AI1C4** | **MACHINE LEARNING AND ITS APPLICATIONS** | **L** | | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **CORE** | **2** | | | | **0** | **4** | **4** |
| **Pre-requisite** | | | | | **Foundation in Mathematics and Programming Skills** | **Syllabus**  **Version** | | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | |
| * To provide insight into fundamental concepts of machine learning and its various algorithms * To understand various plans for generating models from data and evaluating them * To apply ML algorithms on given data and elucidate the results obtained * To design suitable ML solutions to solve real-world problems in the AI domain | | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | | | |
| 1 | | Understand fundamental concepts and principles of machine learning algorithm scenarios. | | | | | | | | K1/K2/K3 | | |
| 2 | | Apply various machine learning to real world datasets | | | | | | | | K2/K5 | | |
| 3 | | Evaluate and find out suitable machine learning models based on dataset characteristics. | | | | | | | | K2/K5 | | |
| 4 | | Design and execute machine learning experiments to solve complex problems. | | | | | | | | K6 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate; **K6** – Create | | | | | | | | | | | | |
| **Unit 1** | | | **Introduction to Machine Learning: Fundamentals and Discriminative Models** | | | | | **9 hours** | | | | |
| Introduction: Machine learning, Terminologies in machine learning, Types of machine learning: supervised, unsupervised, semi-supervised learning. Design of ML system – Model selection, bias, variance, learning curves, and error analysis. | | | | | | | | | | | | |
| **Unit 2** | | | **Improving Models and Learning Theory** | | | | | **12 hours** | | | | |
| Review of probability. Discriminative Models: Least Square Regression, Gradient Descent Algorithm, Univariate and Multivariate Linear Regression, Prediction Model, probabilistic interpretation, Regularization, Logistic regression, multi-class classification, Support Vector Machines- Large margin classifiers, Nonlinear SVM, kernel functions, SMO algorithm. | | | | | | | | | | | | |
| **Unit 3** | | | **Gaussian Models and EM Algorithm** | | | | | | **11 hours** | | | |
| Computational Learning theory- Sample complexity, ε- exhausted version space, PAC Learning, agnostic learner, VC dimensions, Sample complexity - Mistake bounds. Gaussian models: Multivariate Gaussian distributions, Maximum Likelihood Estimate, Inferring parameters, Linear and Quadratic Discriminant Analysis, Mixture models, EM algorithm for clustering and learning with latent variables. | | | | | | | | | | | | |
| **Unit 4** | | | **Models and Unsupervised Learning Algorithms** | | | | | | **12 hours** | | | |
| Generative models: k-Nearest Neighbor Classification, Bayesian concept learning, Likelihood, Posterior predictive distribution, beta-binomial model, Naive Bayes classifiers, classifying documents using bag of words. Bayesian Statistics and Frequentist statistics. Directed graphical models (Bayes nets), Conditional independence, Inference. Dimensionality Reduction, Combining weak learners- AdaBoost. | | | | | | | | | | | | |
| **Unit 5** | | | **Singular Value Decomposition and Clustering** | | | | | | **14 hours** | | | |
| Recommendation Systems – Model for Recommendation Systems, Utility Matrix, Content Based Recommendations, Discovering Features of Documents, Collaborative Filtering. Advertising on the Web: Issues in Online Advertising, Online and offline algorithms, The matching Problem, The AdWords Problem, The Balance Algorithm, A Lower Bound on Competitive Ratio for Balance. | | | | | | | | | | | | |
|  | | | **Total Lecture hours** | | | | **58 hours** | | | | | |
| **Text Book(s)** | | | | | | | | | | | | |
| 1 | Tom Mitchell, “Machine Learning”, McGraw Hill-First edition,1997, Prentice Hall of India Private Limited. Third Edition 2009. | | | | | | | | | | | |
| 2 | E. Alpaydin, “Introduction to Machine Learning”, PHI- First edition,2005-2014. | | | | | | | | | | | |
| 3 | Andrew Ng, Machine learning yearning, https://www.deeplearning.ai/machine-learning-yearning/ | | | | | | | | | | | |
| 4 | AnandRajaRaman, Jure Leskovec and J.D. Ullman, “Mining of Massive Data sets”, e-book, Publisher, Second edition-2014. | | | | | | | | | | | |
| 5 | Kevin P. Murphey, “Machine Learning, a Probabilistic Perspective”, The MIT Press, Cambridge, Massachusetts, First edition-2012. | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | |
| 1 | AurolienGeron, ”Hands-On Machine Learning with Scikit-Learn and Tensor Flow, Shroff/O’Reilly”-Second edition, 2017 | | | | | | | | | | | |
| 2 | Andreas Muller and Sarah Guido, ”Introduction to Machine Learning with Python: A Guide for Data Scientists”, Shroff/O’Reilly,-First edition,2016 | | | | | | | | | | | |
| 3 | Alejandro Barredo Arrieta, Natalia D´ıaz-Rodr´ıguez, Javier Del Ser, et.al.,” Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities, and challenges toward responsible AI, Information Fusion”, Volume 58, 2020, Pages 82-115, ISSN 1566-2535,  <https://doi.org/10.1016/j.inffus.2019.12.012.-> Volume 58,2019. | | | | | | | | | | | |
| Course Designed by: **Dr. D. RAMYACHITRA** | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | L | L | L | M | M | M | L | M |
| **CO2** | L | S | S | L | M | M | L | L | M | M |
| **CO3** | L | L | S | M | M | L | L | M | M | L |
| **CO4** | S | S | M | M | L | M | L | M | M | M |

\*S-Strong; M-Medium; L-Low

**MACHINE LEARNING AND ITS APPLICATIONS – LAB**

**List of Programs**

1. K-nearest neighbors’ classification
2. Linear regression
3. Naïve Bayes theorem for classification of English text
4. Support Vector Machine algorithm
5. Calculation of the VC dimension of a set of hypotheses.
6. Multivariate Gaussian distribution.
7. AdaBoost algorithm for binary classification problem.
8. Implementation of Bayesian and frequent approaches for estimating the mean of a Gaussian distribution.
9. Implementation of matrix factorization for collaborative filtering using Singular Value Decomposition.

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| **Course Code** | | | **25AI1C5** | **FOUNDATIONS OF DATA SCIENCE** | **L** | | **T** | **P** | | **C** |
| **Core/Elective/Supportive** | | | | **CORE** | 4 | 0 | | | 0 | 4 |
| **Pre-requisite** | | | | **FOUNDATION IN MATHEMATICS AND PROGRAMMING SKILLS** | **Syllabus**  **Version** | | | **2025-2026** | | |
| **Course Objectives:** | | | | | | | | | | |
| * To provide a solid understanding of core principles and techniques in data science. * To learn how to collect, preprocess, analyze, and visualize data using Python and relevant libraries. * To gain proficiency in statistical methods and machine learning algorithms. * To develop skills to extract insights and build predictive models. * To learn the inference and classification model and also graph based models. | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | |
| 1 | Understand and master fundamental data science concepts. | | | | | K1/K2/K3 | | | | |
| 2 | Proficiency in data sampling, distributions and correlations of features in samples. | | | | | K2/K3/K5 | | | | |
| 3 | Understand and apply the hypothesis testing and assessing the models. | | | | | K2/K3/K5 | | | | |
| 4 | Understand and apply the resampling and regression techniques for prediction in data analysis. | | | | | K2/K3/K6 | | | | |
| 5 | Understand the classification models and apply these into different domain to making decisions. | | | | | K2/K3/K6 | | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate; **K6** – Create | | | | | | | | | | |
| **Unit 1** | **Foundations of Data Science: Exploring Causality, Pre-processing, Visualization, and Probability** | | | | | **11 hours** | | | | |
| Introduction to Data Science, Causality and Experiments, Data Pre-processing - Data cleaning – Data reduction - Data transformation, Visualization and Graphing: Visualizing Categorical Distributions -Visualizing Numerical Distributions - Overlaid Graphs and plots - Summary statistics of exploratory data analysis, Randomness, Probability | | | | | | | | | | |
| **Unit 2** | **Statistical Fundamentals: Sampling, Distributions, Inference, and Testing** | | | | | **12 hours** | | | | |
| Introduction to Statistics, Sampling, Sample Means and Sample Sizes. Probability distributions and density functions (univariate and multivariate), Error Probabilities, Expectations and moments; Covariance and correlation; Sampling and Empirical distributions; Permutation Testing, Statistical Inference | | | | | | | | | | |
| **Unit 3** | **Advanced Statistical Analysis: Hypothesis Testing, Model Assessment, and**  **Causality** | | | | | **11 hours** | | | | |
| Hypothesis testing of means, proportions, variances and correlations - Assessing Models - Decisions and Uncertainty, Comparing Samples - A/B Testing, PValues, Causality. | | | | | | | | | | |
| **Unit 4** | **Estimation and Prediction in Data Analysis: Resampling, Regression and Confidence** | | | | | **12 hours** | | | | |
| Estimation - Resampling and Bootstrap - Confidence Intervals, Properties of Mean - Central Limit Theorem -Variability of mean -Choosing Sample Size, Prediction - Regression - Method of Least Squares - Visual and Numerical Diagnostics | | | | | | | | | | |
| **Unit 5** | **Advanced Data Analysis Techniques: Inference, Classification, and Bayesian Methods** | | | | | **14 hours** | | | | |
| Inference for true slope - Prediction intervals, Classification - Nearest neighbours - accuracy of a classifier, Updating Predictions - Making Decisions – Bayes Theorem, Graphical Models | | | | | | | | | | |
|  | **Total Lecture hours** | | | | | **60 hours** | | | | |
| **Text Book(s)** | | | | | | | | | | |
| 1 | | Peter Bruce, Andrew Bruce and Peter Gedeck, ”Practical Statistics for Data Scientists: 50+Essential Concepts Using R and Python”, 2/e, O’Reilly Media, 2020.  Hall of India Private Limited. Third Edition 2009. | | | | | | | | |
| 2 | | Joel Grus, ”Data Science from Scratch: First Principles with Python”, 2/e, O’Reilly Media,2019. | | | | | | | | |
| **Reference Books** | | | | | | | | | | |
| 1 | | Allen B. Downey, Think Stats: Probability and Statistics for Programmers”, 2/e, by O’Reilly Media, 2014. | | | | | | | | |
| 2 | | Cathy O’Neil and Rachel Schutt,”Doing Data Science”, O’Reilly Media, 2013. | | | | | | | | |
| 3 | | Ani Adhikari and John DeNero, ”Computational and Inferential Thinking: The Foundations of Data Science”, e-book.2022 | | | | | | | | |
| Course Designed By: **Dr.R.PORKODI** | | | | | | | | | | |

Mapping with programme outcomes:

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| **COS** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| CO1 | **S** | **S** | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| CO2 | **S** | S | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| CO3 | **S** | **S** | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| CO4 | **S** | **S** | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| CO5 | **S** | **S** | **M** | **M** | **S** | **S** | **M** | **L** | **M** | **M** |

S- Strong; M-Medium; L-Low

SEMESTER - II

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| **Course code** | | | | **25AI2C1** | | **COMPUTATIONAL INTELLIGENCE** | | | **L** | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **CORE** | | | **4** | | | **0** | **0** | **4** |
| **Pre-requisite** | | | | | | Basic knowledge of handling digital data | | | **Syllabus Version** | | | | **2025-2026** | | |
| **Course Objectives:** | | | | | | | | | | | | | | | |
| The main objectives of this course are to:   * To provide a strong foundation on fundamental concepts in Computational Intelligence. * To enable Problem-solving through various approaches using neural networks, fuzzy and evolutionary algorithms * To apply Computational Intelligence techniques using nature-inspired algorithms | | | | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | | | | | |
| 1 | | | To understand the fundamentals of Computational Intelligence, models, and its applications | | | | | | | | | K1/K2 | | | |
| 2 | | | To know about Generative AI | | | | | | | | | K1/K2 | | | |
| 3 | | | To understand Prompt Engineering and its applications | | | | | | | | | K1/K2 | | | |
| 4 | | | To Provide a basic exposition of the goals and methods of Computational Intelligence using different types of neural networks | | | | | | | | | K1/K2/  K4 | | | |
| 5 | | | To get familiarity with evolutionary algorithms | | | | | | | | | K2/K3/K4 | | | |
| 6 | | | To apply Intelligent techniques using fuzzy logic | | | | | | | | | K1/K2/  K4/K5 | | | |
| 7 | | | To know about optimization using swarm intelligence | | | | | | | | | K2/K3/K4 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | |
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| **Unit:1** | | | | |  | | | | | | **11 hours** | | | | |
| Introduction to Computational Intelligence- Definition and Scope of Computational Intelligence- Applications in Various Field-Basic Concepts: Optimization, Learning, Adaptation - Soft Computing vs. Hard Computing-Computational Intelligence vs. Classical Techniques vs. Artificial Intelligence - Future Trends and Directions – Traditional AI vs. Generative AI - Generative AI: overview of generative models and its applications - Language models LLM architecture -Understanding GPT - Introduction to Prompt Engineering: Types - application - text and image prompts | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | |  | | | | | **11 hours** | | | | | |
| Neural Networks: Introduction to Artificial Neural Networks (ANN)-Neuron Models and Activation Functions - Single-Layer Perceptrons (SLP)-Multilayer Perceptrons (MLP) and Feedforward Networks - Backpropagation Algorithm - Convolutional Neural Networks (CNN) - Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM)-Self-Organizing Maps (SOM)- Unsupervised Learning with Neural Networks-Applications: Image Recognition, Natural Language Processing | | | | | | | | | | | | | | | |
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| **Unit:3** | | | | |  | | | **12 hours** | | | | | | | |
| Evolutionary Algorithms: Introduction to Evolutionary Algorithms (EA)-Genetic Algorithms (GA): Basic Concepts and Operators-Evolution Strategies (ES) and Evolutionary Programming (EP)-Genetic Programming (GP)-Differential Evolution (DE)-Multi-Objective Optimization using Evolutionary Algorithms-Co-evolutionary Algorithms- Parallel and Distributed Evolutionary Algorithms- Real-World Applications: Engineering Design, Robotics-Comparison with Classical Optimization Techniques | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | |  | | | **12 hours** | | | | | | | |
| Fuzzy Logic: Introduction to Fuzzy Logic- Fuzzy Sets and Membership Functions-Fuzzy Operators: AND, OR, NOT-Fuzzy Rules and Fuzzy Inference Systems (FIS)-Mamdani and Sugeno Fuzzy Inference Methods-Fuzzy Control Systems: PID Controllers vs. Fuzzy Controllers-Fuzzy Logic Applications in Control Engineering-Fuzzy Decision Making and Expert Systems- Fuzzy Clustering and Pattern Recognition- Fuzzy Logic in Medical Diagnosis and Healthcare | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | |  | | **12 hours** | | | | | | | | |
| Swarm Intelligence: Introduction to Swarm Intelligence- Ant Colony Optimization (ACO)-Particle Swarm Optimization (PSO)- Bee Colony Optimization (BCO)-Firefly Algorithm-Artificial Bee Colony Algorithm (ABC)-Grey Wolf Optimizer (GWO)-Differential Evolution Swarm (DES)-Applications in Engineering Design Optimization-Emerging Trends and Hybrid Approaches | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | **2 hours** | | | | | | | | |
| **Expert lectures, online seminars - webinars** | | | | | | | | | | | | | | | |
|  | | | | | **Total Lecture hours** | | **60 hours** | | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | |
| 1 | Computational Intelligence: Concepts to Implementations, Russell C. Eberhart and Yuhui Shi | | | | | | | | | | | | | | |
| 2 | Neural Networks and Deep Learning: A Textbook, Charu C. Aggarwal | | | | | | | | | | | | | | |
| 3 | Evolutionary Algorithms in Theory and Practice, Thomas Bäck | | | | | | | | | | | | | | |
| 4 | Fuzzy Logic with Engineering Applications, Timothy J. Ross | | | | | | | | | | | | | | |
| 5 | Swarm Intelligence, Russell C. Eberhart, Yuhui Shi, and James Kennedy | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | | |
| 1 | Konar A., “Computational Intelligence: Principles, Techniques and Applications”, Springer Verlag, 2005 | | | | | | | | | | | | | | |
| 2 | Engelbrecht, A.P, “Fundamentals of Computational Swarm Intelligence”, John Wiley & Sons, 2006. | | | | | | | | | | | | | | |
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| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | | | | |
| 1 | | https://www.larksuite.com/en\_us/topics/ai-glossary/computational-intelligence | | | | | | | | | | | | | |
| 2 | | https://www.tutorialspoint.com/prompt\_engineering/index.htm | | | | | | | | | | | | | |
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| **Course Designed by: Dr. K. Geetha** | | | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | **S** | **S** | **S** | **M** | **M** | **L** | **M** | **M** | S | S |
| **CO2** | **S** | **S** | **S** | **M** | **M** | **L** | **M** | **M** | S | S |
| **CO3** | **S** | **S** | **S** | **M** | **M** | **L** | **M** | **M** | S | S |
| **CO4** | **S** | **S** | **S** | **M** | **M** | **L** | **M** | **M** | S | S |
| **CO5** | **S** | **S** | **S** | **M** | **M** | **L** | **M** | **M** | S | S |
| **CO6** | **S** | **S** | **S** | **M** | **M** | **L** | **M** | **M** | S | S |
| **CO7** | **S** | **S** | **S** | **M** | **M** | **L** | **M** | **M** | S | S |

\*S-Strong; M-Medium; L-Low

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| **Course code** | | | **25AI2C2** | **DEEP LEARNING TECHNIQUES** | **L** | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | **CORE** | **2** | | | **0** | **4** | **4** |
| **Prerequisite** | | | | **Basic knowledge of mathematics, statistics, and machine learning concepts** | **Syllabus Version** | | | | **2025-**  **2026** | |
| **Course Objectives:** | | | | | | | | | | | |
| The main objectives of this course are to:   * Understand the principles of neural networks * Understand the basic concepts of deep learning * Understand and implement the architectures of deep learning. * Familiarize with the applications of deep learning | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | |
| 1 | | Understand the deep learning concepts and apply them to different problems | | | | K2/K3 | | | | | |
| 2 | | Design and apply Convolutional and Recurrent Neural Networks | | | | K1/K3 | | | | | |
| 3 | | Understand and evaluate different deep learning architectures | | | | K2/K5 | | | | | |
| 4 | | Design and create deep learning applications | | | | K6 | | | | | |
| 5 | | Analyze the role of deep learning models in image processing | | | | K4 | | | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | |
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| **Unit:1** | | | **BASICS OF NEURAL NETWORKS** | | **9 hours** | | | | | |
| Basics of neural networks - Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks. | | | | | | | | | | | |
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| **Unit: 2** | | | **INTRODUCTION TO DEEP LEARNING** | | **12 hours** | | | | | |
| Introduction to deep learning - Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – ReLU Heuristics for Avoiding Bad Local Minima– Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout. | | | | | | | | | | | |
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| **Unit:3** | | | **CONVOLUTIONAL & RECURRENT NEURAL NETWORK** | | **11 hours** | | | | | |
| Convolutional neural networks - Kernel Filters – Multiple Filters - CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning - Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications | | | | | | | | | | | |
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| **Unit:4** | | | **DEEP LEARNING ARCHITECTURES** | | **12 hours** | | | | | |
| LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM | | | | | | | | | | | |
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| **Unit:5** | | | **APPLICATIONS OF DEEP LEARNING** | | | | **14 hours** | | | | | | |
| Applications of deep learning - Image Segmentation – Object Detection – Automatic Image Captioning – Image Generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision | | | | | | | | | | | | |
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| **Unit:6** | | | **Contemporary Issues** | | | | **2 hours** | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | |
|  | | | **Total Lecture hours** | | | | **60** | | | | | | |
|  | | | | | | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | |
| 1 | Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017. | | | | | | | | | | | |
| 2 | Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016. | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | |
| 1 | Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018. | | | | | | | | | | | |
| 2 | Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial | | | | | | | | | | | |
| 3 | Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC | | | | | | | | | | | |
| 4 | Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018. | | | | | | | | | | | |
| 5 | Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016. | | | | | | | | | | | |
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| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | |
| 1 | https://onlinecourses.nptel.ac.in/noc20\_cs11/preview | | | | | | | | | | | |
| 2 | htt[ps://www.course](http://www.coursera.org/specializations/deep-learning)ra.o[rg/specializations/](http://www.coursera.org/specializations/deep-learning)d[eep-learning](http://www.coursera.org/specializations/deep-learning) | | | | | | | | | | | |
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| Course Designed By: **Dr. S. VIJAYARANI** | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | M | M | M | M | M | M | M |
| **CO2** | S | S | S | M | M | M | M | M | M | M |
| **CO3** | S | S | S | M | M | M | M | M | L | S |
| **CO4** | M | S | M | S | M | M | L | M | L | M |
| **CO5** | S | S | S | L | L | M | M | M | L | M |

\*S-Strong; M-Medium; L-Low

**DEEP LEARNING TECHNIQUES - LAB**

**List of Programs**

1. Implementation of feed-forward neural network

2. Implementation of convolutional network

3. Image classification

4. Image segmentation

5. Time series forecasting

6. Text classification and machine translation

7. Text generation

8. Image classification

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| **Course Code** | | | | | **25AI2C3** | **DATA ENGINEERING** | | **L** | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **CORE** | | **2** | | | **0** | **4** | **4** |
| **Pre-requisite** | | | | | | **CONCEPTS OF FEATURE ENGINEERING, MODEL DEVELOPMENT MONITORING** | | **Syllabus**  **Version** | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | | |
| * To understand the ‘X’ of data engineering * To scan proficiency in data manipulation and transformation technology techniques using SQL, python, and Spark tools. * To learn how to design and implement efficient data pipelines for collectivity processing and storing lay volumes of data | | | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | | | |
| 1 | | Understand the principles of data modeling and management. | | | | | | | | | K2/K3 | | |
| 2 | | Gain proficiency in data storage technology and data engineering tools and platforms such as NoSQL, Postgre SQL, Apache Cassandra, Prest, Spark, Python | | | | | | | | | K1/K3 | | |
| 3 | | Learn how to design and implement scalable data pipelines for processing large volumes of data | | | | | | | | | K2/K5 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | |
| **Unit 1** | | | | **Data Modelling and Management** | | | | | **11 hours** | | | | |
| Data modeling, relational data models, ER models – Graph models - Normalization and de-normalization, OLTP and OLAP - Big data – Data Science – Processing big data – Languages – SQL, Cypher  Sieve for primes, Modular exponentiation | | | | | | | | | | | | | |
| **Unit 2** | | | | **Database Management Essentials** | | | | | **12 hours** | | | | |
| Embedded SQL, Constraints – Data Consistency – Query optimization – Object-oriented databases- NoSQL data models – schema migrations - PostgreSQL, Apache Cassandra, Presto | | | | | | | | | | | | | |
| **Unit 3** | | | | **Spark for Data Lakes and Python Programming** | | | | | | **11 hours** | | | |
| Spark and data lakes: Python programming in Spark; Data wrangling – Sparkql, spark data frames- SparkSQL, ETL in Spark, SparkMlLib, Comparison of Pyspark with H2O, Dask, and Vaex | | | | | | | | | | | | | |
| **Unit 4** | | | | **Data Pipeline Management and Optimization** | | | | | | **12 hours** | | | |
| Data Pipeline – Apache Airflow - Set up task dependencies- Create data connections using hooks- Track data lineage - Set up data pipeline schedules - Partition data to optimize pipelines | | | | | | | | | | | | | |
| **Unit 5** | | | | **Data Quality Assurance and Pipeline Management** | | | | | | **14 hours** | | | |
| Write tests to ensure data quality - Backfill data - Build reusable and maintainable pipelines –Implement subDAGs - Set up task boundaries - Monitor data pipelines | | | | | | | | | | | | | |
|  | | | **Total Lecture hours** | | | | **60 hours** | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | |
| 1 | Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-  Hill Education, Sixth edition-2011  Hall of India Private Limited. Third Edition 2009. | | | | | | | | | | | | |
| 2 | NoSQL Distilled: Pramod J. Sadalage, Martin Fowler, Addison-Wesley, Second edition - 20122014. | | | | | | | | | | | | |
| 3 | Learning Spark: Lightning-Fast Big Data Analysis, Holden Karau, Andy Konwinski, Patrick Wendell, MateiZaharia, O’Reilly Media, Inc., First edition-2015 | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | |
| 1 | Practical Machine Learning with H2O: Powerful, Scalable Techniques for Deep Learning and  AI, Darren Cook, O’Reilly Media, Inc., First edition-2016 | | | | | | | | | | | | |
| 2 | Learning PySpark, Tomasz Drabas, Denny Lee, Packt, First edition-2017  for Data Scientists”, Shroff/O’Reilly, 2016 | | | | | | | | | | | | |
| 3 | <https://medium.com/plotly/interactive-and-scalable-dashboards-with-vaex-and-dash-9b104b2dc9f0> | | | | | | | | | | | | |
| Course Designed By: **Dr. D. RAMYACHITRA** | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | M | L | L | M | L | M | L | M |
| **CO2** | L | S | L | L | M | M | L | L | M | M |
| **CO3** | L | S | M | L | M | L | L | ML | L | M |

\*S-Strong; M-Medium; L-Low

**DATA ENGINEERING - LAB**

**List of Programs**

1. Create an Entity-Relationship (ER) model for a given business scenario.
2. Convert the ER model into a relational schema and implement it using PostgreSQL.
3. Write complex SQL queries to retrieve data from a relational database. Include joins, subqueries, and aggregate functions.
4. Set up an Apache Cassandra database and create a schema for a sample application.
5. Set up a Spark environment and perform basic data manipulation using Spark DataFrames.
6. Install and configure Apache Airflow.
7. Create and schedule a simple DAG (Directed Acyclic Graph) to perform a data processing task.
8. Create and execute data transformation pipelines using PySpark
9. Perform normalization and denormalization on a given relational schema
10. Compare performance of PySpark, H2O, and Dask on a sample large dataset

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| **Course Code** | | **25AI2C4** | **PROBABILISTIC GRAPHICAL MODELS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | **CORE** | **4** | **0** | **0** | **4** |
| **Pre-Requisite** | | | **Mathematics, Discrete Structure** | **Syllabus Version** | | **2025- 2026** | |
| **Course Objective:** | | | | | | | |
| The main objectives of this course are:   * To give a comprehensive introduction to probabilistic graphical Models * To make inferences, learning, actions, and decisions while applying these models. * To introduce real-world trade-offs when using probabilistic graphical models in practice * To develop the knowledge and skills necessary to apply these models to solve real-world problems. | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | |
| On the successful completion of the course, students will able to: | | | | | | | |
| 1 | Understand basic concepts of probabilistic graphical modeling | | | | | K1/K2 | |
| 2 | Model and extract inference from various graphical models like Bayesian Networks, Markov Models | | | | | K2/K4 | |
| 3 | Perform Learning and take actions and decisions using probabilistic graphical models | | | | | K2/K4 | |
| 4 | Represent real-world problems using graphical models: design inference algorithms: and learn the structure of the graphical model from data. | | | | | K2/K4 | |
| 5 | Design real-life applications using probabilistic graphical models | | | | | K2/K3/K6 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | |
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| **Unit: 1** | **INTRODUCTION TO PROBABILISTIC GRAPHICAL MODELING** | | | | | **12 Hours** | |
| **Introduction to Probability Theory:** Probability theory, basic concepts in probability, random variables and joint distribution, independence and conditional independence, continuous spaces, expectation, and variances. **Introduction to Graphics:** Nodes and edges, Subgraphs, Paths and Trails, Cycle and Loops. **Introduction to Probabilistic Graph Models:** Bayesian Network, Markov Model, Hidden Markov Model. Application of PGM | | | | | | | |
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| **Unit: 2** | **Bayesian Network Model and Inference** | | | | | **12 Hours** | |
| Directed Graph Model: Bayesian Network- Exploiting Independence properties, Naïve Bayes Model, Bayesian Network Model, Reasoning Patterns, Basic Independences in Bayesian Networks, Bayesian Network Semantics, Graphs and Distribution, Modelling: Picking variables, picking Structure, Picking Probabilities, D-separation. **Local Probabilistic Models:** Tabular CPDs, Deterministic CPDs, Context-Specific CPDs, Generalized Linear Models. **Exact inference variable elimination:** analysis of complexity, variable elimination, conditioning, inference with Structured CPDs. | | | | | | | |
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| **Unit: 3** | **MARKOV NETWORK MODEL AND INFERENCE** | | | | | **12 Hours** | |
| **Undirected Graph Model:** Markov Model-Markov Network, Parameterization of Markov network, Gibbi’s distribution, Reduced Markov Network, Markov Network Independencies, From Distributions to Graph, Fine-Grained Parameterization, Over Parameterization. Exact inference variable elimination: Graph Theoretic Analysis for Variable Elimination, Conditioning | | | | | | | |
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| **Unit: 4** | **Hidden Markov model and inference** | | | | | **11 Hours** | |
| Template-Based Graph Model: HMM- Temporal Models, Template Variables and Template Factors, Directed Probabilistic Models, Undirected Representation, Structural Uncertainty | | | | | | | |
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| **Unit: 5** | **Learning and Taking Actions and Decisions** | | | | | **11 Hours** | |
| **Learning Graphical Models:** Goals of Learning, Density Estimation, Specific prediction tasks, knowledge discovery. Learning as Optimization: Empirical risk, over fitting, Generalization, Evaluating Generalization performance, selecting a learning procedure, goodness of Fit, Learning tasks, Parameter Estimation: Maximum Like hood Estimation, MLE for Bayesian Networks. **Causality:** Conditioning and Intervention, Correlation and Causation, Causal Models, Structural causal Models. Utilities and Decisions: Maximizing Expected Utility, Utility curves, Utility Elicitation. Structured Decision problems: Decision Tree | | | | | | | |
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| **Unit: 6** | **CONTEMPORARY ISSUES** | | | | | **2 Hours** | |
| Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops | | | | | | | |
| **Total Lectures** | | | | | | **60 Hours** | |
| **Text Books** | | | | | | | |
| 1 | Daphne koller and Nir Friedman, “ Probabilistic Graphical Models: Principles amd Techniques” | | | | | | |
| 2 | David Barber, : Bayesian Reasoning and Machine Learning”, Cambridge University Prss, 1st edition, 2011. | | | | | | |
| **Reference Books** | | | | | | | |
| 1 | Finn Jensen and Thomas Nielsen, “ Bayesian Networks and Decision Graphs( Information Science and Statistics)”, 2nd edition, springer, 2007. | | | | | | |
| 2 | Kevin P. Murphy, “ Machine Learning: A probabilistic Perspective”, MIT Press, 2012. | | | | | | |
| 3 | Martin Wainwright and Michael Jordan, M., “ Graphical Models, Exponential Families, and Variational Inference”, 2008. | | | | | | |
|  | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | |
| 1 | https://www.coursera.org/specializations/probabilistic-graphical-models | | | | | | |
| 2 | <https://www.mooc-list.com/tags/probabilistic-graphical-models> | | | | | | |
| 3 | <https://www.upgrad.com/blog/bayesian-networks/> | | | | | | |
| 4 | <https://link.springer.com/chapter/10.1007/978-3-319-43742-2_24> | | | | | | |
| 5 | <https://core.ac.uk/download/pdf/191938826.pdf> | | | | | | |
| 6 | <https://cs.brown.edu/research/pubs/these/ugrad/2005/dbooks.pdf> | | | | | | |
| Course Designed BY**:** | | | | | | | |

Mapping with programme outcomes:

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| **COS** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | M | M | M | M | M | M | M |
| **CO2** | S | S | S | M | M | M | M | M | M | M |
| **CO3** | S | S | S | M | M | M | M | M | L | S |
| **CO4** | M | S | M | S | M | M | L | M | L | M |
| **CO5** | S | S | S | L | L | M | M | M | L | M |

S- Strong; M- Medium; L-Low

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| **Course code** | | **25AI2C5** | **CLOUD AND BIG DATA ANALYTICS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | **CORE** | **2** | **0** | **4** | **4** |
| **Prerequisite** | | | Fundamentals of Database Management, Data Mining, and System Software | **Syllabus Version** | | **2025-**  **2026** | |
| **Course Objectives:** | | | | | | | |
| The main objectives of this course are:   * To explain the concepts and terminologies related to Big Data and Cloud Computing. * To describe the challenges with Big Data analysis and techniques used to perform Big Data analysis in the Cloud. * To describe different types of cloud platforms and their advantages and disadvantages for Big Data analysis * To use a cloud-based platform to store, update, and manage Big Data and Create data-driven models for Big Data analysis based on existing frameworks. * To Apply data-driven models by deploying them to the Cloud. | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | |
| 1 | Understand the basic concepts of cloud computing and its technologies and applications. | | | K2/K3 | | | |
| 2 | Analyze the need and use of different cloud platforms and services. | | | K3/K4 | | | |
| 3 | Understand the concepts and terminologies of big data analytics. | | | K2/K5 | | | |
| 4 | Understand and analyze the use of Hadoop and MapReduce. | | | K2/K4/K5 | | | |
| 5 | Analyze and apply the concepts of cloud and big data analytics to solve real-time problems | | | K4/K5/K6 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | |
|  | | | | | | | |
| **Unit:1** | | **INTRODUCTION TO CLOUD COMPUTING** | | **12 hours** | | | |
| Introduction – Characteristics – Cloud Models – Cloud Services Examples – Cloud-based Services & Applications. Cloud Concepts & Technologies: Virtualization – Load Balancing – Scalability & Elasticity – Deployment – Replication – Monitoring – Software Defined Networking – Network Function Virtualization | | | | | | | |
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| **Unit:2** | | **CLOUD SERVICES & PLATFORMS** | | **12 hours** | | | |
| Cloud Platforms - Computational Services – Storage Services – Database Services – Application Services – Content Delivery Services – Analytics Services –Deployment & Management Services –Identity & Access Management Services – Open Source Private Cloud Software. | | | | | | | |
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| **Unit:3** | | **INTRODUCTION TO BIG DATA ANALYTICS** | | **10 hours** | | | |
| Introduction - Big Data - Scalability and Parallel Processing - Designing Data Architecture - Data Sources, Quality, Pre-Processing and Storing - Data Storage and Analysis | | | | | | | |
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| **Unit:4** | | **HADOOP & MapReduce** | | **12 hours** | | | |
| Introduction to Hadoop and its Ecosystem - Hadoop Distributed File System - MapReduce Framework and Programming Model - Hadoop Yarn - Hadoop Ecosystem Tools. MapReduce: Introduction - MapReduce Map Tasks, Reduce Tasks and MapReduce Execution - Composing MapReduce for Calculations and Algorithms | | | | | | | |
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| |  |  |  |  | | --- | --- | --- | --- | | **Unit:5** | | **CASE STUDY** | **12 hours** | | Real-world Case studies – Web Analytics, Web-scrapping, Google Analytics, Social medial Analytics, Issues in integrating Big data with Clouds- security concerns and measures to handle them - Big Data in Marketing and Sales - Data and Healthcare - Big Data in Medicine - Big Data in Advertising | | | | |  | | | | | **Unit:6** | | **Contemporary Issues** | **2 hours** | | Expert lectures, online seminars - webinars | | | | |  | | **Total Lecture hours** | **60** | |  | | | | | **Text Book(s)** | | | | | 1 | Cloud Computing – A Hands-On Approach – Arshdeep Bahga & Vijay Madisetti, Universities Press, 2014 | | | | 2 | Big Data Analytics: Introduction to Hadoop, Spark, and Machine Learning, Raj Kamal, Preeti Saxena, McGraw Hill, 2020 | | | | 3 | Kai Hwang, Min Chen, Big–Data Analytics for Cloud, IoT and Cognitive Computing Hardcover, John-Wiley and Sons, 2017 | | | |  | | | | | **Reference Books** | | | | | 1 | SeemaAcharya and SubhashiniChellapan, “Big Data and Analytics”, Publisher - Wiley – second edition, 2019 | | | | 2 | Kai Hwang, “Cloud Computing for Machine Learning and Cognitive Applications”, MIT Press,2017. | | | | 3 | Murari Ramuka, “Data Analytics with Google Cloud Platform “, BPB PUBN, 2019 | | | | 4 | V. K. Jain, Big Data and Hadoop, Khanna Publishing, 2017 | | | |  |  | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | 1 | https://onlinecourses.nptel.ac.in/noc21\_cs14/preview | | | | 2 | https://onlinecourses.nptel.ac.in/noc20\_cs92/preview | | | | 3 | https://www.coursera.org/learn/cloud-applications-part2 | | | | 4 | https://www.analyticsvidhya.com/trainings/all-in-one-big-data-cloud-computing-training-simpli-learn/ | | | | 5 | https://www.edx.org/learn/big-data | | | |  | | | | | Course Designed By: **Dr. S. VIJAYARANI** | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | S | S | L | M | M | M | M | L | S |
| **CO2** | M | M | S | L | M | M | M | S | L | S |
| **CO3** | S | S | S | L | M | M | M | M | L | M |
| **CO4** | M | S | S | L | M | M | M | M | M | S |
| **CO5** | M | S | M | M | M | M | M | S | L | S |

\*S-Strong; M-Medium; L-Low

CLOUD AND BIG DATA ANALYTICS - LAB

List of Programs

1. **To simulate a basic cloud environment using CloudSim with a single datacenter, one virtual machine (VM), and one cloudlet.**
2. **To simulate a cloud environment that contains multiple virtual machines and multiple cloudlets.**
3. **To implement and analyze the Time-Shared VM Scheduling policy in a cloud environment.**
4. **To implement and analyze the Space-Shared VM Scheduling policy using CloudSim.**
5. **To simulate and analyze the cost involved in the creation and execution of virtual machines in a cloud datacenter.**
6. **To evaluate how the length of a task (cloudlet) affects its execution time in the cloud environment.**
7. **To simulate the creation of virtual machines with different MIPS (Million Instructions Per Second) values and compare their execution performance.**
8. **To statically bind specific cloudlets to selected virtual machines and confirm that each cloudlet executes only on its assigned VM.**
9. Installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
10. Hadoop Implementation of file management tasks, such as adding files and directories, retrieving files, and deleting files.
11. Run a basic Word Count Map Reduce program to understand the Map Reduce Paradigm.
12. Experiment on Hadoop Map-Reduce / PySpark: -Implementing simple algorithms in Map-Reduce: Matrix multiplication.
13. Implement an application that stores big data in MongoDB / Pig using Hadoop / R.
14. Implementing basic AI pipelines using PyTorch or TensorFlow.

SEMESTER - III

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| **Course code** | | | | **25AI3C1** | | **INTRODUCTION TO SPEECH PROCESSING** | **L** | | | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **CORE** | **4** | | | | |  | | **0** | **4** |
| **Pre-requisite** | | | | | | Basic knowledge of Digital Data | **Syllabus Version** | | | | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | | | | | |
| The main objectives of this course are to:   * To introduce the fundamentals of speech signal processing. * To acquire the fundamentals of the digital signal processing that allows them to assimilate the concepts related to the speech processing. * To present basic principles of speech analysis and construction of models. * To give an overview of speech processing applications including speech synthesis, speech recognition and speaker recognition. | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | | | | | | | |
| 1 | | | To understand fundamental of speech processing and its applications | | | | | | | | | | K1/K2 | | | |
| 2 | | | To know about representation of Speech in digital form | | | | | | | | | | K1/K2/  K4 | | | |
| 3 | | | To familiar with speech synthesis and models | | | | | | | | | | K2/K3/K4 | | | |
| 4 | | | To understand about Speech recognition, approaches, applications and tools | | | | | | | | | | K1/K2/  K4/K5 | | | |
| 5 | | | To know about applications of speech processing- speaker identification and verification | | | | | | | | | | K2/K3/K4 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | | |
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| **Unit:1** | | | | |  | | | | **10 -- hours** | | | | | | | |
| Introduction to speech processing – History – Applications- Speech production: Mechanism of speech production- Acoustic phonetics – Digital models for speech signals – Speech waveform representations- Sampling speech signals- Basics of quantization | | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | |  | | | **10-- hours** | | | | | | | | |
| Short-time analysis of speech- Short-time energy and Zero crossing rate-Short-time auto correlation method – Short-time Fourier Transform –Speech spectrogram- Homomorphic speech analysis-Cepstrum and Complex Cepstrum-The short-time cepstrum - Computation of Cepstrum - Mel Frequency Cepstrum Co-efficients - Linear predictive analysis. | | | | | | | | | | | | | | | | |
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| **Unit:3** | | | | |  | | | | | | **8-- hours** | | | | | |
| Text to Speech Synthesis: Basic principles - Rule based speech synthesis - Corpus based peech synthesis -Linguistic processing - Prosodic processing | | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | |  | | | | | | **13-- hours** | | | | | |
| Speech Recognition: Speech recognition architecture- Types of speech recognition-Issues in speech recognition-Speech databases-Performance evaluation of SR systems-Applications - Feature extraction methods- Speech recognition methodologies: Acoustic-phonetic approach Pattern recognition approach: Template based approach-Dynamic Time Warping- Hidden Markov Model-Vector Quantization – Support Vector Machine - Neural network based approaches. Language Model- Trigram language model –CMU SLM Toolkit. | | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | |  | | | | | **13-- hours** | | | | | | |
| Speaker Identification and Verification: Measuring speaker features- Statistical Vs Dynamic features - Cepstral analysis – Similarity Vs Distance measures - Constructing speaker models – Adaptation - Applications of speaker recognition - Text dependent speaker recognition - Text independent speaker recognition- Generative approaches: Rationale - Gaussian mixture model (GMM)- Neural network approaches - Discriminative approaches: Support Vector Machine(SVM) - Kernels. | | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | | | **2 hours** | | | | | | |
| **Expert lectures, online seminars - webinars** | | | | | | | | | | | | | | | | |
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|  | | | | | **Total Lecture hours** | | | | | **56-- hours** | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | | |
| 1 | L. R. Rabiner, R. W. Schaffer, “Digital Processing of Speech signals”, Prentice Hall, 1978. | | | | | | | | | | | | | | | |
| 2 | Jacob Benesty, M. Mohan Sondhi, Yiteng Huang “Springer handbook of speech Processing”, Springer, 2007. | | | | | | | | | | | | | | | |
| 3 | Douglas O’Shaughnessy, “Speech Communications: Human and Machine”, Wiley- IEEE Press, 1999. | | | | | | | | | | | | | | | |
| 4 | L.R. Rabiner, B. H. Juang, “Fundamentals of speech recognition”, Prentice Hall,1993. | | | | | | | | | | | | | | | |
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| **Reference Books** | | | | | | | | | | | | | | | | |
| 1 | Thomas F. Quatieri - Discrete Time Speech signal Processing principles and practice, Third Edition, Pearson Education, 2009. | | | | | | | | | | | | | | | |
| 2 | Dr.Shaila D.Apte - Speech and Audio Processing, First Edition, WILEY Precise Textbook, 2015. | | | | | | | | | | | | | | | |
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| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | | | | | |
| 1 | | https://www.tutorialspoint.com/artificial\_intelligence\_with\_python/artificial\_intelligence\_with\_python\_speech\_recognition.htm | | | | | | | | | | | | | | |
| 2 | | https://www.javatpoint.com/speech-recognition-python | | | | | | | | | | | | | | |
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| **Course Designed By: Dr. K. Geetha** | | | | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | **M** | **S** | **S** | **S** | **S** | **M** | **L** | **M** | S | S |
| **CO2** | **M** | **S** | **S** | **S** | **S** | **M** | **L** | **M** | S | S |
| **CO3** | **M** | **S** | **S** | **S** | **S** | **M** | **L** | **M** | S | S |
| **CO4** | **M** | **S** | **S** | **S** | **S** | **M** | **L** | **M** | S | S |
| **CO5** | **M** | **S** | **S** | **S** | **S** | **M** | **L** | **M** | S | S |

\*S-Strong; M-Medium; L-Low

**INTRODUCTION TO SPEECH PROCESSING – LAB**

**List of Programs**

1. Record and digitize speech signals, and explore quantization effects.
2. Understand the concept of sampling and its impact on speech signals
3. Generate and interpret the spectrogram of speech signals
4. Extract MFCC features from speech signals.
5. Perform LPC analysis on speech signals.
6. Synthesize speech signals using different techniques.
7. Detect voiced and unvoiced regions in a speech signal.
8. Identify and analyze formants in speech signals.
9. Train a basic speech recognition model using a small dataset.
10. Create a practical application using speech recognition for voice commands.
11. Train a model to recognize different speakers.
12. Preprocess data for speaker identification
13. Train a model to identify speakers from a given set of audio samples.

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| **Course Code** | | **25AI3C2** | **NATURAL LANGUAGE PROCESSING** | **L** | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | **ELECTIVE** | **2** | **0** | | **4** | **4** |
| **Pre-Requisite** | | | Fundamentals of finite automata, regular expressions and grammar structures. | **Syllabus Version** | | | **2025-2026** | |
| **Course Objective:** | | | | | | | | |
| The main objectives of this course are:   1. To understand algorithms for the processing of linguistic information and computational properties of natural languages. 2. To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks. 3. To familiarize various NLP software libraries and data sets publicly available. 4. To develop systems for various NLP problems with moderate complexity. 5. To learn steps for creating Machine learning models and Gen AI | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | |
| 1 | Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language. | | | | | K1/K2 | | |
| 2 | Demonstrate understanding of the relationship between NLP and statistics & machine learning. | | | | | K2/K4 | | |
| 3 | Discover various linguistic and statistical features relevant to the basic NLP task and Demonstrate the concept of semantic analysis and word sense disambiguation. | | | | | K2/K4 | | |
| 4 | Understand and Demonstrate Generative AI capabilities in NLP. | | | | | K2/K4/K6 | | |
| 5 | Understand the components of machine translation process and develop the model for NLP applications. | | | | | K2/K3/K6 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | |
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| **Unit:1** | **INTRODUCTION** | | | | | **10 hours** | | |
| Introduction - NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field - N-gram Language Models - The role of language models. Simple N- gram models. Estimating parameters and smoothing. Evaluating language models. | | | | | | | | |
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| **Unit:2** | **BASIC NLP TECHNIQUES** | | | | | **12 hours** | | |
| Part Of Speech Tagging and Sequence Labeling - Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training) - Basic Neural Networks. Any basic introduction to perceptron and back propagation. | | | | | | | | |
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| **Unit:3** | **PARSING & SEMANTIC ANALYSIS** | | | | | **13 hours** | | |
| LSTM Recurrent Neural Networks -Syntactic parsing - Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing - Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing. | | | | | | | | |
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| **Unit:4** | **GENERATIVE AI USES, APPLICATIONS AND TOOLS** | | | | | **12 hours** | | |
| Introduction to Generative AI – Generative AI capabilities – Generative AI uses and applications across industries – Generative text and speech models – Generative image models – Generative AI models - Generative Adversarial Networks (GANs) - Variational auto encoders (VAEs). | | | | | | | | |
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| **Unit:5** | **MACHINE TRANSLATION** | | | | | **13 hours** | | |
| Information Extraction (IE) - Named entity recognition and relation extraction. IE using sequence labelling. -Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. | | | | | | | | |
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| Unit:6 | **Contemporary Issues** | | | | | **2 hours** | | |
| Discussion on case study - Expert lectures - Online seminars – Webinars – Workshops | | | | | | | | |
| **Total Lectures** | | | | | | **62** | | |
| **Text Books** | | | | | | | | |
| 1 | Jurafsky Dan and Martin James H. “Speech and Language Processing” ,3rd Edition, 2018. | | | | | | | |
|  | Learn Python Generative AI: Journey from autoencoders to transformers to large language models, Zonunfeli Ralte, Indrajit Kar, BPB Publications, 2024. | | | | | | | |
| **Reference Books** | | | | | | | | |
| 1 | Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, Practical Natural Language Processing, 2020. | | | | | | | |
| 2 | Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, 2009. | | | | | | | |
| 3 | Joseph Babcock, Raghav Bali, Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models, Packt publishing, 2021. | | | | | | | |
|  | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | |
| 1 | <https://onlinecourses.nptel.ac.in/noc19_cs56/preview> | | | | | | | |
| 2 | <https://www.edx.org/learn/natural-language-processing> | | | | | | | |
| 3 | <https://www.coursera.org/specializations/natural-language-processing> | | | | | | | |
| 4 | <https://www.tutorialspoint.com/natural_language_processing/index.htm> | | | | | | | |
| 5 | https://www.geeksforgeeks.org/generative-ai-models/ | | | | | | | |
| Course Designed By:**Dr.R.Porkodi** | | | | | | | | |

Mapping with programme outcomes:

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| **COS** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| CO1 | **S** | **S** | **M** | **M** | **M** | **M** | **M** | **L** | **M** | **M** |
| CO2 | **S** | S | **M** | **M** | **M** | **M** | **M** | **L** | **M** | **M** |
| CO3 | **S** | **S** | **M** | **M** | **M** | **M** | **M** | **L** | **M** | **M** |
| CO4 | **S** | **S** | **M** | **M** | **M** | **M** | **M** | **L** | **M** | **M** |
| CO5 | **S** | **S** | **M** | **M** | **M** | **M** | **M** | **L** | **M** | **M** |

S- Strong; M-Medium; L-Low

**List of Programs**

1. Illustrate part of speech tagging.

a. POS tagging and chunking of user defined text.

b. Named Entity recognition of user defined text.

c. Named Entity recognition with diagram using NLTK corpus – Treebank.

1. Implement word Tokenizer, Sentence and Paragraph Tokenizers.
2. Write a program to implement TF-IDF for any corpus.
3. Implement the various stemmers such as PorterStemmer, LancasterStemmer, RegexpStemmer, SnowballStemmer, WordNetLemmatizer, etc.
4. Write a program to implement both user-defined and pre-defined functions to generate

(a) Uni-grams (b) Bi-grams (c) Tri-grams (d) N-grams

1. Implement N‐gram Language model to classify the text into class labels.
2. Implement LSA and Topic model.
3. Implementation text classification using Naïve Bayes, SVM.
4. Implementation of K‐means Clustering algorithm on text.
5. Convert the given text to speech and speech to Text. Extract the important features from it.

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| **Course code** | | **25AI3C3** | **REINFORCEMENT LEARNING** | **L** | **T** | **P** | **C** | |
| **Core/Elective/Supportive** | | | **CORE** | **2** | **0** | **4** | **4** | |
| **Prerequisite** | | | Basic knowledge of Mathematics, Statistics, Programming, Data Structures and Algorithms, Artificial Intelligence, and Machine Learning concepts | **Syllabus Version** | | **2025-**  **2026** | | |
| **Course Objectives:** | | | | | | | |
| The main objectives of this course are:   * To acquire knowledge on the essentials of reinforcement learning and the methods used to solve different types of complex tasks. * To understand the basic concepts of reinforcement learning, multi-arm bandit problems, and Markov decision processes. * To analyze the use of dynamic programming and Monte Carlo methods. * To provide the concepts of temporal-difference learning and the use of tabular methods for planning and learning**.** | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | |
| 1 | Understand the reinforcement learning concepts and multi-arm bandit problems | | | K2/K3 | | | | |
| 2 | Analyze the need and use of finite Markov decision processes. | | | K3/K4 | | | | |
| 3 | Understand the dynamic programming concepts, efficiency, and their applications | | | K2/K5 | | | | |
| 4 | Understand and analyze the Role of Monto Carlo methods in reinforcement learning | | | K2/K4/K5 | | | | |
| 5 | Analyze and apply the concepts of temporal-difference learning and the use of tabular methods for planning and learning | | | K4/K5/K6 | | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | |
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| **Unit:1** | | **The Reinforcement Learning Problem** | | **12 hours** | | | | |
| Reinforcement Learning - Examples - Elements of Reinforcement Learning - Limitations and Scope - An Extended Example: Tic-Tac-Toe - History of Reinforcement Learning. Multi-arm Bandits: An n-Armed Bandit Problem - Action-Value Methods - Incremental Implementation - Tracking a Nonstationary Problem - Gradient Bandits - Associative Search (Contextual Bandits). | | | | | | | |
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| **Unit:2** | | **Finite Markov Decision Processes** | | **12 hours** | | | | |
| The Agent-Environment Interface - Goals and Rewards - Returns - Unified Notation for Episodic and Continuing Tasks - The Markov Property - Markov Decision Processes - Value Functions - Optimal Value Functions - Optimality and Approximation. | | | | | | | |
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| **Unit:3** | | **Dynamic Programming** | | **10 hours** | | | | |
| Policy Evaluation - Policy Improvement - Policy Iteration - Value Iteration - Asynchronous Dynamic Programming - Efficiency of Dynamic Programming. | | | | | | | |
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| **Unit:4** | | **Monte Carlo Methods** | | **12 hours** | | | | |
| Monte Carlo Methods: Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Off-policy Prediction via Importance Sampling - Incremental Implementation – Off-Policy Monte Carlo Control - Importance Sampling on Truncated Returns. | | | | | | | |
| |  |  |  |  | | --- | --- | --- | --- | |  | | | | | **Unit:5** | | **Temporal-Difference Learning** | **12 hours** | | TD Prediction - Advantages of TD Prediction Methods - Optimality of TD (0) - Sarsa: On-Policy TD Control - Q-Learning: Off-Policy TD Control - Games, Afterstates, and Other Special Cases. Planning and Learning with Tabular Methods: Models and Planning - Integrating Planning, Acting, and Learning - When the Model Is Wrong - Prioritized Sweeping - Full vs. Sample Backups | | | | |  | | | | | **Unit:6** | | **Contemporary Issues** | **2 hours** | | Expert lectures, online seminars - webinars | | | | |  | | **Total Lecture hours** | **60** | |  | | | | | **Text Book(s)** | | | | | 1 | “Reinforcement learning: An introduction,” First Edition, Sutton, Richard S., and Andrew G. Barto, MIT Press 2020. | | | |  | | | | | **Reference Books** | | | | | 1 | “Bandit algorithms,” First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press.2020 | | | | 2 | “Reinforcement Learning Algorithms: Analysis and Applications,” Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021 | | | | 3 | Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012): 3.. | | | | 4 | Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018). | | | |  |  | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | 1 | https://onlinecourses.nptel.ac.in/noc19\_cs55/preview | | | | 2 | https://www.coursera.org/specializations/reinforcement-learning | | | | 3 | https://www.udemy.com/topic/reinforcement-learning/ | | | | 4 | https://www.simplilearn.com/tutorials/machine-learning-tutorial/reinforcement-learning | | | | 5 | https://www.udacity.com/course/deep-reinforcement-learning-nanodegree--nd893 | | | |  | | | | | Course Designed By: **Dr. S. VIJAYARANI** | | | | | | | | | | | |

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| Mapping with Programme Outcomes | | | | | | | | | | |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | S | S | L | M | M | M | M | L | M |
| CO2 | S | S | S | M | M | M | M | M | L | S |
| CO3 | S | S | S | M | M | M | M | M | L | M |
| CO4 | M | S | S | L | M | M | M | M | S | M |
| CO5 | S | M | S | M | M | M | M | M | M | M |

REINFORCEMENT LEARNING - LAB

List of Programs

1. Q-Learning agent to play Tic-Tac-Toe.
2. N-armed bandit problem with ε-greedy strategy.
3. Markovian Decision Process
4. Markov Chain for simple prediction
5. Basic MDP solver using Value Iteration.
6. Monte Carlo methods for prediction and control.
7. TD (0) and Q-Learning algorithms for simple environments
8. Policy evaluation for a given policy.
9. SARSA algorithm

10. A small GRID game with reinforcement learning

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| **Course Code** | | | **25AI3C4** | | | **MULTI-AGENT SYSTEMS** | | **L** | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **CORE** | | **2** | | | **0** | **4** | **4** |
| **Pre-requisite** | | | | | | **PROGRAMMING SKILLS , ARTIFICIAL INTELLIGENCE BASICS AND DISTRIBUTED SYSTEMS** | | **Syllabus**  **Version** | | | | **2025 - 2026** | |
| **Course Objectives:**   * To understand fundamental concepts of multi agent system * To learn various techniques for agent design and in plots * To study practical applications | | | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | | | | |
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| On the successful completion of the course, students will be able to: | | | | | | | | | | | | | |
| 1 | | 1. Provide insight into fundamental concepts of agents and their various algorithms. | | | | | | | | | K2/K3 | | |
| 2 | | Understand various strategies of problem-solving and learning | | | | | | | | | K1/K3 | | |
| 3 | | Apply ML algorithms on given data and interpret the results obtained | | | | | | | | | K2/K5 | | |
| 4 | | Design and apply the agents in various domains | | | | | | | | | K6 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | |
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| **Unit 1** | | | | | **Fundamentals of Data Management and Analysis** | | | | **9 hours** | | | | |
| Intelligent Agents - Abstract architectures for Intelligent agents - Concrete architectures for Intel- ligent agents - Agent communications - Agent interaction protocols - Societies of Agents - Search algorithms for agents - Constraint satisfaction problems - Path-Finding Problem Sieve for primes, Modular exponentiation | | | | | | | | | | | | | |
| **Unit 2** | | | | | **Intelligent Agents and Search Algorithms Systems** | | | | **12 hours** | | | | |
| Distributed Problem-solving and Planning - Task and Result sharing - Planning representations and execution - Learning in Multi-agent systems - Interactive Reinforcement Learning of coordination -Learning and communication | | | | | | | | | | | | | |
| **Unit 3** | | | | | **Planning in Various Domains** | | | | | **11 hours** | | | |
| Partial Order Planning – Graphs – Non deterministic Domains Conditional Planning - Continuous Planning – Multi Agent Planning. | | | | | | | | | | | | | |
| **Unit 4** | | | | | **Advanced Concepts in Agents and Learning** | | | | | **12 hours** | | | |
| Higher level Agents, Knowledge in Learning- Statistical Learning Methods -Logics for Multi agent systems - Possible-Worlds Semantics for Modal Logics - Normal Modal Logics - Epistemic Logic for Multiagent Systems. | | | | | | | | | | | | | |
| **Unit 5** | | | | | **Practical Applications of Agents in Various Domains** | | | | | **14 hours** | | | |
| Industrial and Practical Applications - Agents for Workflow and Business Process Management - Agents for Electronic Commerce - Agents for Human-Computer Interfaces - Agents for Virtual Environments | | | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | **60 hours** | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | |
| 1 | Stuart Russell and Peter Norvig, “Artificial Intelligence - A Modern Approach”, 2nd Edition, Prentice Hall, 2002Hill Education, 2011 | | | | | | | | | | | | |
| 2 | Stuart J. Russell and Peter Norvig “Artificial Intelligence A Modern Approach” Third Edition -2009 | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | |
| 1 | Gerhard Weiss, ”Multi agent Systems”, Second Edition, MIT Press, 2016 | | | | | | | | | | | | |
| 2 | Michael Wooldridge, “An Introduction to Multi Agent System”, John Wiley, First edition- 2002.  for Data Scientists”, Shroff/O’Reilly, 2016 | | | | | | | | | | | | |
| Course Designed By: **Dr.D.RAMYACHITRA** | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | L | L | L | M | L | M | L | M |
| **CO2** | S | M | S | L | M | L | L | M | M | L |
| **CO3** | L | S | S | M | M | L | M | L | M | L |
| **CO4** | S | S | M | M | L | M | L | M | L | M |

\*S-Strong; M-Medium; L-Low

**MULTI-AGENT SYSTEMS - LAB**

**List of programs**

1. Create a basic intelligent which should be able to perceive its environment and take simple actions based on predefined rules.
2. Implement a search algorithm (e.g., A\*, BFS, DFS) for a path-finding problem. Use a grid-based environment where the agent finds the shortest path from a start to a goal position.
3. Solve a simple CSP such as the Sudoku puzzle using backtracking and visualize the steps taken by the algorithm.
4. Create a simulation where two agents communicate to achieve a common goal. Implement a simple protocol for agent communication and demonstrate the interaction.
5. Develop a basic multi-agent system where agents must coordinate to complete a task (e.g., moving boxes to specific locations). Implement simple coordination strategies and observe their effectiveness.
6. Implement a Q-learning algorithm for a simple grid-world environment. Train an agent to reach a goal state while avoiding obstacles and maximizing rewards.
7. Implement a partial order planning algorithm for a given set of actions and goals. Demonstrate the execution of the plan in a simulated environment.
8. Implement a basic machine learning model (e.g., decision tree) to classify agent actions based on historical data. Use a small dataset and evaluate the model's performance.
9. Create an agent-based chatbot using a simple rule-based system. The chatbot should interact with users and provide responses based on predefined rules.
10. Implement an agent that navigates a virtual environment (e.g., a maze) and collects items. Use a simple graphical interface to visualize the agent's actions.

ELECTIVE

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| **Course code** | | | **25AI1E1** | | **REPRESENTATION LEARNING** | **L** | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **ELECTIVE** | **4** | | **0** | **0** | **4** |
| **Pre-requisite** | | | | | Basic knowledge of Mathematics and statistics | **Syllabus Version** | | | **2025-2026** | | |
| **Course Objectives:** | | | | | | | | | | |
| The main objectives of this course are to:   * To introduce the fundamentals of Representation Learning. * To acquire the fundamentals of the NLP. * To give an overview of Self-supervised learning and Multimodal representation learning. | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | |
| 1 | | To understand the foundations for Representation Learning | | | | | | K1/K2 | | |
| 2 | | To know about the representation of Natural languages | | | | | | K1/K2/  K4/K5 | | |
| 3 | | To be familiar with contrastive learning and to know the challenges | | | | | | K2/K3/K4 | | |
| 4 | | To introduce Self-supervised learning | | | | | | K1/K2/  K4 | | |
| 5 | | To inculcate Multimodal representation learning | | | | | | K2/K3/K4 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | |
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| **Unit:1** | | | | **Representation Learning** | | | **12 hours** | | | |
| Introduction to Representation Learning - Introduction to autoencoders for representation learning, early traditional approaches - Overview of visual self-supervised learning methods- Self-supervised learning VS Transfer Learning, Pretext VS Downstream Task, Pretext tasks: Colorization, Jigsaw puzzles, Image inpainting, Shuffle and Learn - Classify corrupted images, Rotation Prediction, Semi-supervised learning | | | | | | | | | | |
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| **Unit:2** | | | | **Natural Language Representations** | | | **11 hours** | | | |
| Learning Natural Language Representations – Basics of Natural Language Processing, RNN, self-attention, and Transformer, Language pretext tasks, Pretext tasks for representation learning in NLP. Contrastive Learning, SimCLR and mutual information-based proof- Contrastive learning, theory, and proof of MI bound. | | | | | | | | | | |
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| **Unit:3** | | | | **Contrastive Learning** | | | **11 hours** | | | |
| Understanding Contrastive learning &MoCOand image clustering- Contrastive Learning, L2 normalization, Properties of contrastive loss, Momentum encoder (MoCO): Issues and concerns regarding batch normalization, Multi-view contrastive learning: Deep Image Clustering: task definition and challenges, K-means and SCAN, PMI and TEMI. Vision Transformers and Knowledge Distillation- Transformer encoder and Vision transformer, ViTs VS CNNs: receptive field and inductive biases, Knowledge distillation and the mysteries of model ensembles, Knowledge distillation in ViTs and masked image modeling | | | | | | | | | | |
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| **Unit:4** | | | | **Self-Supervised Learning** | | | **12 hours** | | | |
| Self-supervised learning without negative samples - self-supervised methods, review of knowledge distillation, Self-Supervised Learning & knowledge distillation, Masked-based visual representation learning, iBOT, DINOv2 | | | | | | | | | | |
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| **Unit:5** | | | | **Multimodal Representation Learning** | | | **12 hours** | | | |
| Multimodal representation learning, robustness, and visual anomaly detection- Defining Robustness and Types of Robustness, Zero-shot learning, Contrastive Language Image Pretraining (CLIP), Image captioning, Few-shot learning, Visual anomaly detection: task definition, Anomaly detection scores, Anomaly detection metric AUROC | | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | | **2 hours** | | | |
| **Expert lectures, online seminars - webinars** | | | | | | | | | | |
|  | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | **60hours** | | | |
| **Text Book(s)** | | | | | | | | | | |
| 1 | Representation Learning for Natural Language Processing,Zhiyuan Liu, Yankai Lin,Maosong Sun | | | | | | | | | |
| 2 | An introduction to representation learning- Michael A. Alcorn | | | | | | | | | |
| 3 | Representation Learning: Propositionalization and Embeddings- by Marko Robnik-Sikonja, Nada Lavrac, Vid Podpecan | | | | | | | | | |
|  | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | |
| 1 | Kevin Murphy. Probabilistic Machine Learning: Advanced Topics. MIT Press, 2023. | | | | | | | | | |
| 2 | EthemAlpaydin. Introduction to Machine Learning, 3rd edition. MIT Press, 2014. | | | | | | | | | |
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| **Course Designed By: Dr. K. Geetha** | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | **S** | **M** | **S** | **M** | **S** | **M** | **L** | **M** | S | **M** |
| **CO2** | **S** | **M** | **S** | **M** | **S** | **M** | **L** | **M** | S | **M** |
| **CO3** | **S** | **M** | **S** | **M** | **S** | **M** | **L** | **M** | S | **M** |
| **CO4** | **S** | **M** | **S** | **M** | **S** | **M** | **L** | **M** | S | **M** |
| **CO5** | **S** | **M** | **S** | **M** | **S** | **M** | **L** | **M** | S | **M** |

\*S-Strong; M-Medium; L-Low

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| **Course code** | | | | **25AI1E2** | | **DATA VISUALIZATION** | **L** | **T** | | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **ELECTIVE** | **4** |  | | | **0** | **4** |
| **Pre-requisite** | | | | | | Basic knowledge of Digital Data | **Syllabus Version** | | | **2025- 2026** | | |
| **Course Objectives:** | | | | | | | | | | | | |
| The main objectives of this course are to:   * To introduce students to the fundamental visualization concepts, and approaches of data visualization systems. * To familiarize students with the visualization techniques using different types of data | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | | |
| 1 | | | To understand the fundamentals of Visualization and its importance | | | | | K1/K2 | | | | |
| 2 | | | To know about visualization Techniques for Spatial and geospatial Data | | | | | K1/K2/  K4/K5 | | | | |
| 3 | | | To understand time-oriented data and to apply visualization | | | | | K2/K3/K4/K5 | | | | |
| 4 | | | To be familiar with visualization techniques for Trees, Graphs, and Networks | | | | | K1/K2/  K4/K5 | | | | |
| 5 | | | To discover the main subjects, themes, or topics within large collections of text data. | | | | | K2/K3/K4/K5 | | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | |
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| **Unit:1** | | | | |  | | | | **12 hours** | | | |
| Unit 1: Introduction to Data Visualization – What is Visualization and Why imagery is important - Applications of visualizations to problem solving - visualization pipeline- Data foundation -External representation – Interactivity – Difficulty in Validation. Data Abstraction: Dataset types – Attribute types – Semantics. Task Abstraction – Analyze, Produce, Search, Query. Four levels of validation – Validation approaches | | | | | | | | | | | | |
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| **Unit:2** | | | | |  | | | **12 hours** | | | | |
| Arrange tables: Categorical regions – Visualization Techniques for Spatial Data: Spatial axis orientation – Spatial layout density. Arrange spatial data: Geometry – Scalar fields – Vector fields – Tensor fields. Visualization Techniques for Geospatial Data: Overview of the special characteristics and methods - basics of geospatial visualization: map projections- visualization techniques for point, line, area, and surface data. | | | | | | | | | | | | |
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| **Unit:3** | | | | |  | | | **10 hours** | | | | |
| Visualization Techniques for Time-Oriented Data: Importance and need of handling the temporal dimension- different temporal data visualization techniques. Visualization Techniques for Multivariate Data : techniques and presentations based on the graphical primitive used in the rendering, namely, points, lines, or regions, techniques that combine two or more of these types of primitives. | | | | | | | | | | | | |
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| **Unit:4** | | | | |  | | | **12 hours** | | | | |
| Visualization Techniques for Trees, Graphs, and Networks: representing relationship between data- part/subpart, parent/child, hierarchical relation and simple or complex: unidirectional or bi-directional, nonweighted or weighted, certain or uncertain relationships. Connections, Matrix views – Containment. Map color: Color theory, Color maps and other channels | | | | | | | | | | | | |
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| **Unit:5** | | | | |  | | | **12 hours** | | | | |
| Text and Document Visualization - analyzing data from libraries, e-mail archives, all facets of applications running on the World Wide Web. Visualizing blogs, wiki, twitter feed, digital library- tasks deals with text, documents, or web-based object. Enabling interaction techniques and designing effective visualization | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | **2 hours** | | | | |
| **Expert lectures, online seminars - webinars** | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
|  | | | | | **Total Lecture hours** | | | **60 hours** | | | | |
| **Text Book(s)** | | | | | | | | | | | | |
| 1 | Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014. | | | | | | | | | | | |
| 2 | Scott Murray, Interactive Data Visualization for the Web, O’Reilly, 2013. | | | | | | | | | | | |
| 3 | Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012 | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | |
| 1 | Fundamentals of Data Visualization by Claus O. Wilke, O’Reilly Media, Inc, March 2019: | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | |
| 1 | | https://www.tutorialspoint.com/business\_writing\_skills/data\_visualization.htm | | | | | | | | | | |
| 2 | | https://www.javatpoint.com/what-is-data-visualization | | | | | | | | | | |
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| **Course Designed By: Dr. K. Geetha** | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | **M** | **S** | **S** | **M** | **S** | **M** | **L** | **M** | S | S |
| **CO2** | **M** | **S** | **S** | **M** | **S** | **M** | **L** | **M** | S | S |
| **CO3** | **M** | **S** | **S** | **M** | **S** | **M** | **L** | **M** | S | S |
| **CO4** | **M** | **S** | **S** | **M** | **S** | **M** | **L** | **M** | S | S |
| **CO5** | **M** | **S** | **S** | **M** | **S** | **M** | **L** | **M** | S | S |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | **25AI1E3** | **AI in IoT** | **L** | | | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **ELECTIVE** | **4** | | | | | **0** | **0** | **4** |
| **Pre-requisite** | | | | | Basic knowledge of Python Programming and Machine Learning | **Syllabus Version** | | | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | | |
| The main objectives of this course are:   * Understand the general concepts in IoT and get familiar with the various hardware and software components of it * Understand how to build real-life IoT-based projects for different application domains * Hands-on training to implement IoT with Raspberry Pi. | | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | | | | |
| 1 | | | Understand the architectural overview and design principles of IoT. | | | | | | | K2 | | | |
| 2 | | | To develop a machine learning application using Raspberry Pi. | | | | | | | K4/K5 | | | |
| 3 | | | Building Machine learning models for edge devices using Raspberry Pi. | | | | | | | K4/K5 | | | |
| 4 | | | Understanding deep learning models using TensorFlowLite. | | | | | | | K2 / K4 | | | |
| 5 | | | Understanding object detection using TensorFlow. | | | | | | | K2 /K4 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create | | | | | | | | | | | | | |
| **Unit:1** | | | | **Introduction to IoT** | | | | | **10 hours** | | | | |
| Introduction to IoT, Architectural Overview and Design Principles, Elements of IoT (Arduino, Raspberry Pi, NodeMCU, Sensors & Actuators), IoT Applications, Sensing, Actuation, Networking Basics, Embedded OS, IoT and Cloud, Security aspects in IoT. | | | | | | | | | | | | | |
| **Unit:2** | | | | **Raspberry Pi** | | | | **12 hours** | | | | | |
| IoT Application Development, Introduction to Raspberry Pi, Integrating Sensors and Actuators with Raspberry Pi, Pushing and Managing Data in IoT Clouds, Programming APIs (Python/Node.js/Arduino) for communication protocols (MQTT, ZigBee, Bluetooth, UDP, TCP). | | | | | | | | | | | | | |
| **Unit:3** | | | | **ML and Deep learning models** | | | **15 hours** | | | | | | |
| Implementation of IoT with Raspberry Pi (lab - sensor, MQTT, visualization) Introduction to ML and Deep learning models for IoT (challenges, opportunities, solutions). | | | | | | | | | | | | | |
| **Unit:4** | | | | **TensorFlowLite** | | | **11 hours** | | | | | | |
| Sensor data classification using ML in Raspberry Pi (lab), Introduction to TensorFlowLite, Image classificationon Raspberry Pi (lab). | | | | | | | | | | | | | |
| **Unit:5** | | | | **Case Study** | | | **10 hours** | | | | | | |
| Object detection on Raspberry Pi (optional lab), building scalable ML pipeline using Flask, Python, uWSGI, TensorFlow. | | | | | | | | | | | | | |
| **Unit:6** | | | |  | | | **2 hours** | | | | | | |
| Discussion on case study – Demo - Online seminars – Webinars - Workshops | | | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | **60 hours** | | | | | | |
| **Text Books** | | | | | | | | | | | | | |
| 1 | Vijay Madisetti, Arshdeep Bahga, ¨Internet of Things, “A Hands on Approach”, University Press, 2014. | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | |
| 1 | Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill,2017. | | | | | | | | | | | | |
| 2 | Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach” , 3rd Edition Prentice Hall | | | | | | | | | | | | |
| 3 | Elaine Rich and Kevin Knight, “Artificial Intelligence”, 3rd Edition, Tata McGraw Hill. | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | | |
| 1 | | https://www.tensorflow.org/lite/tutorials | | | | | | | | | | | |
| 2 | | https://www.classcentral.com/course/introduction-iot-boards-12535 | | | | | | | | | | | |
| Course Designed By: **Dr. P. B. Pankajavalli** | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | L | S | L | L | L | L | M | L |
| **CO2** | L | S | S | M | M | M | L | L | M | M |
| **CO3** | M | M | S | S | M | M | L | M | M | L |
| **CO4** | L | L | M | M | L | M | L | M | L | M |
| **CO5** | L | L | M | M | L | M | L | M | M | M |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | **25AI2E1** | **AI FOR ROBOTICS** | **L** | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **ELECTIVE** | **4** | **0** | | **0** | **4** |
| **Pre-requisite** | | | | | 1. Data Structures and Algorithms 2. Foundation of Data Science 3. Linear Algebra and Optimization 4. Principles of AI and ML | **Syllabus Version** | | | **2025- 2026** | |
| **Course Objectives:** | | | | | | | | | | |
| The main objectives of this course are:   * To understand the principles of reinforcement learning which is one of the key learning techniques for robots * To understand uncertainty handling in robotics through probabilistic approaches * To learn how measurements work for robots | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | |
| 1 | | | Understand the basic introduction and methods in AI. | | | | K2 | | | |
| 2 | | | Explore the various reinforcement learning approaches. | | | | K2/K1 | | | |
| 3 | | | Build various solution methods using reinforcement in Robotics | | | | K3 | | | |
| 4 | | | Understand the various filters used for real time robotic implementation. | | | | K2 / K4 | | | |
| 5 | | | Understand the various models applied in robot perception. | | | | K2 /K4 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create | | | | | | | | | | |
| **Unit:1** | | | | **Introduction to Robotics** | | | | **10 hours** | | |
| Overview: Robotics introduction, historical perspective on AI and Robotics, Uncertainty in Robotics Reinforcement Learning: Basic overview, examples, elements, Tabular Solution Methods – Multiarmed bandits, Finite Markov decision process. | | | | | | | | | | |
| **Unit:2** | | | | **Dynamic programming** | | | | **12 hours** | | |
| Dynamic programming (Policy Evaluation, Policy Iteration, Value Iteration), Monte Carlo Methods, Temporal-Difference Learning (Q-learning, SARSA). | | | | | | | | | | |
| **Unit:3** | | | | **Approximation** | | | | **15 hours** | | |
| Approximate Solution Methods - On-policy Prediction with Approximation, Value function approximation, Non-linear function approximation, Reinforcement Learning in robotic. | | | | | | | | | | |
| **Unit:4** | | | | **Filters** | | | | **11 hours** | | |
| Recursive state estimation: Robot Environment Interaction, Bayes filters, Gaussian filters – The Kalman filter, The Extended Kalman Filter, The information filter, The particle filter Robot motion: Velocity Motion Model, Odometry Motion Model, Motion and maps. | | | | | | | | | | |
| **Unit:5** | | | | **Models** | | | | **10 hours** | | |
| Measurement: Beam Models of Range Finders, Likelihood Fields for Range Finders, Correlation- Based Sensor Models, Feature-Based Sensor Models, Overview of POMDP. | | | | | | | | | | |
| **Unit:6** | | | |  | | | | **2 hours** | | |
| Discussion on case study – Demo - Online seminars – Webinars - Workshops | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | | **60 hours** | | |
| **Text Books** | | | | | | | | | | |
| 1 | Sebastian Thrun, Wolfram Burgard, Dieter Fox, Probabilistic Robotics, MIT Press 2005 | | | | | | | | | |
| 2 | Richard S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction”, Second edition, MIT Press, 2018. | | | | | | | | | |
| **Reference Books** | | | | | | | | | | |
| 1 | Jens Kober, Jan Peters, Learning Motor Skills: From Algorithms to Robot Experiments, Springer, 2014. | | | | | | | | | |
| 2 | Francis X. Govers, Artificial Intelligence for Robotics, Packt, 2018. | | | | | | | | | |
|  | | | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | |
| 1 | | https://www.tensorflow.org/lite/tutorials | | | | | | | | |
| 2 | | https://www.classcentral.com/course/introduction-iot-boards-12535 | | | | | | | | |
| Course Designed By: **Dr. P. B. Pankajavalli** | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | L | S | L | L | L | L | M | L |
| **CO2** | L | S | S | M | M | M | L | L | M | M |
| **CO3** | M | S | S | M | M | M | L | M | M | M |
| **CO4** | S | M | M | L | M | M | L | M | M | M |
| **CO5** | M | M | M | S | M | M | L | M | M | M |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | **25AI2E2** | **AI in HEALTHCARE** | **L** | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **ELECTIVE** | **2** | **0** | | **4** | **4** |
| **Pre-requisite** | | | | | **A FOUNDATION IN BOTH MEDICAL KNOWLEDGE AND AI TECHNIQUES** | **Syllabus**  **Version** | | | **2025- 2026** | |
| **Course Objectives:** | | | | | | | | | | |
| * To equip students with AI techniques for healthcare improvement. * To explore machine learning, NLP, and computer vision in healthcare. * To analyze medical data and assist in diagnosis. * To personalize treatment plans and automate administrative tasks | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | |
| 1 | Master AI techniques tailored for healthcare applications, including machine learning, natural language processing, and computer vision. | | | | | | K2/K3 | | | |
| 2 | Analyse medical data, assist in diagnosis, and personalize treatment plans using AI | | | | | | K1/K3 | | | |
| 3 | Understand ethical considerations and regulatory frameworks in AI-powered healthcare | | | | | | K2/K5 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate; **K6** – Create | | | | | | | | | | |
| **Unit 1** | | | **AI Foundations: Definitions, Future Trends, and Applications** | | | | **11 hours** | | | |
| Artificial Intelligence Overview: Definitions and Future Trends - Intelligent Agents and Problem-Solving in Healthcare - Operationalizing AI in Consumerism and Supply Chain Management - Machine Learning, AI, and Decision Support Sieve for primes, Modular exponentiation | | | | | | | | | | |
| **Unit 2** | | | **Exploring Problem Solving: From Search Strategies to Real-World Applications"** | | | | **12 hours** | | | |
| Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Constraint Satisfaction Problems -Constraint Propagation - Backtracking Search - Case studies - Journey Mapping and Pain Points, - Patient Monitoring, Differential Diagnosis, - Care Management - Preventive Screening | | | | | | | | | | |
| **Unit 3** | | | **Advancing Medical AI: Learning Methods and Predictive Modeling in diagnosis** | | | | **11 hours** | | | |
| Learning methods, Rule-based systems- Decision tree learning- Reinforcement learning. AI in Medical diagnosis. Taxonomies and Relationships, Predictive Modeling Process, Analytic Maturity Model, Identifying Historic Addressable Opportunity, Predicting Addressable Opportunity, Measuring Predictive Accuracy. | | | | | | | | | | |
| **Unit 4** | | | **Foundations of AI: Exploring Predicate Logic, Prolog, and Knowledge Representation with Case Studies** | | | | **12 hours** | | | |
| 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. Case studies | | | | | | | | | | |
| **Unit 5** | | | **Integrating Intelligent Agent Architectures in Biomedical Applications** | | | | **14 hours** | | | |
| Architecture for Intelligent Agents - Agent communication - Negotiation and Bargaining - Argumentation among Agents - Trust and Reputation in Multi-agent systems. Biomedical applications. Blood pressure control, Speech Recognition – Robot control for surgical applications - Hardware - Perception- Planning – Moving image guidance. | | | | | | | | | | |
|  | | | **Total Lecture hours** | | | | | **60 Hours** | | |
| **Text Book(s)** | | | | | | | | | | |
| 1 | | M. Tim Jones, “Artificial Intelligence: A Systems Approach ”, Jones and Bartlett Publishers, Inc.; First Edition, 2015 Reprint. ISBN-13: 978-9380298139 Hall of India Private Limited. Third Edition 2009. | | | | | | | | |
| 2 | | NoSQL Distilled: Pramod J. Sadalage, Martin Fowler, Addison-Wesley,Second edition – 2012-2014. | | | | | | | | |
| 3 | | Arjun Panesar, Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes (1 ed.),Apress, 019. ISBN 978-1484237984 | | | | | | | | |
| **Reference Books** | | | | | | | | | | |
| 1 | | William F. Clocksin and, Christopher S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2012 Reprint. ISBN 978-3-642-55481-0, DOI 10.1007/978- 3-642-5548. | | | | | | | | |
| 2 | | Ian Millington, John Funge, “Artificial intelligence for Games”, Second edition, Morgan Kaufmann Publishers, CRC Press, 2012, ISBN: 978-0-12-374731-0. for Data Scientists”, Shroff/O’Reilly, 2016 | | | | | | | | |
| 3 | | David L. Poole and Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, Cambridge University Press, 2010. ISBN-13: 978-0521519007. | | | | | | | | |
| 4 | | S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition,2016. ISBN-1537600311, 97-81537600314 | | | | | | | | |
| Course Designed By: **Dr.R.PORKODI** | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | **S** | **S** | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| **CO2** | **S** | S | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| **CO3** | **S** | **S** | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| **CO4** | **S** | **S** | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |
| **CO5** | **S** | **S** | **M** | **S** | **S** | **S** | **M** | **M** | **M** | **M** |

\*S-Strong; M-Medium; L-Low

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| **Course code** | | **25AI2E3** | **MACHINE LEARNING FOR BIG DATA** | **L** | **T** | | **P** | **C** | |
| **Core/Elective/Supportive** | | | **ELECTIVE** | **2** | **0** | | **4** | **4** | |
| **Prerequisite** | | | Fundamentals of Database Management, Data Mining, and System Software | **Syllabus Version** | | **2025-**  **2026** | | |
| **Course Objectives:** | | | | | | | | |
| The main objectives of this course are:   * To explain the concepts of machine learning and the need for handling big data. * To describe the challenges of analyzing massive data sets. * To describe different types of machine learning algorithms used for a variety of complex tasks. | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | |
| 1 | Understand the basic concepts of machine learning and MapReduce. | | | K2/K3 | | | | |
| 2 | Analyze the use of machine learning algorithms for finding similar items and data stream domain | | | K3/K4 | | | | |
| 3 | Understand the concepts of frequent item sets and clustering. | | | K2/K5 | | | | |
| 4 | Understand and analyze the use of machine learning for recommendation systems and its applications on social networks. | | | K2/K4/K5 | | | | |
| 5 | Analyze the use of large-scale machine learning and deep learning concepts in different domains | | | K4/K5/K6 | | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | |
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| **Unit:1** | | **MACHINE LEARNING** | | **12 hours** | | | | |
| Concept of Machine Learning: Approaches to Modeling- Importance of Words in Documents - Hash Functions- Indexes - Secondary Storage -The Base of Natural Logarithms - Power Laws - Map Reduce – Algorithms Using MapReduce – Extensions to MapReduce – The Communication Cost Model. | | | | | | | | |
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| **Unit:2** | | **FINDING SIMILAR ITEMS & DATA STREAMS** | | **12 hours** | | | | |
| Finding similar items: Applications of Near-Neighbor Search - Shingling – LSH - Distance Measures. Mining Data Streams: Stream data model - Sampling data - Filtering streams. Link Analysis: Page Rank, Link Spam | | | | | | | | |
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| **Unit:3** | | **FREQUENT ITEM SETS & CLUSTERING** | | **10 hours** | | | | |
| Frequent Item Sets: Market Basket Analysis, A-Priori Algorithm - PCY Algorithm. Clustering: Hierarchical clustering, K-Means, Clustering in Non-Euclidean Spaces, BFR, CURE. | | | | | | | | |
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| **Unit:4** | | **RECOMMENDATION SYSTEMS** | | **12 hours** | | | | |
| Recommendation Systems: Utility matrix - Content-based - Collaborative filtering - UV Decomposition. Mining Social Network Graphs: Social networks as graphs–Clustering – Partitioning - Simrank. Dimensionality Reduction: Eigen Value Decomposition- PCA – SVD | | | | | | | | |
| |  |  |  |  | | --- | --- | --- | --- | | **Unit:5** | | **LARGE-SCALE MACHINE LEARNING** | **12 hours** | | Large Scale Machine Learning: Neural Networks - The Support Vector Machines model and use of Kernels to produce separable data and non-linear classification boundaries. Overview - Deep learning; Tools for Data Ingestion; analytics and visualization | | | | |  | | | | | **Unit:6** | | **Contemporary Issues** | **2 hours** | | Expert lectures, online seminars - webinars | | | | |  | | **Total Lecture hours** | **60 hours** | |  | | | | | **Text Book(s)** | | | | | 1 | Tom M. Mitchel, “Machine Learning”, McGraw Hill, 2013 | | | | 2 | AnandRaja Raman, Jure Leskovec and J.D. Ullman, “Mining of Massive Data  Sets”, eBook, Cambridge University Press, 2014 | | | |  | | | | | **Reference Books** | | | | | 1 | Kevin P. Murphey, “Machine Learning, a Probabilistic Perspective”,  The MIT Press Cambridge, Massachusetts, 2012 | | | | 2 | Machine Learning and Big Data: Concepts, Algorithms, Tools and Applications  [Uma N. Dulhare (Editor)](https://www.wiley.com/en-ae/search?filters%5Bauthor%5D=Uma+N.+Dulhare&pq=++), [Khaleel Ahmad (Editor)](https://www.wiley.com/en-ae/search?filters%5Bauthor%5D=Khaleel+Ahmad&pq=++), [Khairol Amali Bin Ahmad (Editor)](https://www.wiley.com/en-ae/search?filters%5Bauthor%5D=Khairol+Amali+Bin+Ahmad&pq=++), Wiley, 2020 | | | | 3 | 0BBig Data, IoT, and Machine LearningTools and Application Tools and Applications, Edited By [Rashmi Agrawal](https://www.routledge.com/search?author=Rashmi%20Agrawal" \o "Search for more titles by Rashmi Agrawal), [Marcin Paprzycki](https://www.routledge.com/search?author=Marcin%20Paprzycki), [Neha Gupta](https://www.routledge.com/search?author=Neha%20Gupta), 2021, Taylor and Francis. | | | |  |  | | | | **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | 1 | https://nptel.ac.in/courses/106106139 | | | | 2 | https://nptel.ac.in/courses/106104189 | | | | 3 | https://www.geeksforgeeks.org/machine-learning/ | | | | 4 | https://www.javatpoint.com/machine-learning | | | | 5 | https://www.coursera.org/learn/machine-learning | | | |  | | | | | Course Designed By: **Dr. S. VIJAYARANI** | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | L | M | M | M | M | L | M |
| **CO2** | S | S | S | M | M | M | M | M | L | M |
| **CO3** | S | S | S | M | M | M | M | M | M | S |
| **CO4** | S | S | M | L | M | M | L | M | S | M |
| **CO5** | S | S | S | L | M | M | M | M | L | M |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | **25AI3E1** | **COMPUTER VISION** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **ELECTIVE** | **2** | **0** | **4** | **4** |
| **Pre-requisite** | | | | |  | **Syllabus**  **Version** | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | |
| * To Master the principles and algorithms of computer vision. * To Gain proficiency in image and video processing using Python and OpenCV. * To develop skills in object detection, recognition, and tracking. * To apply computer vision techniques to real-world applications. | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | |
| 1 | | Understand the computer vision fundamentals. | | | | | K2/K3 | | |
| 2 | | Apply algorithms to analyse images/videos. | | | | | K1/K3 | | |
| 3 | | Implement solutions using Python. | | | | | K2/K5 | | |
| 4 | | Develop object detection/recognition applications. | | | | | K6 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate; **K6** – Create | | | | | | | | | |
| **Unit 1** | | | **Foundations of Image Processing: Enhancing, Detecting, and Transforming** | | | | **11 hours** | | |
| Introduction to Image Processing-Basic mathematical concepts: Image enhancement: Grey level transforms, Spatial filtering. Extraction of special features: edge and corner detection. Morphological processing, Image transforms, Discrete Fourier Transform, Fast Fourier Transform. Frequency domain enhancement. Sieve for primes, Modular exponentiation | | | | | | | | | |
| **Unit 2** | | | **Advanced Techniques in Image Segmentation, Feature Detection, and Recognition** | | | | **12 hours** | | |
| Image Segmentation Algorithms: contextual, non-contextual segmentation, texture segmentation. Feature Detectors and Descriptors, Feature Matching-Object Recognition, Face detection (Viola Jones), Face Recognition, Modern computer vision architectures based on deep convolutional neural networks | | | | | | | | | |
| **Unit 3** | | | **Dynamic Vision: Tracking, Detection, and Action Recognition** | | | | **11 hours** | | |
| The Use of Motion in Segmentation Optical Flow & Tracking Algorithms, YOLO, Deep SORT: Deep Learning to Track Custom Objects in a Video, Action classification with convolutional neural networks, RNN,LSTM | | | | | | | | | |
| **Unit 4** | | | **Advanced Image Registration and Camera Calibration Techniques** | | | | **12 hours** | | |
| Image registration, 2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration,-Camera Models and Calibration: Camera Projection Models – orthographic, affine, perspective projective models. Projective Geometry, transformation of 2-d and 3-d, Internal Parameters, Lens | | | | | | | | | |
| **Unit 5** | | | **Mastering Camera Calibration and 3D Reconstruction Techniques: From Distortion Models to SLAM** | | | | **14 hours** | | |
| Distortion Models, Calibration Methods – linear, direct, and indirect and multi plane methods. Geometry of Multiple views- Stereopsis, Camera and Epipolar Geometry, Fundamental matrix; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration., Introduction to SLAM (Simultaneous Localization and Mapping). algorithms. | | | | | | | | | |
|  | | | **Total Lecture hours** | | | | **60 hours** | | |
| **Text Book(s)** | | | | | | | | | |
| 1 | Deep Learning (Adaptive Computation and Machine Learning series) Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, January 2017, MIT Press | | | | | | | | |
| 2 | Introduction to Computer Vision and its Application, Richard Szelinski,2010 | | | | | | | | |
| 3 | E. Trucco and A. Verri, Prentice Hall, 1998.Introductory techniques for 3D Computer Vision. | | | | | | | | |
| **Reference Books** | | | | | | | | | |
| 1 | Marco Treiber, “An Introduction to Object Recognition Selected Algorithms for a Wide Variety of Applications”, Springer, 2010. | | | | | | | | |
| 2 | Forsyth and Ponce, “Computer Vision – A Modern Approach”, Second Edition, Prentice Hall,2011 | | | | | | | | |
| 3 | R. C. Gonzalez, R. E. Woods, ‘Digital Image Processing’, 4th edition Addison-Wesley,2016 | | | | | | | | |
| Course Designed By: **Dr. R. PORKODI** | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | L | M | M | M | M | L | M |
| **CO2** | S | S | S | M | M | M | M | M | L | M |
| **CO3** | S | S | S | M | M | M | M | M | M | S |
| **CO4** | S | S | M | L | M | M | L | M | S | M |
| **CO5** | S | S | S | L | M | M | M | M | L | M |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | **25AI3E2** | **QUANTUM AI** | | | **L** | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **ELECTIVE** | | | **4** | | | **0** | | **0** | **4** |
| **Pre-requisite** | | | | | Basic knowledge in:   * Machine Learning * Programming Languages * Probability | | | **Syllabus Version** | | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | | | |
| The main objectives of this course are:   * To understand how the physical nature, as described by quantum physics, can lead to algorithms that imitate human behavior * To explore possibilities for the realization of artificial intelligence using quantum computation * To learn computational algorithms as described by quantum computation | | | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | | | | |
| 1 | | | Understand the usage of quantum algorithms in AI. | | | | | | | | | K2 | | |
| 2 | | | To develop problem-solving techniques. | | | | | | | | | K3 | | |
| 3 | | | To understand quantum physics-based information and probability theory. | | | | | | | | | K2 | | |
| 4 | | | To identify the quantum physics relationship to AI by associative memory and Bayesian networks | | | | | | | | | K2 / K4 | | |
| 5 | | | To understand the principles of quantum computation and its mathematical framework. | | | | | | | | | K2 /K4 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | |
| **Unit:1** | | | |  | | | | | | **10 hours** | | | | |
| Introduction - artificial intelligence - computation - Cantor’s diagonal argument - complexity theory - Decision problems - P and NP - Church–Turing Thesis - Von Neumann architecture – Problem Solving - Rules - Logic-based operators - Frames - Categorial representation - Binary vector representation - Production System - Deduction systems - Reaction systems - Conflict resolution. | | | | | | | | | | | | | | |
| **Unit:2** | | | |  | | | | | **12 hours** | | | | | |
| Human problem-solving - Information and measurement - Reversible Computation - Reversible circuits - Toffoli gate. | | | | | | | | | | | | | | |
| **Unit:3** | | | |  | | | **15 hours** | | | | | | | |
| Introduction to quantum physics - Unitary Evolution - Quantum Mechanics - Hilbert space - Quan- tum Time Evolution - Von Neumann Entropy - Measurement - Heisenberg’s uncertainty principle - Randomness - computation with Qubits - Computation with m Qubit - Matrix Representation of Serial and Parallel Operations - Quantum Boolean Circuits - Periodicity - Quantum Fourier Transform - Unitary Transforms - Search and Quantum Oracle. | | | | | | | | | | | | | | |
| **Unit:4** | | | |  | | | **11 hours** | | | | | | | |
| Grover’s Amplification - Circuit Representation - Speeding up the Traveling Salesman Problem - The Generate-and-Test Method - Quantum Problem - Solving - Heuristic Search - Quantum Tree Search - Tarrataca’s Quantum Pro- duction System. | | | | | | | | | | | | | | |
| **Unit:5** | | | |  | | **10 hours** | | | | | | | | |
| A General Model of a Quantum Computer - Cognitive architecture - Representation – Quantum Cognition - Decision making - Unpacking Effects - Quantum walk on a graph - Quantum annealing - Optimization problems - Quantum Neural Computation - Applications on Quantum annealing Computer - Development libraries - Quantum Computer simulation tool kits. | | | | | | | | | | | | | | |
| **Unit:6** | | | |  | | **2 hours** | | | | | | | | |
| Discussion on case study - Online seminars – Webinars - Workshops | | | | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | **60 hours** | | | | | | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1 | Andreas Wichert, Principles of Quantum Artificial Intelligence, First edition, World Scientific Publishing, 2014. | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | |
| 1 | Peter Wittek, Quantum Machine Learning: what Quantum means to data mining, Academic Press, 2014. | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | | | |
| 1 | | https://www.udemy.com/topic/quantum-computing/ | | | | | | | | | | | | |
| Course Designed By: **Dr. P. B. Pankajavalli** | | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | L | M | L | S | L | M | M | M |
| **CO2** | S | S | S | S | M | S | L | M | M | M |
| **CO3** | M | M | M | M | M | M | L | M | M | S |
| **CO4** | S | M | M | S | S | S | L | M | M | M |
| **CO5** | M | S | M | M | M | M | L | M | M | M |

\*S-Strong; M-Medium; L-Low

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| **Course Code** | | | | | **25AI3E3** | **APPLIED PREDICTIVE ANALYTICS** | | | **L** | | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **ELECTIVE** | | | **4** | | | | **0** | **0** | **4** |
| **Pre-requisite** | | | | | | **Linear Algebra and Probability** | | | **Syllabus Version** | | | | | **2025-2026** | |
| **Course Objectives:** | | | | | | | | | | | | | | | |
| The main objectives of this course are:   * To familiarize students with the methods for exploration and visualization of data. * To develop machine learning models for predictive tasks. * To choose suitable performance measures for predictive models. * To apply predictive modeling techniques in real-world data. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | | | | | | | | |
| 1 | | | Understanding the basics of predictive analytics | | | | | | | | | K2 | | | |
| 2 | | | To review the various analytical methods | | | | | | | | | K3 | | | |
| 3 | | | To gain an in-depth understanding of supervised and unsupervised learning for predictive analytics | | | | | | | | | K2 | | | |
| 4 | | | To understand the various analytics methods and time series approaches | | | | | | | | | K2 / K4 | | | |
| 5 | | | To understand the principles of forecasting analytics | | | | | | | | | K2 /K4 | | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | |
| **Unit:1** | | | |  | | | | | | | **10 hours** | | | | |
| Introduction and Overview of Predictive Analytics – Building a Predictive Model - Predictive Power and Overfitting - Data Partitioning – Exploratory Data Analysis - Data Visualization – Dimension | | | | | | | | | | | | | | | |
| **Unit:2** | | | |  | | | | | | **12 hours** | | | | | |
| Reduction - Principal Components Analysis - Performance Evaluation - Evaluating Predictive Performance - Judging Classifier Performance – Lift and Decile Charts – Oversampling. | | | | | | | | | | | | | | | |
| **Unit:3** | | | |  | | | | **12 hours** | | | | | | | |
| Prediction and Classification Methods - Multiple Linear Regression - Explanatory vs. Predictive Modeling - Estimating the Regression Equation and Prediction - The k-NN Classifier (Categorical Outcome) - The Naive Bayes Classifier - Classification and Regression Trees - Logistic Regression. | | | | | | | | | | | | | | | |
| **Unit:4** | | | |  | | | | **14 hours** | | | | | | | |
| Neural Nets - Discriminant Analysis - Combining Methods: Ensembles - Uplift Modeling – Association Rules and Collaborative Filtering - Clustering. Forecasting Time Series – Components of a Time Series – Data Partitioning and Performance Evaluation for Time Series – Na¨ıve Forecasts - Smoothing Methods - Introduction - Moving Average. | | | | | | | | | | | | | | | |
| **Unit:5** | | | |  | | | **10 hours** | | | | | | | | |
| Simple Exponential Smoothing – Advanced Exponential Smoothing–Regression-Based Forecasting - Autocorrelation and ARIMA Models - Data Analytics - Social Network Analytics - Text Mining -predictive analytics in business application - Other Case Studies. | | | | | | | | | | | | | | | |
| **Unit:6** | | | |  | | | **2 hours** | | | | | | | | |
| Discussion on case study - Online seminars – Webinars - Workshops | | | | | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | **60 hours** | | | | | | | | |
| **Text Books** | | | | | | | | | | | | | | | |
| 1 | Max Kuhn and Kjell Johnson, “Applied Predictive Modeling”, Springer, 2018. | | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | | |
| 1 | GalitShmueli, Peter C. Bruce, InbalYahav, Nitin R. Patel, Kenneth C. LichtendahlJr“ Data Mining for Business Analytics: Concepts, Techniques, and Applications in Python”, Wiley, 2019. | | | | | | | | | | | | | | |
| 2 | Daniel T. Larose and Chantal D. Larose, “Data Mining and Predictive Analytics” (Wiley Series on Methods and Applications in Data Mining), Wiley, 2015. | | | | | | | | | | | | | | |
| 3 | Ratner Bruce, ”Statistical and Machine-Learning Data Mining:: Techniques for Better Predictive Modeling and Analysis of Big Data”, CRC Press, 2017. | | | | | | | | | | | | | | |
| 4 | Abbott Dean, ”Applied predictive analytics: Principles and techniques for the professional data analyst”, John Wiley & Sons, 2014. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | | | | | |
| 1 | | https://www.udemy.com/topic/quantum-computing/ | | | | | | | | | | | | | |
| Course Designed By: **Dr. P. B. Pankajavalli** | | | | | | | | | | | | | | | |

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| **Mapping with Programme Outcomes** | | | | | | | | | | |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | M | M | L | L | L | M | M | M |
| **CO2** | S | S | S | M | M | M | L | M | M | M |
| **CO3** | S | M | M | M | M | M | L | M | M | S |
| **CO4** | M | S | S | M | S | S | L | M | S | S |
| **CO5** | M | M | S | S | S | M | L | M | M | M |

\*S-Strong; M-Medium; L-Low

JOB ORIENTED

&

VALUE ADDED COURSES

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Job Oriented Course - DATA ANALYSIS USING EXCEL** | | | | | | | | |
| **Name of the Department** | | | | | **Computer Science** | | | |
| **Name of the Faculty Member i/c**  **with Complete Address with Phone and**  **E-mail** | | | | | Dr. S. Vijayarani  Assistant Professor  Department of Computer Science  Bharathiar University, Coimbatore – 641 046  [vijayarani@buc.edu.in](mailto:vijayarani@buc.edu.in) | | | |
| **Inter / Intra Department Course** | | | | | **Intra Department Course** | | | |
| **Duration of the Course** | | | | | **30 Hours** | | | |
| **Eligibility** | | | | | U.G. in Computer Science / Computer  Applications / Information Technology or its  equivalent | | | |
| **Number of Candidates to be Admitted** | | | | | **30** | | | |
| **Mode of the Course** | | | | | **Both Regular and Online** | | | |
| **Collaboration if any with Companies**  (if Yes, Full Address of the Company Address ,  Name of the Contact Person, Phone, e-mail etc.) | | | | | **---** | | | |
| **Registration Procedure** | | | | |  | | | |
| **Job Opportunities:** | | | | |  | | | |
| * Data Analyst * Data Scientist | | | | | | | | |
| The main objectives of this course are:   1. To understand the basics of the analysis process in Excel 2. To remember the various components and their functions in the Excel worksheet 3. To learn about advanced formulas creation and charts preparation 4. To implement different kinds of data analysis tasks 5. To handle pivot tables and macros | | | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | |
| 1 | | | Understand the need for MS-Excel and the working of various components | | | | | K1/K2/K4 |
| 2 | | | Experiment with the given data by using different functions, ranges and formulas | | | | | K2/K3/K4 |
| 3 | | | Evaluate the data analysis results and visualize them by using charts | | | | | K4/K5/K6 |
| 4 | | | Analyze the pivot tables and the different spreadsheet tools | | | | | K4/K5 |
| 5 | | | Create the macros and applied them for analytical tasks | | | | | K4 / K6 |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | |
|  | | | | | | | | |
| **Course Content** | | | | **Lecture / Practical / Project / Internship** | | | | |
| **DATA ANALYSIS USING EXCEL (30 Hours, 2 Credits)** | | | | | | | | |
| **Module 1** | | | | **Introduction to Excel:** About Excel & Microsoft, Uses of Excel, Excel software, Spreadsheet window pane, Title Bar, Menu Bar, Standard Toolbar, Formatting Toolbar, the Ribbon, File Tab and Backstage View, Formula Bar, Workbook Window, Status Bar, Task Pane, Workbook & sheets | | 3 Hours | | |
| **Module 2** | | | | **Columns & Rows:**  Selecting Columns & Rows, Changing Column Width & Row Height, Autofitting Columns & Rows, Hiding/Unhiding Columns & Rows, Inserting & Deleting Columns & Rows, Cell, Address of a cell, Components of a cell – Format, value, formula, Use of paste and paste special | | | 3 Hours | |
| **Module 3** | | | | **Functionality Using Ranges:** Using Ranges, Selecting Ranges, Entering Information into a Range, Using AutoFill | | | 2 Hours | |
| **Module 4** | | | | **Creating Formulas:** Using Formulas, Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower, Using AutoSum | | | 4 Hours | |
| **Module 5** | | | | **Advance Formulas:** Concatenate, Vlookup, Hlookup, Match, Countif, Text, Trim | | | 3 Hours | |
| **Module 6** | | | | **Spreadsheet Charts:**  Creating Charts, Different types of charts, Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table | | | 4 Hours | |
| **Module 7** | | | | **Data Analysis:** Sorting, Filter, Text to Column, Data Validation | | | 3 Hours | |
| **Module 8** | | | | **PivotTables:**  Creating PivotTables, Manipulating a PivotTable, Using the PivotTable Toolbar, Changing Data Field, Properties, displaying a PivotChart, Setting PivotTable Options. Adding Subtotals to PivotTables | | | 3 Hours | |
| **Module 9** | | | | **Spreadsheet Tools:** Moving between Spreadsheets, Selecting Multiple Spreadsheets, Inserting and Deleting Spreadsheets Renaming Spreadsheets, Splitting the Screen, Freezing Panes, Copying and Pasting Data between Spreadsheets, Hiding, Protecting worksheets | | | 3 Hours | |
| **Module 10** | | | | **Making Macros:** Recording Macros, Running Macros, Deleting Macros | | | 2 Hours | |
| **Text Books** | | | | | | | | |
| 1 | Hector Guerrero, Excel Data Analysis Modeling and Simulation, Second Edition, Springer, 2019 | | | | | | | |
| 2 | Berk & Carey, Data Analysis with Microsoft Excel, Brooks / Cole Cengage Learning, 2010 | | | | | | | |
| 3 | Ash Narayan Sah, Data Analysis using Microsoft Excel, Excel Books, 2009 | | | | | | | |
|  | | | | | | | | |
| **Reference Books** | | | | | | | | |
| 1 | Stephen Nelson and Elizabeth C.Nelson, Excel Data Analysis for Dummies, 3rd Edition, John Wiley & Sons, Inc., 2016 | | | | | | | |
| 2 | Paul McDefries, Microsoft Excel Data Analysis for Dummies, John Wiley & Sons, Inc., 2019 | | | | | | | |
|  | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | |
| 1 | | https://www.coursera.org/learn/excel-data-analysis | | | | | | |
| 2 | | https://www.datacamp.com/courses/data-analysis-in-excel | | | | | | |
| 3 | | https://online.rice.edu/courses/excel-data-analysis | | | | | | |
| 4 | | https://www.tutorialspoint.com/excel\_data\_analysis/index.htm | | | | | | |
| 5 | | https://www.excel-easy.com/data-analysis.html | | | | | | |

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| **Job Oriented Course - POWER BI FOR DATA ANALYTICS** | | | | | | | | |
| **Name of the Department** | | | | | **Computer Science** | | | |
| **Name of the Faculty Member i/c**  **with Complete Address with Phone and**  **E-mail** | | | | | Dr. S. Vijayarani  Assistant Professor  Department of Computer Science  Bharathiar University, Coimbatore – 641 046  [vijayarani@buc.edu.in](mailto:vijayarani@buc.edu.in) | | | |
| **Inter / Intra Department Course** | | | | | **Intra Department Course** | | | |
| **Duration of the Course** | | | | | **30 Hours** | | | |
| **Eligibility** | | | | | U.G. in Computer Science / Computer  Applications / Information Technology or its  equivalent | | | |
| **Number of Candidates to be Admitted** | | | | | **40** | | | |
| **Mode of the Course** | | | | | **Both Regular and Online** | | | |
| **Collaboration if any with Companies**  (if Yes, Full Address of the Company Address ,  Name of the Contact Person, Phone, e-mail etc.) | | | | | **---** | | | |
| **Registration Procedure** | | | | |  | | | |
| **Job Opportunities:** | | | | |  | | | |
| * Data Analyst * Data Scientist | | | | | | | | |
| The main objectives of this course are:  To understand the key concepts of business intelligence and the Power BI ecosystem   1. To perform different operations by using the data 2. To learn about the creation of data models and final reports 3. To understand the use of dashboards, apps and security 4. To conduct the business data analysis tasks | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | | |
| 1 | | | Understand the key concepts of business intelligence and Power BI Desktop | | | | | K1/K2 |
| 2 | | | Perform data transformation tasks and create the data models | | | | | K3 / K6 |
| 3 | | | Apply advanced visualization and create the reports | | | | | K3/K4/K6 |
| 4 | | | Create the dashboards and apps | | | | | K4/K5/K6 |
| 5 | | | Use data gateways and refreshing datasets. | | | | | K3/K4/K5 |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create | | | | | | | | |
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| **Course Content** | | | | **Lecture / Practical / Project / Internship** | | | | |
| **POWER BI FOR DATA ANALYTICS (30 Hours, 2 Credits)** | | | | | | | | |
| **Module 1** | | | | **Introduction to Power BI:** Key concepts of business intelligence, The Power BI ecosystem, Power BI Licensing, Power BI Desktop and Service | | 3 Hours | | |
| **Module 2** | | | | **Power BI Desktop:** Downloading and installing Power BI Desktop, Touring the Desktop, generating data, Creating Visualizations | | | 3 Hours | |
| **Module 3** | | | | **Connecting and Shaping Data:** Getting data, transforming data, Merging, Copying and Appending Queries, Verifying and Loading data | | | 2 Hours | |
| **Module 4** | | | | **Creating Data Models and Calculations:** Creating a data model, creating calculations, checking and troubleshooting calculations | | | 4 Hours | |
| **Module 5** | | | | **Unlocking Insights:** Segmenting data, Using report navigation features, Advanced visualization techniques | | | 3 Hours | |
| **Module 6** | | | | **Creating the final report:**  Preparing the final report, creating the final report pages, Finishing up | | | 4 Hours | |
| **Module 7** | | | | **The Service:** Getting an account, Introducing the Service, Publishing and Sharing | | | 3 Hours | |
| **Module 8** | | | | **Using Reports in the Service:**  Viewing reports, exporting reports, embedding reports, Editing and creating reports | | | 3 Hours | |
| **Module 9** | | | | **Understanding Dashboards, Apps and Security:** Understanding dashboards, understanding apps, Understanding security and permissions | | | 3 Hours | |
| **Module 10** | | | | **Data Gateways and Refreshing Datasets:** Installing and using data gateways, Refreshing datasets | | | 2 Hours | |
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| **Text Books** | | | | | | | | |
| 1 | Greg Deckler Learn Power BI - A beginner's guide to developing interactive business intelligence solutions using Microsoft Power BI, Packt Publishing, 2019 | | | | | | | |
|  | | | | | | | | |
| **Reference Books** | | | | | | | | |
| 1 | Alberto Ferrari and Marco Russo, Introducing Microsoft Power BI, Microsoft Press, 2016 | | | | | | | |
| 2 | Devin Knight, Brian Knight, Mitchell Pearson, Manuel Quintana, Brett Powell, Microsoft Power BI Complete Reference- Bring your data to life with the powerful features of Microsoft  Power BI, Packt Publishing, 2018 | | | | | | | |
|  | | | | | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | |
| 1 | | https://powerbi.microsoft.com/en-us/learning/ | | | | | | |
| 2 | | https://www.udemy.com/topic/microsoft-power-bi/ | | | | | | |
| 3 | | https://www.simplilearn.com/power-bi-certification-training-course | | | | | | |
| 4 | | https://intellipaat.com/power-bi-training/ | | | | | | |
| 5 | | https://www.tutorialspoint.com/power\_bi/index.htm | | | | | | |
| 6 | | https://www.javatpoint.com/power-bi | | | | | | |
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| **Job Oriented Course -** **MOBILE APPLICATION DEVELOPMENT** | | | | | | | | | |
| **Name of the Department** | | | | | | | **Computer Science** | | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | | **Dr. R. Porkodi**  **Associate Professor**  **Department of Computer Science**  **Bharathiar University**  **Coimbatore – 46**  **0422-2428349**  **porkodi\_r76@buc.edu.in** | | |
| **Inter / Intra Department Course** | | | | | | | **Intra Department Course** | | |
| **Duration of the Course** | | | | | | | **30 Hours** | | |
| **Eligibility** | | | | | | | U.G. in Computer Science/Computer Applications/Information Technology or its equivalent | | |
| **Number of Candidates to be Admitted** | | | | | | | **40** | | |
| **Mode of the Course** | | | | | | | **Both Regular and Online** | | |
| **Collaboration if any with Companies**  (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.) | | | | | | | **---** | | |
| **Registration Procedure** | | | | | | |  | | |
| **Job Opportunities:** | | | | | | | | | |
| * To become mobile app developer in Retail, healthcare sector, Travel and tourism industry, Entertainment industry, Financial services and Media organizations. | | | | | | | | | |
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| **The objectives of the Course are:** | | | | | | | | | |
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| 1 | | | Provides a comprehensive overview and focuses on developing multiplatform mobile applications using the Web skills. | | | | | | |
| 2 | | | Strengthen the skills of students in learning hybrid application framework to develop and target multiple mobile platforms with a single codebase. | | | | | | |
| 3 | | | Enrich the knowledge of students in Ionic one of fastest growing mobile application framework. | | | | | | |
| 4 | | |  | | | | | | |
| **Course Outcomes:** | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | |
| 1 | | | Understand the basics of mobile devices, app store, development environments, characteristics, history of mobile application frameworks. | | | | | | |
| 2 | | | Understand the mobile application frameworks and setting up java, eclipse, android development components. Creating user interface design for mobile applications and managing application data. | | | | | | |
| 3 | | | Understanding the enterprise requirements and testing methodologies for mobile applications. | | | | | | |
| 4 | | | Understanding the hybrid mobile app development frameworks: CSS3, HTML 5, Iconic, Angular JS, Node.JS and developing the hybrid mobile applications | | | | | | |
| 5 | | | Understanding the mobile app deployment process, Usage of Sqlite, mongo DB and Mysql and IBM BlueMix. | | | | | | |
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| **Course Content** | | | | | | Lecture / Practical / Project / Internship | | | |
|  | | | | | | | | | |
| **Module 1** | | | | | Introduction to Mobile Devices: Introduction - Mobile vs. Desktop devices - App Store, Google Play, Windows Store - Development environments - PhoneGAP | | | | **3 hours** |
| **Module 2** | | | | | Native vs. web applications - Mobile Connectivity Evolution - Characteristics of mobile applications - History of mobile application frameworks | | | | **3 hours** |
| **Module 3** | | | | | Application models of mobile application frameworks - Setting up an android development environment: setting up java, eclipse, android development components, verify the development environment | | | | **3 hours** |
| **Module 4** | | | | | User interface design for mobile applications - Managing application data | | | | **3 hours** |
| **Module 5** | | | | | Addressing enterprise requirements in mobile applications: performance, scalability, modifiability, availability, and security | | | | **3 hours** |
| **Module 6** | | | | | Testing methodologies for mobile applications - Publishing, deployment, maintenance and management | | | | **3 hours** |
| **Module 7** | | | | | Hybrid Mobile App Development Frameworks: Introduction to CSS3.HTML5 - Full-Stack Web Development | | | | **3 hours** |
| **Module 8** | | | | | Hybrid Mobile App Development: Ionic and AngularJS - node.JS | | | | **3 hours** |
| **Module 9** | | | | | APP deployment: Angular ui-router and Resolve - Using Local Storage(Sqlite) -Databases - mongoDB, MySQL | | | | **3 hours** |
| **Module 10** | | | | | Ionic Adding Platforms - Building and Deploying the App - Hybrid Mobile Development and IBM BlueMix | | | | **3 hours** |
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| **Text Book(s)** | | | | | | | | | |
| 1 | Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, Android Programming: The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 3rd edition, 2017. | | | | | | | | |
| 2 | Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK 3 for Dummies, Wiley. | | | | | | | | |
| 3 | Brian Fling, Mobile Design and Development, O’Reilly Media, Inc., 2009. | | | | | | | | |
|  | | | | | | | | | |
| **Reference Book(s)** | | | | | | | | | |
| 1 | Maximiliano Firtman, Programming the Mobile Web, O’Reilly Media, Inc., 2nd ed., 2013. | | | | | | | | |
|  | | | | | | | | | |
| **Related Online Contents** | | | | | | | | | |
| 1 | | <https://developer.android.com/> | | | | | | | |
| 2 | | <https://www.w3schools.in/category/android-tutorial/> | | | | | | | |
| 3 | | <https://www.tutorialspoint.com/android/index.htm> | | | | | | | |
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| **Job Oriented Course - SMART APPLICATIONS WITH INTERNET OF THINGS** | | | | | | | | | |
| **Name of the Department** | | | | | | | **Computer Science** | | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | | Dr.P.B.Pankajavalli  Assistant Professor  Dept. of Computer Science  Bharathiar University, Coimbatore  Phone : 2428603, pankajavalli@buc.edu.in | | |
| **Inter / Intra Department Course** | | | | | | | Intra Department Course | | |
| **Duration of the Course** | | | | | | | 30 Hours | | |
| **Eligibility** | | | | | | | U.G. in Computer Science/Computer Applications/Information Technology or its equivalent | | |
| **Number of Candidates to be Admitted** | | | | | | | 40 | | |
| **Mode of the Course** | | | | | | | **Both Regular and Online** | | |
| **Collaboration if any with Companies**  (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.) | | | | | | | **No** | | |
| **Registration Procedure** | | | | | | |  | | |
| **Job Opportunities:** | | | | | | | | | |
| Hardware and device development, Sensor networking professionals | | | | | | | | | |
| IoT cloud engineer, Product Manager | | | | | | | | | |
| **The objectives of the Course are:** | | | | | | | | | |
| The main objectives of this course are to: | | | | | | | | | |
| 1 | | | To understand the concept of sensors and microcontrollers | | | | | | |
| 2 | | | To remember basic syntax in C programming | | | | | | |
| 3 | | | To apply sensor on microcontrollers | | | | | | |
| 4 | | | To understand the interfacing of cloud with sensors | | | | | | |
| 5 | | | To evaluate and visualize the data in the cloud | | | | | | |
| **Expected Course Outcomes:** | | | | | | | | | |
| 1 | | | | Understand the basics of sensors and sensor networks | | | | K2/K3 | |
| 2 | | | | Create basic arduino code and to gain knowledge on built in code | | | | K1/K2/K4 | |
| 3 | | | | Develop small IoT prototype using different sensors. | | | | K3/K4 | |
| 4 | | | | Explore the usage of buzzers, motors, relays and LED lights | | | | K3/K4 | |
| 5 | | | | Deploy interface with cloud and to visualize data | | | | K2/K3/K5 | |
| **K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5- Create** | | | | | | | | | |
| **Course Content** | | | | | | **Lecture / Practical** / Project / Internship | | | |
| **Smart Applications with Internet of Things (30 Hours, 2 credits)** | | | | | | | | | |
| **Module 1** | | | | | Anatomy of Sensors Networks – Topology of Sensor Network – Type of Sensor Nodes – Sensors- Sensors measures | | | | **2 hours** |
| **Module 2** | | | | | Analog Sensors- Digital Sensors – Storing senor data – Examples | | | | **2 hours** |
| **Module 3** | | | | | Understanding the Arduino board – Arduino Board types- Virtronics Simulator for Arduino- Tinkercad -Arduino IDE - Installing and Setting up the Arduino IDE - Connecting the Arduino IDE with devices | | | | **3 hours** |
| **Module 4** | | | | | Program Structure in C - Basic Syntax - Data Types / Variables / Constants - Operators, Conditional Statements and Loops -Functions, Array and Pointers - Strings and I/O - Arduino C Library functions - Working with Arduino inbuilt examples. | | | | **4 hours** |
| **Module 5** | | | | | Understanding Sensors and Devices - Understanding basic electronic components and power elements - Understanding the Inputs from Sensors - Working with Temperature Sensors, Ultrasound Sensor, Humidity sensor, Motion Sensor | | | | **3 hours** |
| **Module 6** | | | | | Working with IR Sensor - Working with Proximity Sensor - Working with Photo Diode - Working with Accelerometer and vibration sensor - Introduction to Raspberry Pi. | | | | **3 hours** |
| **Module 7** | | | | | Understanding the Outputs - Activating LED Lights - Activating Relays - Activating Buzzer | | | | **3 hours** |
| **Module 8** | | | | | Running DC Motors - Running - Stepper Motors and Servo Motors | | | | **3 hours** |
| **Module 9** | | | | | Introduction to cloud – Thingspeak IoT Analytics Platform – API key – Thingspeak login – API Key Process | | | | **3 hours** |
| **Module 10** | | | | | ESP8266 WI-FI Module – Installation of ESP8266 board package to Arduino IDE – Circuit Diagram – Graph visualization – Introduction to Adafruit, Bolt, Blynk, and ​IFTTT | | | | **4 hours** |
|  | | | | |  | | | |  |
| **Text Book(s)** | | | | | | | | | |
| 1 | Michael Margolis, “Arduino Cookbook” 2nd Edition, O'Reilly Media, 2011. | | | | | | | | |
| 2 | Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi”, 1st Edition, Technology in Action, 2013. | | | | | | | | |
|  | | | | | | | | | |
| **Reference Book(s)** | | | | | | | | | |
| 1 | Arvind Ravulavaru, Enterprise Internet of Things Handbook: Build end-to-end IoT solutions using popular IoT platforms, Packt Publishing Limited, 2018. | | | | | | | | |
|  | | | | | | | | | |
| **Related Online Contents** | | | | | | | | | |
| 1 | | <https://electronics-project-hub.com/send-data-to-thingspeak-using-esp8266/> | | | | | | | |
| 2 | | <https://virtronics.com.au/Simulator-for-Arduino.html> | | | | | | | |
| 3 | | <https://www.instructables.com/id/ESP8266-to-IFTTT-Using-Arduino-IDE/> | | | | | | | |
| Course Designed by: Dr.P.B.Pankajavalli | | | | | | | | | |

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| **Job-Oriented Course -** **DevOps** | | | | | | | |
| **Name of the Department** | | | | | | **Computer Science** | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | **Dr. S. Vijayarani**  **Associate Professor**  **Department of Computer Science**  **Bharathiar University**  **Coimbatore – 46**  **0422-2428353**  **vijayarani@buc.edu.in** | |
| **Inter / Intra Department Course** | | | | | | **Intra Department Course** | |
| **Duration of the Course** | | | | | | **30 Hours** | |
| **Eligibility** | | | | | | **U.G. in Computer Science/Computer Applications/Information Technology or its equivalent** | |
| **Number of Candidates to be Admitted** | | | | | | **40** | |
| **Mode of the Course** | | | | | | **Both Regular and Online** | |
| **Collaboration if any with Companies**  (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.) | | | | | | **---** | |
| **Registration Procedure** | | | | | |  | |
| **Job Opportunities:** | | | | | | | |
| * This course prepares students for roles such as DevOps Engineer, Site Reliability Engineer, and Build & Release Engineer. * Graduates will be able to automate software development, streamline deployments, and manage cloud infrastructure using DevOps tools and practices. | | | | | | | |
|  | | | | | | | |
| **The objectives of the Course are:** | | | | | | | |
|  | | | | | | | |
| 1 | | | To introduce the core principles and practices of DevOps methodology. | | | | |
| 2 | | | To provide hands-on knowledge of continuous integration and continuous deployment tools. | | | | |
| 3 | | | To build knowledge of automation, infrastructure as code, and containerization. | | | | |
| 4 | | | To understand the role of DevOps in cloud platforms and agile development. | | | | |
| **Course Outcomes:** | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | |
| 1 | | | Understand the DevOps culture, practices, and their impact on the software development life cycle. | | | | |
| 2 | | | Implement continuous integration/continuous deployment (CI/CD) pipelines. | | | | |
| 3 | | | Utilize popular DevOps tools, including Git, Jenkins, Docker, and Kubernetes. | | | | |
| 4 | | | Automate infrastructure provisioning using tools like Ansible or Terraform. | | | | |
| 5 | | | Apply DevOps practices in cloud platforms like AWS or Azure. | | | | |
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| **Course Content** | | | | | Lecture / Practical / Project / Internship | | |
|  | | | | | | | |
| **Module 1** | | | | Introduction to DevOps – History, Principles, Benefits, DevOps Lifecycle | | | **3 hours** |
| **Module 2** | | | | Agile and Scrum Overview – Relationship with DevOps | | | **3 hours** |
| **Module 3** | | | | Version Control using Git and GitHub | | | **3 hours** |
| **Module 4** | | | | Continuous Integration using Jenkins – Pipelines and Build Automation | | | **3 hours** |
| **Module 5** | | | | Configuration Management using Ansible or Chef | | | **3 hours** |
| **Module 6** | | | | Containerization with Docker – Docker Images, Dockerfile | | | **3 hours** |
| **Module 7** | | | | Orchestration using Kubernetes – Pods, Services, Deployments | | | **3 hours** |
| **Module 8** | | | | Monitoring & Logging – Prometheus, Grafana, ELK Stack | | | **3 hours** |
| **Module 9** | | | | Infrastructure as Code using Terraform – Basics and Examples | | | **3 hours** |
| **Module 10** | | | | DevOps on Cloud – AWS DevOps Services Overview | | | **3 hours** |
| **Total** | | | |  | | | **30 hours** |
| **Text Book(s)** | | | | | | | |
| 1 | Len Bass, Ingo Weber, Liming Zhu, DevOps: A Software Architect's Perspective, Addison-Wesley, 2015. | | | | | | |
| 2 | Gene Kim, Patrick Debois, John Willis, Jez Humble, The DevOps Handbook, IT Revolution Press, 2016. | | | | | | |
|  | | | | | | | |
| **Reference Book(s)** | | | | | | | |
| 1 | Stephen Fleming, DevOps Handbook for Beginners, 2019. | | | | | | |
| 2 | Viktor Farcic, The DevOps 2.0 Toolkit, Packt Publishing, 2016. | | | | | | |
| 3 | Rajesh S. R., Getting Started with DevOps, Packt Publishing, 2017. | | | | | | |
|  | | | | | | | |
| **Related Online Contents** | | | | | | | |
| 1 | | <https://www.edx.org/learn/devops> | | | | | |
| 2 | | <https://www.coursera.org/specializations/devops> | | | | | |
| 3 | | <https://www.tutorialspoint.com/devops/index.htm> | | | | | |
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| **Value Added Course - SOFTWARE TESTING TOOLS** | | | | | | | |
| **Name of the Department** | | | | | | **Computer Science** | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | **Dr.K. Geetha**  Assistant Professor  Department of Computer Science Bharathiar University Coimbatore – 641 046.  Phone **: 9965497121**  E mail **: geetha.k@buc.edu.in** | |
| **Inter / Intra Department Course** | | | | | | **Intra Department Course** | |
| **Duration of the Course** | | | | | | **30 Hours** | |
| **Eligibility** | | | | | | U.G. in Computer Science/Computer Applications/Information Technology or its  equivalent | |
| **Number of Candidates to be Admitted** | | | | | | 40 | |
| **Registration Procedure** | | | | | |  | |
| **Job Opportunities:** Opportunities available in IT sectors | | | | | | | |
|  | | | | | | | |
| **The objectives of the Course are:** | | | | | | | |
| The main objectives of this course are to: | | | | | | | |
| 1 | | Inculcate the knowledge on the fundamentals of security | | | | | |
| 2 | | Present the different types of software testing, | | | | | |
| 3 | | Learn the different types of errors | | | | | |
| 4 | | Examine the tools for Software Testing | | | | | |
| 5 | | Testing few test cases using tool | | | | | |
|  | | | | |  | | |
| **Course Content** | | | | | Lecture / Practical / Project / Internship | | |
| **Expected Course Outcomes** | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | |
| 1 | | | Understand and Remember the basic concepts of Software Testing | | | | K1/K2 |
| 2 | | | Understand and Remember the types of testing | | | | K1/K4 |
| 3 | | | Analyze the types of errors | | | | K2/K4 |
| 4 | | | Analyze and developing test cases | | | | K2/K4/K6 |
| 5 | | | Experimenting test cases using testing tools available as open source | | | | K3/K4/K5 |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | |
| **Module 1** | | | | Introduction to Software Testing and Terminology | | | **2 hours** |
| **Module 2** | | | | Types of Testing | | | **2 hours** |
| **Module 3** | | | | Types of errors | | | **2 hours** |
| **Module 4** | | | | Penetration testing and security | | | **2 hours** |
| **Module 5** | | | | Types of Hacking | | | **2 hours** |
| **Module 6** | | | | Developing test cases | | | **4hours** |
| **Module 7** | | | | Unit testing - test cases | | | **4 hours** |
| **Module 8** | | | | Functional testing with test cases | | | **4 hours** |
| **Module 9** | | | | Security testing with test cases | | | **4 hours** |
| **Module 10** | | | | Penetration testing with test cases | | | **4 hours** |
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| **Text Book(s)** | | | | | | | |
| 1 | Software Testing- A Craftsman’s Approach, Paul C. Jorgensen, Fourth Edition, CRC Press, 2014 | | | | | | |
| 2 | Penetration Testing- A Hands-On Introduction to Hacking, by Georgia Weidman, No Starch Press, USA, 2014 | | | | | | |
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| **Related Online Contents** | | | | | | | |
| 1 | https://www.tutorialspoint.com/software\_testing/index.htm | | | | | | |
| 2 | https://www.geeksforgeeks.org/software-testing-basics/ | | | | | | |

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| **Value Added Course -**  **CYBER SECURITY AND DIGITAL FORENSICS** | | | | | | | |
| **Name of the Department** | | | | | | **Department of Computer Science** | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | **Dr. R. Porkodi**  **Associate Professor**  **Department of Computer Science**  **Bharathiar University**  **Coimbatore – 46**  **0422-2428349**  **porkodi\_r76@buc.edu.in** | |
| **Inter / Intra Department Course** | | | | | | **Intra Department Course** | |
| **Duration of the Course** | | | | | | **30 hrs** | |
| **Eligibility** | | | | | |  | |
| **Number of Candidates to be Admitted** | | | | | | **40** | |
| **Mode of the Course** | | | | | | **Both Regular and Online** | |
| **Collaboration if any with Companies**  (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.) | | | | | | **---** | |
| **Registration Procedure** | | | | | |  | |
| **Job Opportunities:** | | | | | | | |
| * To become cyber security expert to identify IT breaches, vulnerabilities and threats facing companies in today’s digital world. | | | | | | | |
|  | | | | | | | |
| **The objectives of the Course are:** | | | | | | | |
|  | | | | | | | |
| 1 | | | To learn the impact of Cyber security risk in an Ethical, Social, and Professional Manner | | | | |
| 2 | | | To provide knowledge on data acquisition methods, tools, collecting, preserving and seizing of various digital evidences. | | | | |
| 3 | | | To understand the security services for email | | | | |
| **Course Outcomes:** | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | |
| 1 | | | Understand the basics of cyber space, ethical hacking and attacks in cyber world. | | | | |
| 2 | | | Understand unauthorized access to digital devices and cyber psychology. | | | | |
| 3 | | | Study of Collection of evidences, preservation and forensic analysis. | | | | |
| 4 | | | Describe the digital forensics software and hardware, tools, technologies, and practices in forensics. | | | | |
| 5 | | | Understanding the email tracking, IP tracking, cracking of passwords and forensic analysis of different artifacts. | | | | |
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| **Course Content** | | | | | Lecture / Practical / Project / Internship | | |
|  | | | | | | | |
| **Module 1** | | | | Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Traditional Problems associated with Computer Crimes, brief history of the internet, contaminants and destruction of data, unauthorized access. | | | **3 hrs** |
| **Module 2** | | | | Computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet. | | | **3 hrs** |
| **Module 3** | | | | Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling. Forensic analysis and its advanced tools, forensic technology and practices. | | | **3 hrs** |
| **Module 4** | | | | Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis. | | | **3 hrs** |
| **Module 5** | | | | Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation. | | | **3 hrs** |
| **Module 6** | | | | Email investigation, email tracking, IP tracking, email recovery, | | | **3 hrs** |
| **Module 7** | | | | search and seizure of computer systems, password cracking. | | | **3 hrs** |
| **Module 8** | | | | Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts. | | | **3 hrs** |
| **Module 9** | | | | Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences. | | | **3 hrs** |
| **Module 10** | | | | Social media analysis, data retrieval, Email analysis from mobile phones. | | | **3 hrs** |
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| **Book(s) for Study** | | | | | | | |
| 1 | M.T.Britz, Computer Forensics and Cyber Crime, Pearson Education, 2012. | | | | | | |
| 2 | Charles P. Fleeger, "Security in Computing", Prentice Hall, New Delhi, 2009. | | | | | | |
| 3 | BehrouzA.Forouzan, Cryptography & Network Security, Tata McGraw Hill, India, New Delhi, 2009. | | | | | | |
|  | | | | | | | |
| **Book(s) for reference** | | | | | | | |
| 1 | Bruce Schneier, Applied Cryptography, John Wiley & Sons, New York, 2004. | | | | | | |
| 2 | William Stallings, Cryptography and Network Security, Prentice Hall, New Delhi, 2006. | | | | | | |
| 3 | Neal Krawetz, Introduction to Network Security, Thomson Learning, Boston, 2007. | | | | | | |
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| **Related Online Contents** | | | | | | | |
| 1 | | https://www.w3schools.com › cybersecurity | | | | | |
| 2 | | https://www.javatpoint.com/cyber-security-tutorial | | | | | |
| 3 | | https://www.tutorialspoint.com/python\_digital\_forensics | | | | | |
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| **Value Added Course - REMOTE SENSING AND GIS** | | | | | | | |
| **Name of the Department** | | | | | | **Computer Science** | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | **Dr.D.Napoleon**  Assistant Professor  Department of Computer Science  Bharathiar University  Coimbatore – 641 046.  Phone **: 9655162717**  E mail **: mekaranapoleon@yahoo.co.in** | |
| **Inter / Intra Department Course** | | | | | | **Intra Department Course** | |
| **Duration of the Course** | | | | | | **30 Hours** | |
| **Eligibility** | | | | | | U.G. in Computer Science/Computer Applications/Information Technology or its equivalent | |
| **Number of Candidates to be Admitted** | | | | | | 40 | |
| **Registration Procedure** | | | | | |  | |
| **Job Opportunities: GIS Analysts/Sr. GIS Analyst,** **GIS Engineer, Senior GIS Executive,** **Sr. Modeling Analyst** | | | | | | | |
|  | | | | | | | |
| **The objectives of the Course are:** | | | | | | | |
| The main objectives of this course are to: | | | | | | | |
| 1 | | | Explain the basics of geographic information systems (GIS) and related areas such as geodesy and remote sensing | | | | |
| 2 | | | Select and acquire both primary and secondary spatial data for use in GIS | | | | |
| 3 | | | Manage, and analyze digital data in raster and vector formats | | | | |
| 4 | | | Describe how common analytical methods and techniques work | | | | |
| 5 | | | Create and present a GIS project. | | | | |
| **Course Content** | | | | | Lecture / Practical / Project / Internship | | |
| **Expected Course Outcomes** | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | |
|  | | | | | | | |
| **1.** | | | | Understand and Remember the basic concepts of remote sensing | | | K1/K2 |
| **2.** | | | | Understand and Remember the functionalities of GIS-Photogrammetry | | | K1/K2 |
| **3.** | | | | Analyze the Statistical Concepts based on the Images | | | K2/K4 |
| **4.** | | | | Analyze and Evaluate the case studies | | | K3/K4/k5 |
| **5.** | | | | Create and analyze environmental Monitoring and Assessment | | | K2/K4/K6 |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | |
| **Module 1** | | | | Fundamentals & Physics of Remote Sensing- Platforms and Sensors-Fundamentals of Geographic Information System-Digital Cartography-Photogrammetry-Surveying and Global Positioning System | | | **2 hours** |
| **Module 2** | | | | Fundamentals of GIS-Photogrammetry, Surveying& GPS-Information Extraction from Satellite Images-Thermal and Microwave Remote Sensing-Hyper spectral Remote Sensing | | | **2 hours** |
| **Module 3** | | | | GIS Data Analysis-Geodesy-Fundamental Statistical Concepts-Geo-statistics & Statistical applications in GIS | | | **4 hours** |
| **Module 4** | | | | Advance Remote Sensing: Data Processing & Applications-Fundamental Statistical Concepts & Geo-Statistics | | | **4 hours** |
| **Module 5** | | | | Application of Geo-informatics-Spatial decision support system | | | **6 hours** |
| **Module 6** | | | | Fundamental of Research-Research Methodology and Project Management | | | **6 hours** |
| **Module 7** | | | | Application of Geo-Informatics and Spatial Decision Support System | | | **4 hours** |
| **Module 8** | | | | Generation of Case Studies(Compulsory Field study) | | | **4 hours** |
| **Module 9** | | | | Environmental Monitoring and Assessment- QGIS Customization Using Python | | | **4 hours** |
| **Module 10** | | | | Customization of Geospatial Tools-GIS Customization Using ArcGIS | | | **4 hours** |
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| **Text Book(s)** | | | | | | | |
| 1 | George Joseph and C Jeganathan, Fundamentals of Remote Sensing,3rd Edition, January 2018 | | | | | | |
| 2 | Lillesand , Kiefer, Chipman ,Remote Sensing and Image Interpretation, 6th Edition, January 2011 | | | | | | |
| 3 | Basudeb Bhatta, Remote Sensing and GIS, 2nd Edition, August 2011 | | | | | | |
|  |  | | | | | | |
| **Related Online Contents** | | | | | | | |
| 1 | | https://onlinecourses.nptel.ac.in/noc19\_ce41/preview | | | | | |
| 2 | | <https://www.coursera.org/lecture/spatial-analysis-satellite-imagery-in-a-gis/what-is-remote-sensing-27nfo> | | | | | |
| 3 | | https://gisgeography.com/remote-sensing-earth-observation-guide/ | | | | | |
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| **Value Added Course -**  **Digital Marketing** | | | | | | | |
| **Name of the Department** | | | | | | **Department of Computer Science** | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | **Dr. D. Napoleon**  **Associate Professor**  **Department of Computer Science**  **Bharathiar University**  **Coimbatore – 46**  **napoleon@buc.edu.in** | |
| **Inter / Intra Department Course** | | | | | | **Intra-Department Course** | |
| **Duration of the Course** | | | | | | **30 hrs** | |
| **Eligibility** | | | | | | **U.G. in Computer Science/Computer Applications/Information Technology or its equivalent** | |
| **Number of Candidates to be Admitted** | | | | | | **40** | |
| **Mode of the Course** | | | | | | **Both Regular and Online** | |
| **Collaboration if any with Companies**  (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.) | | | | | | **---** | |
| **Registration Procedure** | | | | | |  | |
| **Job Opportunities:** | | | | | | | |
| * To become a skilled digital marketer capable of handling real-time digital campaigns. * To support businesses in leveraging digital platforms for lead generation, branding, and customer engagement. * To work as SEO analysts, content strategists, social media managers, or digital marketing consultants. | | | | | | | |
|  | | | | | | | |
| **The objectives of the Course are:** | | | | | | | |
|  | | | | | | | |
| 1 | | | To understand the fundamentals and evolution of digital marketing. | | | | |
| 2 | | | To explore digital marketing strategies and tools used in the industry. | | | | |
| 3 | | | To apply techniques like SEO, PPC, email marketing, affiliate marketing, and mobile marketing. | | | | |
| **Course Outcomes:** | | | | | | | |
| On the successful completion of the course, students will be able to: | | | | | | | |
| 1 | | | Understand the digital marketing landscape, concepts, and digital consumer behavior. | | | | |
| 2 | | | Design effective digital marketing strategies using segmentation and targeted messaging. | | | | |
| 3 | | | Apply SEO, PPC, social media, and content marketing practices. | | | | |
| 4 | | | Utilize display advertising models and programmatic marketing tools. | | | | |
| 5 | | | Analyze marketing campaigns using web analytics and optimize digital performance. | | | | |
|  | | |  | | | | |
| **Course Content** | | | | | Lecture / Practical / Project / Internship | | |
|  | | | | | | | |
| **Module 1** | | | | **Fundamentals of Digital Marketing**: Significance, Traditional vs. Digital, Evolution of Digital Marketing, Key Drivers, Digital Consumers & Communities. | | | **4 hrs** |
| **Module 2** | | | | |  | | --- | | **Digital Marketing Strategy**: Indian digital user trends, Consumer decision journey, POEM Framework (Paid, Owned, Earned Media), Segmenting & Customizing Messages, Skills Required in Digital Marketing, Drafting a Digital Marketing Plan. | | | | **4 hrs** |
| **Module 3** | | | | **Digital Marketing Techniques**: Terminologies, Pay-per-click (PPC), Online Marketing through Social Media, Social Media Marketing (SMM), SEO Techniques, Google Webmasters, Google Analytics Overview, Affiliate Marketing, Email & Mobile Marketing. | | | **4 hrs** |
| **Module 4** | | | | **Display Advertising**: Buying Models, Display Ad Terminology, Ad Tools & Formats, Ad Placement Techniques, Programmatic Advertising. | | | **3 hrs** |
| **Module 5** | | | | **Analytics and Optimization**: Channel Attribution, AdWords, Email, Mobile, Social Media Analytics, Web Analytics, Changing Strategy Based on Insights, Latest Trends in Digital Marketing. | | | **4 hrs** |
| **Module 6** | | | | **Hands-on Practice**: Using Digital Marketing Tools – SEO Auditing, Google Ads, Facebook Ads Manager, Content Planning with Trello, Using Google Analytics Dashboards. | | | **4 hrs** |
| **Module 7** | | | | |  | | --- | | **Mini Project / Case Study**: Students will create a campaign strategy for a hypothetical or real business using what they have learned. | | | | **4 hrs** |
| **Module 8** | | | | **Expert Interaction / Webinar / Guest Lecture**: Industry expert session on digital campaign management or social media trends. | | | **3 hrs** |
| **Total** | | | |  | | | **30hrs** |
| **Book(s) for Study** | | | | | | | |
| 1 | Deepak Kanakaraju, Digital Marketing for Beginners, 2020. | | | | | | |
| 2 | Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, Marketing 4.0: Moving from Traditional to Digital, Wiley, 2016. | | | | | | |
| 3 | Seema Gupta, Digital Marketing, McGraw Hill Education, 2017. | | | | | | |
|  | | | | | | | |
| **Book(s) for reference** | | | | | | | |
| 1 | Ryan Deiss & Russ Henneberry, Digital Marketing for Dummies, Wiley, 2020. | | | | | | |
| 2 | Damian Ryan, Understanding Digital Marketing, Kogan Page, 2020. | | | | | | |
| 3 | Dave Chaffey & Fiona Ellis-Chadwick, Digital Marketing, Pearson Education, 2019. | | | | | | |
|  | | | | | | | |
| **Related Online Contents** | | | | | | | |
| 1 | | https://www.coursera.org/specializations/digital-marketing | | | | | |
| 2 | | https://learndigital.withgoogle.com/digitalgarage | | | | | |
| 3 | | https://www.hubspot.com/courses | | | | | |
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