ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
M.TECH INFORMATION TECHNOLOGY
(Specialization in Artificial Intelligence and Data Science)

DEPARTMENT OF INFORMATION SCIENCE AND TECHNOLOGY

VISION OF THE DEPARTMENT:

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

MISSION OF THE DEPARTMENT:

1. To inculcate in students, affirm foundation in theory and practice of IT skills coupled with the thought process for disruptive innovation and research methodologies, to keep pace with emerging technologies.
2. To provide a conducive environment for all academic, administrative, and interdisciplinary research activities using state-of-the-art technologies.
3. To produce graduates and doctorates, who will enter the workforce as productive IT engineers, researchers, and entrepreneurs with necessary soft skills, and continue higher professional education with competence in the global market.
4. To enable seamless collaboration with the IT industry and Government for consultancy and sponsored research.
5. To cater to cross-cultural, multi-national and demographic diversity of students.
6. To educate the students on the social, ethical, and moral values needed to make significant contributions to society.

PROGRESS THROUGH KNOWLEDGE

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

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To prepare students to excel in research and to succeed in Information Technology Profession by adapting to the rapid advances in new emerging technologies through rigorous post-graduate education.
2. To provide students with a solid foundation in mathematical, scientific, and computing fundamentals required to develop IT solutions to real-world problems of Industries, Businesses and Society.
3. To train students with multimedia computing knowledge and creative thinking to comprehend, analyze, design innovative products with immersive user experience.
4. To inculcate leadership qualities, teamwork, and effective communication skills in students for successful professional growth.
5. To be aware of and practice ethical codes and guidelines and contribute to sustainable development of society.

2. PROGRAMME OUTCOMES (POs):

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

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

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3. CO/ POMapping:

Programme Educational Objectives	PO1	PO2	PO3	PO4	PO5	PO6
PE01	3	3	3	3	3	
PE02	3	3	3		3	
PE03		3	3		3	3
PE04		3				3
PE05	3				3	3

4. Mapping of Course Outcome and Programme Outcome

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

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CURRICULUM AND SYLLABI

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3160	Probability and Statistical Methods	FC	4	0	0	4	4
2.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
3.	IF3151	Advanced Data Structures and Algorithms	PCC	3	0	3	6	4.5
4.	DS3101	Fundamentals of Data Science	PCC	3	0	2	5	4
5.	DS3102	Artificial Intelligence	PCC	3	0	0	3	3
6.	IF3152	Advanced Database Management Systems	PCC	3	0	2	5	4
			TOTAL	**18**	**1**	**7**	**26**	**22.5**

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	DS3201	Foundations of Machine Learning	PCC	3	0	3	6	4.5
2.	DS3202	Foundations of Deep Learning	PCC	3	0	0	3	3
2.	DS3203	Big Data Analytics	PCC	3	0	0	3	3
3.		Professional Elective I	PEC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	2	5	4
			TOTAL	**15**	**0**	**5**	**20**	**17.5**

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SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	IF3351	Next Generation Wireless Networks	PCC	3	0	2	5	4
2		Professional Elective III	PEC	3	0	2	5	4
3		Professional Elective IV	PEC	3	0	2	5	4
4		Professional Elective V	PEC	3	0	2	5	4
PRACTICALS								
4.	DS3311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**20**	**32**	**22**

SEMESTER IV

S.NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	DS3411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS: 74

LIST OF FOUNDATION COURSES (FC)

S.NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MA3160	Probability and Statistical Methods	FC	4	0	0	4	4
			TOTAL	**4**	**0**	**0**	**4**	**4**

LIST OF RESEARCH METHODOLOGY AND IPR COURSE (RMC)

S.NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
			TOTAL	**2**	**1**	**0**	**3**	**3**

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LIST OF PROFESSIONAL CORE COURSES (PCC)

S.NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF3151	Advanced Data Structures and Algorithms	PCC	3	0	3	6	4.5
2.	DS3101	Fundamentals of Data Science	PCC	3	0	2	5	4
3.	DS3102	Artificial Intelligence	PCC	3	0	0	3	3
4.	IF3152	Advanced Database Management systems	PCC	3	0	2	5	4
5.	DS3201	Foundations of Machine Learning	PCC	3	0	3	6	4.5
6.	DS3202	Foundation of Deep Learning	PCC	3	0	0	3	3
7	DS3203	Big Data Analytics	PCC	3	0	0	3	3
8	IF3351	Next Generation Wireless Networks	PCC	3	0	2	5	4
		TOTAL		**24**	**0**	**12**	**36**	**30**

LIST OF EMPLOYABLITY ENHANCEMENT COURSES (EEC)

S.NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	DS3311	Project Work I	EEC	0	0	12	12	6
2.	DS3411	Project Work II	EEC	0	0	24	24	12
		TOTAL		**0**	**0**	**36**	**36**	**18**

LIST OF PROFESSIONAL ELECTIVES (PEC)
(GROUP – I)

S.NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF3051	Artificial Life and Robotics	PEC	3	0	0	3	3
2.	IF3057	Information Retrieval	PEC	3	0	0	3	3
3.	IF3055	Human Computer Interaction	PEC	3	0	0	3	3
4.	IF3052	Autonomous Ground Vehicle Systems	PEC	3	0	0	3	3
5.	IF3060	Open Source Technologies	PEC	3	0	0	3	3
6.	IF3061	Reasoning Methods in Computer Science	PEC	3	0	0	3	3
7.	IF3062	Social Network Analysis	PEC	3	0	0	3	3

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LIST OF PROFESSIONAL ELECTIVES (PEC)
(GROUP – II)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	DS3001	Streaming Analytics	PEC	3	0	2	5	4
2	DS3002	Cognitive Computing	PEC	3	0	2	5	4
3	DS3003	Agent Based Systems	PEC	3	0	2	5	4
4	DS3004	Text and Speech Analytics	PEC	3	0	2	5	4
5	DS3005	Reinforcement Learning	PEC	3	0	2	5	4
6	IF3059	Mobile Application Development and Deployment	PEC	3	0	2	5	4
7	IF3053	Blockchain Technologies	PEC	3	0	2	5	4
8	IF3054	Building IoT Systems	PEC	3	0	2	5	4
9	IF3063	Visualization Methods and Techniques	PEC	3	0	2	5	4
10	IF3056	Image Processing and Computer Vision	PEC	3	0	2	5	4
11	IF3058	Mixed Reality Techniques	PEC	3	0	2	5	4
12	DS3006	Framework for Artificial Intelligence and Machine Learning with Python	PEC	3	0	2	5	4
13	DS3007	Explainable AI	PEC	3	0	2	5	4
14	DS3008	Financial Technologies	PEC	3	0	2	5	4
15	DS3009	Quantum AI	PEC	3	0	2	5	4
16	DS3010	Recommender Systems	PEC	3	0	2	5	4
17	DS3011	Artificial Neural Networks	PEC	3	0	2	5	4

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S.NO	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1	FC	4	-	-	-	4
2	PCC	15.5	10.5	4	-	30
3	PEC	-	7	12	-	19
5	EEC	-	-	6	12	18
6	MC	3	-	-	-	3
	Total	22.5	17.5	22	12	74

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MA3160 PROBABILITY AND STATISTICAL METHODS L T P C
4 0 0 4

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES 12

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 12

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Use the appropriate and relevant, fundamental and applied mathematical and statistics knowledge and methodologies in solving practical problem.

CO2: Bring together and flexibly apply knowledge to characterize, analyse and solve a wide range of problems.

CO3: Understand the balance between the complexity/accuracy of the mathematical/statistical models used and the timeliness of the delivery of the solution.

CO4: Steeped in research methods and rigor.

CO5: Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

REFERENCES:

1. Dallas E Johnson , “Applied multivariate methods for data analysis”, Thomson and Duxbury press, Singapore, 1998.
2. Gupta S.C. and Kapoor V.K. “Fundamentals of Mathematical Statistics”, Sultan and Sons, 11th Edition, Reprint, New Delhi, 2019.
3. Jay L. Devore, “Probability and statistics for Engineering and Sciences”, Thomson and Duxbury, 9th Edition, Singapore, Boston, 2016.
4. Krishnaiah K. and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI, New Delhi, 2012.
5. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.

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6. Richard Johnson. ”Miller & Freund"s Probability and Statistics for Engineer”, Prentice Hall of India Private Ltd., 8th Edition, New Delhi, 2011.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	2	2
CO2	3	3	3	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	3	3	2	2
CO5	3	3	3	3	2	2
AVG	3	3	3	3	2	2

RM3151 RESEARCH METHODOLOGY AND IPR L T P C
2 1 0 3

UNIT I RESEARCH PROBLEM FORMULATION 9

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

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

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

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

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

UNIT V PATENTS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem

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CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data
CO3: Explain the process of data analysis; interpret and present the result in suitable form
CO4: Explain about Intellectual property rights, types and procedures
CO5: Execute patent filing and licensing

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, "Research methodology for natural sciences", IISc Press, Kolkata, 2022,
3. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

IF3151	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	3	4.5

UNIT I ALGORITHMS IN COMPUTING 9

Algorithms – Iterative and Recursive Algorithms – Insertion Sort – Analyzing Algorithms – Designing Algorithms – Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions – Recurrences: The Substitution Method – The Recursion Tree Method – Randomized Algorithms – Quick Sort.

UNIT II ALGORITHM DESIGN TECHNIQUES 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence – Greedy Algorithms: An Activity Selection Problem – Elements of the Greedy Strategy – Huffman Codes – Amortized analysis: Aggregate Analysis – The accounting method – The potential method.

UNIT III HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees: Basics – Querying a Binary Search Tree – Insertion and Deletion – Red-Black Trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion – Definition of B-trees – Basic Operations on B-Trees – Deleting a Key from a B-Tree – Splay Tree (Amortized bound) -Min Max Heaps – Leftist Heaps – Fibonacci Heaps (Amortized analysis)

UNIT IV GRAPH ALGORITHMS 9

Graphs: Representations of Graphs – Breadth First Search- Depth First Search- Topological Sort – Strongly Connected Components – Minimum Spanning Trees: Kruskal and Prim – Single-Source Shortest Paths: The Bellman Ford Algorithm, Single-Source Shortest Paths in Directed Acyclic Graphs, Dijkstra's Algorithm – All- Pairs Shortest Paths: The Floyd-Warshall Algorithm.

UNIT V NP-COMPLETE AND NP –HARD 9

NP-Completeness – Polynomial Time – Polynomial-Time Verification – NP Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems – Clique Problem – The Hamiltonian Cycle Problem – Approximation Algorithms – Vertex Cover Problem- Travelling Salesman Problem.

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PRACTICAL EXERCISES: **45**

Implement the following programs using C/ Python:

1. Iterative and recursive algorithms and its complexity analysis.
2. Merge sort algorithm analysis using Divide and Conquer approach.
3. Quick sort algorithm using randomized algorithmic approach.
4. Matrix chain multiplication using Dynamic programming approach.
5. Activity selection and Huffman coding using Greedy approach.
6. Binary search tree and a Red-Black tree implementation.
7. Implementation of basic heap operations.
8. Implementation of Top down Splay and Fibonacci Heap operations using
9. Amortized analysis.
10. Representation of Graphs and Graph traversals.
11. Implementation of a Spanning tree for a given graph using Prim's algorithm.
12. Implementation of a Shortest path of a given graph using Dijkstra's algorithm and

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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

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

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

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

CO5: Solve NP Complete problems efficiently.

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

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Fourth Edition, Prentice-Hall, 2022.
2. S. Sridhar, "Design and Analysis of Algorithms", Second Edition, Oxford University Press, 2014.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis using C", Second Edition, Pearson Education, 2002.
4. Robert Sedgewick, Kevin Wayne, "Algorithms", Fourth Edition, Pearson Education. 2011.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	2	2
CO6	3	2	3	3	3	3

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DS3101 **FUNDAMENTALS OF DATA SCIENCE** **L T P C**
3 0 2 4

UNIT I INTRODUCTION **9**

Introduction to Data Science - Overview of Data - Sources of Data - Types of Data – SmallData and Big Data - Data collection methods - Surveys - Interviews - Log and Diary data - User studies in Lab and Field - Web Scraping - Public datasets - Data cleaning - Tools forData Science.

UNIT II DESCRIPTIVE DATA ANALYSIS **9**

Dataset Construction - Sampling of data - Stem and Leaf Plots - Frequency table - Time Series data - Central Tendency Measures of the location of data - Dispersion measures – Correlation analysis - Data reduction techniques - Principal Component analysis – Independent component analysis – Hypothesis testing – Statistical Tests.

UNIT III DATA VISUALIZATION **9**

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

UNIT IV PREDICTIVE ANALYTICS AND EVALUATION **9**

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

UNIT V DATA SCIENCE APPLICATIONS **9**

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

PRACTICAL EXERCISES: **30**

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

TOTAL: 75 PERIODS

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COURSE OUTCOMES:

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

CO1: Clearly demonstrate the data collection methods.
CO2: Collect, investigate, clean, munge, and alter data.
CO3: Use Data Visualization techniques to explore data.
CO4: Use regression and classification models and evaluate it
CO5: Use Python-based toolkits to create data science applications.
CO6: Implement suitable data science applications.

REFERENCES:

1. Chirag Shah, A Hands-on Introduction to Data Science, Cambridge University Press,UK, 2020
2. Grus, Joel, Data science from scratch: first principles with python. O'Reilly Media,2019.
3. Aragues, A. Visualizing Streaming Data: Interactive Analysis beyond Static Limits.O'Reilly Media, Inc, 2018.
4. https://www.coursehero.com/study-guides/introstats1/
5. Géron, A. Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts,Tools, and Techniques to Build Intelligent Systems O'Reilly Media, 2017.
6. Wes McKinney, Python for Data Analysis, 3rd Edition, O' Reilly, 2022
7. T.V.Geetha and S.Sendhilkumar, Machine Learning: Concepts,Techniques and Applications, 1 st Edition, CRC Press, Taylor and Franics, 2022.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	1
CO2	3	3	2	3	2	1
CO3	3	2	3	2	2	1
CO4	3	3	2	3	2	1
CO5	3	3	3	3	2	1
CO6	3	3	3	3	2	1

PROGRESS THROUGH KNOWLEDGE

DS3102 ARTIFICIAL INTELEGENCE **L T P C**
3 0 0 3

UNIT I INTELLIGENT AGENTS AND SEARCH TECHNIQUES 9

Agents and Environments – Good Behavior: The concepts of Rationality – The Nature of Environments – The Structure of Agents, Problem solving - Solving problems by searching - Search in Complex Environments - Adversarial Search and games - Constraint Satisfaction Problem

UNIT II KNOWLEDGE AND REASONING 9

Logical Agents - Propositional Logic - Theorem proving, First Order Logic: Syntax and Semantics - Knowledge Engineering in First Order Logic, Inference in First Order Logic: Forward Chaining - Backward Chaining - Resolution, Knowledge Representation: - Ontological Engineering - Categories and Objects - Events - Mental Objects and Modal Logic - Reasoning System for

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Categories - Reasoning with Default Information

UNIT III BAYESIAN NETWORKS 9

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

UNIT IV DECISION MAKING/ DECISION PROCESS 9

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

UNIT V AI APPLICATIONS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

REFERENCES:

1. Stuart J. Russell, Peter Norvig, Artificial Intelligence – A Modern Approach, Pearson Education, 4th Edition, 2021
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, Third Edition, Tata McGraw-Hill, 2008.
3. DheepakKhemani, “A First Course in Artificial Intelligence”, McGraw-Hill, 2013.
4. NPTEL Artificial Intelligence Course by Prof. Dasgupta – http://nptel.ac.in/courses/106105079/2
5. https://cloud.google.com/dialogflow
6. https://cloud.google.com/community/tutorials/kubernetes-ml-ops
7. https://www.tensorflow.org/tutorials/images/cnn

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	1
CO2	3	-	3	3	3	1
CO3	3	-	3	3	3	1
CO4	3	-	3	3	3	1
CO5	3	-	3	3	3	1
CO6	3	1	3	3	3	2

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IF3152 ADVANCED DATABASEMANAGEMENT SYSTEMS L T P C
3 0 2 4

UNIT I DISTRIBUTED DATABASES 9

Distributed Systems – Introduction – Architecture; Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing.

UNIT II NOSQL DATABASES 9

NoSQL – CAP Theorem – Sharding – Document based - MongoDB Operation: Insert, Update, Delete, Query, Indexing, Application, Replication, Sharding, Deployment – Using MongoDB with PHP / JAVA/ Python – Cassandra: Data Model – Key Space – Table Operations – CRUD Operations – CQL Types – HIVE : Data types – Database Operations – Partitioning – HiveQL

UNIT III ADVANCED DATABASE SYSTEMS 9

Spatial Databases: Spatial Data Types – Spatial Relationships – Spatial Data Structures – Spatial Access Methods – Temporal Databases: Overview – Active Database – Deductive Databases – Recursive Queries in SQL – Mobile Databases: Location and Handoff Management – Mobile Transaction Models – Concurrency - Transaction Commit Protocols – Multimedia Databases.

UNIT IV DOCUMENT DATABASES 9

XML Database: XML – XML Schema – XML DOM – XSL – XSLT – XPath and XQuery – JSON Document Databases – Document (MongoDB) Data Model - JSON and BSON– Polymorphic Schemas – Using MongoDB Shell – Basic Querying – Create and Insert – Creating Collections – Update and Delete.

UNIT V GRAPH DATABASES 9

Introduction to Graph Databases – The Power of Graph Databases – Data Modeling with Graphs – Querying Graphs – Introduction to Cypher – CQL Clauses – Write Clause – Read Clause – General Clauses – CQL Functions – Building a Graph Database application.

PRACTICAL EXERCISES: 30

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

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Design a distributed database system and execute distributed queries.
CO2: Implement NoSQL database systems and manipulate the data associated with it.
CO3: Disseminate knowledge on advanced database system concepts.
CO4: Create real time applications using Spatial, temporal and Mobile Databases.

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CO5: Design and develop document databases using XML /JSON/ BSON databases.
CO6: Build a simple real time application using graph databases and execute queries on it.

REFERENCES:

1. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw-Hill, 2011.
2. R. Elmasri, S. B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education/Addison Wesley, 2017.
3. C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
4. Brad Dayley, “Teach Yourself NoSQL with MongoDB in 24 Hours”, Sams, 2014.
5. Shashank Tiwari, “Professional NoSQL”, O’Reilly Media, 2011.
6. Vijay Kumar, “Mobile Database Systems”, John Wiley, 2006.
7. Ian Robinson, Jim Webber and Emil Eifrem, "Graph Databases”, O’Reilly Media, Second Edition, 2015.
8. Elliotte Rusty Harold, W. Scott Means, “XML in a Nutshell“,O’Reilly Media, Third Edition, 2004.
9. Shakuntala Gupta Edward (Author), Navin Sabharwal, “Practical MongoDB: Architecting, Developing, and Administering MongoDB”, APRESS, First Edition, 2018

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3	3	1
CO2	3		3	3	3	1
CO3	3		3	3	3	1
CO4	3	2	3	3	3	3
CO5	3		3	3	3	2
CO6	3	2	3	3	3	3

DS3201 FOUNDATIONS OF MACHINE LEARNING L T P C
3 0 3 4.5

UNIT I INTRODUCTION 9

Machine Learning – Basic Concepts in Machine Learning – Types of Machine Learning – Applications of Machine Learning - Basics of Learning Theory – Concept Learning - Hypothesis Space - Find-S algorithm - Version spaces - Bias-Variance Trade offs - Modelling in Machine learning- Model Selection and Model Evaluation - Model Performance - Resampling Methods.

UNIT II DATA PREPARATION 9

Understanding of data – Data preprocessing - Linear Regression – Multiple variable regression – Logistic regression – Regularization techniques - LASSO, Ridge and Elastic Net Regression.

UNIT III SUPERVISED LEARNING I 9

Decision Tree Learning – ID3 - Univariate Analysis – Bivariate and multivariate analysis – PCA and feature reduction – Data Visualization. - Support Vector Machines – Support Vector Regression - Neural Networks – Perceptron - Feed-Forward Networks for binary and multi-class classification- Multi Layer Perceptron - Back Propagation - Ensemble Methods – Bagging –

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Random Forest - Boosting – AdaBoost.

UNIT IV PROBABILISTIC GRAPHICAL MODELS 9

Introduction to Graphs – Inference in Graphical Models – Bayesian Belief Networks - Markov Chain – Markov Model - Hidden Markov Models – Inference – Learning - Generalization – Undirected Graphical Models – Markov Random Fields – Conditional Independence Properties – Conditional Random Fields.

UNIT V UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

Clustering– K-means Clustering– Hierarchical Clustering – Expectation Maximization algorithm – Gaussian Mixture Model- Cluster Evaluation Methods.

Overview of Reinforcement Learning - Components of Reinforcement Learning - Model Based Learning - Model Free Learning - Q Learning – Evolutionary techniques – Genetic algorithms in neural networks.

PRACTICAL EXERCISES: 45

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

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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

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

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

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

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

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

REFERENCES:

1. Sridhar S, Vijayalakshmi M, “Machine Learning”, First Edition, Oxford University Press, 2021.
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, First Edition, Springer, 2006.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.

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4. EthemAlpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2005.
5. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997.
6. T. Hastie, R. Tibshirani, J. Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008.
7. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, CRC Press, 2009.
8. T.V.Geetha and S.Sendhilkumar, Machine Learning: Concepts,Techniques and Applications, 1 st Edition, CRC Press, Taylor and Franics, 2022.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	2	2	2	1	2
CO3	2	1	3	2	1	2
CO4	2	2	2	1	2	2
CO5	2	2	2	2	1	1
CO6	3	2	1	2	1	2

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

UNIT I BASICSOFNEURALNETWORKS 9

Basic concept of Neurons–Perceptron Algorithm–Feed Forward and Back Propagation Networks.

UNIT II CONVOLUTIONALNEURALNETWORKS 9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning.

UNIT III ADVANCED DEEPLEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM,

UNIT IV DEEPREINFORCEMENT LEARNING 9

Introduction to Reinforcement Learning – Deep Q Networks – Naïve REINFORCE Algorithm - Actor–Critic Method – Introduction to Deep Belief Networks.

UNIT V APPLICATIONSOFDEEP LEARNING 9

Image Segmentation – Object Detection – Automatic Image Captioning – Image Generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision –Analysis using Recursive Neural Networks – Dialogue Generation with LSTMs – Transformers like BERT.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the role of Deep Learning in Machine Learning Applications.

CO2: To get familiar with using Tensor Flow / Keras in Deep Learning Applications.

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CO3: To design and implement Deep Learning Applications.
CO4: Critically Analyse Different Deep Learning Models in Image–Related Projects.
CO5: To design and implement Convolutional Neural Networks.
CO6: To know about applications of Deep Learning in NLP and ImageProcessing

REFERENCES:

1. Ian Good Fellow,Yoshua Bengio, Aaron Courville,“Deep Learning,” MIT Press, 2017
2. Francois Chollet,“Deep Learning with Python,”ManningPublications,2018.
3. PhilKim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence,”Apress, 2017
4. Jon Krohn,” Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence,” Addison-Wesley, 2020.
5. Andrew Glassner, “Deep Learning – A visual Approach,” No Starch Press, 2021.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	1	1
CO2	1	1	1	1	3	1
CO3	1	1	1	1	1	3
CO4	1	2	1	2	1	1
CO5	2	1	1	1	3	3
CO6	1	3	1	1	1	2

DS3203 BIG DATA ANALYTICS L T P C
3 0 0 3

UNIT I INTRODUCTION TOBIG DATA 9

Introduction to Big Data - Need for processing Big Data – Need for analytics- Characteristics of big data, Domain-specific examples of big data, Big Data Stack – Setting up of Hadoop.

UNIT II MAPREDUCE AND NEW SOFTWARE STACK 9

Distributed File System – MapReduce, algorithms using MapReduce, Extensions – Communication model – Complexity Theory for MapReduce. Overview of Spark.

UNIT III BIG-DATA TECHNOLOGY OVERVIEW 9

Big Data Collection Systems – Apache Flume – Big data Storage – HDFS Systems – Pig and Hadoop – Grunt – Data Model – Pig Latin – Hive Overview – Hive Ql – Overview of Hbase - Overview of Workflow – Apache Oozie–Workflow and Scheduling - Introduction to NoSQL Databases – Basics of MongoDB.

UNIT IV STREAMING ANALYTICS AND LINK ANALYSIS 9

Introduction to Stream analytics – Stream data model – Sampling Data – filtering streams – Count distinct elements in a stream,Counting ones, Estimating moments – Decaying windows – Link Analysis – PageRank Computation – Market Basket model – Limited pass algorithms for Frequent Item sets.

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UNIT V RECOMMENDER SYSTEMS AND SOCIAL NETWORK MINING 9

Advertising on the Web – Online Algorithms – matching Problem – Adwords problem and Implementation – recommendation systems – Collaboration filtering – Dimensionality reduction – mining social – Network graphs – Clustering of social network graphs – Partitioning of graphs – Simrank –counting triangles – Neighborhoods properties of Graphs.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basics of Big Data.
CO2: Know about Hadoop and MapReduce.
CO3: Know about Big Data Technology, Tools, and Algorithms.
CO4: Analyze the stream data and link analysis.
CO5: Know about the role of big data in Recommender systems and social network analysis.
CO6: Design and Implementation of basic data-intensive applications.

REFERENCES:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Third Edition, Cambridge University Press,2010
2. Arshdeep Bagha and Vijay Madisetti, Big Data Science& Analytics, A Hands-on Approach, Arshdeep Bahga& Vijay Madisetti, 2016.
3. Vignesh Prajapati, “Big Data Analytics with R and Hadoop,” Packt Publishing,2013.
4. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications,” Wiley Publishers,2014.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	1
CO2	3	3	3	3	3	1
CO3	3	3	3	3	3	1
CO4	3	3	3	3	3	1
CO5	3	3	3	3	3	1
CO6	3	3	3	3	3	1

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

UNIT I 5G INTERNET AND LEAP TO 6G VISION 9

Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – Ten Pillars of 5G – The 6G Vision -6G Vertical Industries-Technologies enabling 6G-Other 6G Considerations

UNIT II SMALL CELLS FOR 5G MOBILE NETWORKS 9

Introduction to Small Cells – Capacity Limits and Achievable Gains with Densification – Mobile Data Demand – Demand vs. Capacity – Small Cell Challenges.

UNIT III COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS 9

Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding, Cooperative ARQ MAC Protocols – PHY Layer Impact on MAC Protocol Analysis-Introduction – The Mobile

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Cloud – Mobile Cloud Enablers – Network Coding – Overview of Cognitive Radio Technology in 5G Wireless – Spectrum Optimization using Cognitive Radio – Relevant Spectrum Optimization Literature in 5G

UNIT IV NETWORKING TECHNIQUES AND APPLICATIONS FOR 5G NETWORKS 9

5G RAN Architecture: C-RAN with NGFI- User-Centric Wireless Network for 5G - Energy Harvesting Based Green Heterogeneous Wireless Access for 5G -Resource Allocation for Cooperative D2D Communication Networks- Fog Computing and Its Applications in 5G -A Conceptual 5G Vehicular Networking -Communications Protocol Design for 5G Vehicular Networks -Next-Generation High-Efficiency WLAN -Shaping 5G for the Tactile Internet

UNIT V FUTURISTIC TECHNOLOGICAL ASPECTS OF 6G 9

6G Beamforming Techniques-Aerial and satellite Components of 6G Networks-Underwater Communication Components of 6G Networks-6G Networks-Radar Sensing-Imaging and Sensing-Localization-Other verticals.

PRACTICAL EXERCISES: 30

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

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Compare the 5G network with older generations of networks.
CO2: Identify suitable small cells for different applications in 5G networks.
CO3: Simulate 5G network scenarios.
CO4: Connect applications of FOG Computing

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CO5: Design applications with 5G network support.
CO6: Analyze the 6G Networks

REFERENCES:

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.
2. Wireless Communications: Principles and Practice, by Theodore S. Rappaport, Prentice Hall., 2014
3. Mobile Communication Networks: 5G and a Vision of 6G springer Božanić, Mladen, and Saurabh Sinha. *Mobile Communication Networks: 5G and a Vision of 6G*. Springer, 2021.
4. 5G Mobile Communications: Concepts and Technologies 1st Edition

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	2	1	1	2	3	2
CO3	1	2	1	2	2	1
CO4	1	2	2	1	2	3
CO5	3	1	2	2	2	3
CO6	2	2	2	2	2	1

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

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

COURSE OUTCOMES:

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

CO1: Work as a individual, identify a real-world problem that can be solved using IT tools and techniques.
CO2: Analyse existing artifacts and solutions and design novel effective approaches.
CO3: Explore, select, and deploy the appropriate tools for effective implementation of the design.
CO4: Prepare the documentation for the design and implementation, write reports and make presentations justifying the choices made.
CO5: Develop the required collaboration and communication skills to work in a professional team and multi-disciplinary context.
CO6: Quickly develop Proof-of-Concept of solutions to problems.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2

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CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
CO6	3	3	3	3	3	2

DS3411 **PROJECT WORK II** **L T P C**
0 0 24 12

Individual student carry out project II , which can be a continuation of project I work or a new problem can be formulated, with necessary Literature Survey by referring to IEEE/ACM transactions/standard peer reviewed journals/conference papers, identify the challenges to be addressed/gaps in the existing research works, propose a solution with necessary architecture with modular design including data required, relevant algorithms, study of necessary simulation software (if any), implement the project, evaluate the work with relevant metrics and finally present the project work with a detailed report.

COURSE OUTCOMES:

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

CO1: Apply the acquired knowledge of basic science and engineering concepts to solve real-world problems.

CO2: Analyse, design and develop IT solutions following best practices.

CO3: Explore, select, and deploy the appropriate tools for effective implementation of projects.

CO4: Prepare the documentation for the design and implementation, write reports and make presentations justifying the choices made.

CO5: Develop the required collaboration and communication skills to work in a professional team and multi-disciplinary context.

CO6: Develop and showcase the complete solution for a given problem in industry/research.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
CO6	3	3	3	3	3	2

IF3051 **ARTIFICIAL LIFE AND ROBOTICS** **L T P C**
3 0 0 3

UNIT I ARTIFICIAL LIFE **9**

The Artificial Life - foundations, scope, problems, and approaches of AI, reactive, deliberative, goal-driven, utility-driven, and learning agents-Behavior systems – Emergent behavior-Approaches for Designing the Behavior Programs - Modeling Adaptive Autonomous Agents -

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Characteristics of Agent Architectures - Example Autonomous Agents.

UNIT II INTRODUCTION TO ROBOTICS 9

Fundamentals: Classification of Robots- History of Robotics- Robot Components – Robot DOF- Joints-Coordinates- Reference Frames- Characteristics-Workspace- Collaborative Robots- Robotics and programmable automation - Human systems and Robotics - Machine Intelligence Computer and Robotics-Future Trends.

UNIT III ROBOTIC SENSORS AND TRAJECTORY PLANNING 9

Sensors - Characteristics – Sensor Utilization- Types of Sensors-Position Sensors- Velocity Sensors- Acceleration Sensors- Proximity Sensors- Force and Torque Sensors - Range finders - Voice recognition devices - Range Sensors - Ultrasonic sensors - Touch and Slip sensors. sensors for motion and position, Force, torque and tactile sensors, Flow sensors, Temperature sensing devices - Basics of Trajectory planning - Joint-Space Trajectory Planning - Continuous Trajectory Recording – Path Planning.

UNIT IV COMPUTER VISION IN ROBOTICS AND ROBOT PROGRAMMING 9

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

UNIT V ROBOTICS APPLICATIONS 9

Robotics and its applications - Robotics and automation in food Industry - Medical Robots - Artificial Intelligence Aspect of Cognitive Robotics: Vision and Action to create Cognitive humanoids- Cognitive Robotics Approach - Perceiving and Interacting with Environment – Design of Chatbots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design and implement an intelligent autonomous agent for problem solving

CO2: Demonstrate and illustrate the fundamentals of Robotics.

CO3: Develop robotic design with proper navigation to solve real time problems.

CO4: Apply program able automation in different subfields of robotics.

CO5: Develop vision-based systems for robot guidance.

CO6: Design and implement arobotforfew real time applications.

REFERENCES:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, “Robotic Engineering – An integrated approach”, PHI Publication,2016
3. S. B. Nikku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., 2020
4. Langton, C. G. (Ed.), Artificial life: An overview, springer1997.
5. Caldwell, D. G. (Ed.), Robotics and automation in the food industry: current and future technologies. Elsevier,2012

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6. Gomes, P. (Ed.), Medical robotics: Minimally invasive surgery. Elsevier,2012.
7. Samani, H. (Ed.), Cognitive robotics. CRC Press, 2015.
8. S. R. Ruocco, Robot Sensors & Transducers, Springer, 2013
9. Martin, F.G. Robotic explorations: a hands-on introduction to engineering. Upper Saddle River, N.J.: Prentice-Hall, 2001

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	2	2	2	3	2
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	3
CO6	3	3	3	3	3	3

IF3057 INFORMATION RETRIEVAL L T P C
3 0 0 3

UNIT I INTRODUCTION TO INFORMATION RETRIEVAL 9

Goals and History of IR – The Impact of the Web on IR – Basic IR Models Boolean and Vector Space Retrieval Models – Ranked Retrieval – Text Metrics – TF-IDF (term frequency/inverse document frequency) Weighting – Cosine Similarity - Pre-processing: Simple tokenizing, Stop-word removal, and stemming, Basic Searching and Indexing: inverted indices and files, efficient processing with sparse vectors.

UNIT II TEXT REPRESENTATION AND QUERYING 9

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

UNIT III CATEGORIZATION AND CLUSTERING 9

Text classification - Naive Bayes – Decision Trees and Nearest Neighbor- Vector space classification - Support vector machines, Expectation Maximization (EM) - Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing - Applications to Information Filtering – Organization and Relevance Feedback.

UNIT IV INFORMATION EXTRACTION AND INTEGRATION 9

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

UNIT V RECOMMENDER SYSTEMS AND IR EVALUATION 9

Recommender Systems – Collaborative Filtering – Content Based Recommendation ofDocuments and Products – Information Extraction and Integration – Extracting Data from Text – XML – Semantic Web – Collecting and Integrating Specialized Information on the Web. Experimental Evaluation of IR Performance Metrics - Recall, Precision and F Measure – Evaluations on

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Benchmark Text Collections.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Build an Information Retrieval system using the available tools.
CO2: Identify and design the various components of an Information Retrieval system.
CO3: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO4: Analyze the Web content structure.
CO5: Analyze the approaches used for recommendation systems.
CO6: Design an efficient search engine

REFERENCES:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, “Introduction toInformation Retrieval”, Cambridge University Press, 2008.
2. F. Ricci, L. Rokach, B. Shapira, P. B. Kantor, “Recommender Systems Handbook”,Springer, 2011.
3. Peter Brusilovsky, “The Adaptive Web Methods and Strategies of Web Personalization”, Springer, 2007.
4. Manu Konchady, “Building Search Applications: Lucene, LingPipe, and Gate”,Mustru Publishing 2008.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	1
CO2	2	1	2	2	2	1
CO3	3	2	3	2	2	2
CO4	1	2	2	2	2	2
CO5	1	2	2	2	1	2
CO6	2	2	2	2	2	2

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

UNIT I INTRODUCTION TO HUMAN-COMPUTER INTERACTION 9

The Human - Information Processing – The Computer – Information Processing – Human Computer Interaction – Models – Ergonomics – Interaction Styles – Interactivity – Context of Interaction – Strategies for building interactive systems – Paradigms of Interaction.

UNIT II DESIGNING INTERACTIVE SYSTEMS 9

Introduction to basics of design – Process – User focus – Navigation – Screen design – Iteration and Prototyping – HCI in software process – Usability Engineering - Iteration and Prototyping – Design Rules – Principles – Standards – Guidelines – Golden rules and heuristics – Implementation support – Windowing systems – Programming in the application – Toolkits – User Interface Management Systems

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UNIT III EVALUATION AND UNIVERSAL DESIGN PRINCIPLES 9

Need for evaluation – Goals – Expert Analysis – User Participation and Feedback – Reporting Results - Choosing the evaluation method – Universal Design Principles – Multimodal Interaction – Designing for Diversity - Requirements for User support – Approaches - Adaptive help systems

UNIT IV MODELS AND THEORIES 9

Cognitive Models – Goals & Task Hierarchies – Linguistic models – Challenges of the display-based system – Physical – Device models – Socio- Organizational issues – Communication and collaboration – Face-to-face – conversation – text based – group working – Task analysis techniques – decomposition of task – knowledge-based analysis – entity-relationship based analysis – Dialog design model – design notations – graphical – textual – semantics – System models – formalisms – interactions – continuous behavior.

UNIT V HCI IN COLLABORATIVE APPLICATIONS 9

Groupware – Computer–Mediated Communication – Meeting & Decision Support – Shared applications and artifacts – Frameworks – Synchronous groupware – Ubiquitous computing – Virtual and Augmented Reality – Information & Data visualization – Web – Hypertext – Finding things – Issues – Static web – Dynamic web

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

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

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

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

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

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

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Prentice Hall, 2004.
2. Preece, J., Sharp, H., Rogers, Y., “Interaction Design: Beyond Human-Computer Interaction”, Sixth Edition, Wiley, 2022.
3. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, “Research Methods in Human-Computer Interaction”, Second edition, Morgan Kaufmann, 2021.
4. Ben Shneiderman, Catherine Plaisant, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Addison Wesley, 2021.
5. Jeff Johnson, “Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules”, Third Edition, Morgan Kaufmann, 2020.
6. Benyon, D, “Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design”. Third Edition Pearson Education Limited, 2019.

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PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	1
CO2	3	2	1	1	3	1
CO3	3	2	2	1	3	1
CO4	3	1	2	2	1	1
CO5	3	1	3	3	3	2
CO6	2	1	2	3	3	1

IF3052 AUTONOMOUS GROUND VEHICLE SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION TO AUTONOMOUS DRIVING 9

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

UNIT II SENSORS FOR AUTONOMOUS GROUND VEHICLES 9

Sensor Characteristics –Vehicle Internal State Sensing: OEM Vehicle Sensors, GPS, Inertial Measurements, Magnetometer – External World Sensing: RADAR, Lidar, Image Processing Sensors, IMU sensor for Raspberry Pi, Jetson.

UNIT III ENVIRONMENT PERCEPTION AND MODELING 9

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

UNIT IV NAVIGATION FUNDAMENTALS 9

Introduction – Navigation: GNSS Overview, GPS, GLONASS, Galileo, Compass – Inertial Navigation Overview: Inertial Sensor Technology – GNSS/INS Integration Overview – Case Study on Kalman Filtering.

UNIT V VEHICLE CONTROL AND CONNECTED VEHICLE 9

Vehicle Control: Cruise Control, Antilock Brake Systems, Steering Control and Lane Following, Parking – Connected Vehicles: Vehicle to Vehicle Communication, Vehicle to Infrastructure Communication, Device to Device Communication, Security for Autonomous Ground Vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Identify the requirements and design challenges of AGVs.
CO2: Select suitable sensors to sense the internal state and external world of AGVs.
CO3: Implement lane detection, road detection & vehicle detection algorithms.
CO4: Simulate/implement ground vehicle navigation algorithms.

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CO5: Simulate/implement ground vehicle control systems.
CO6: Design communication protocols for connected vehicles.

REFERENCES:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, “Creating Autonomous Vehicle Systems”, Morgan & Claypool, 2018.
2. Umit Ozguner, Tankut Acarman, Keith Redmill, “Autonomous Ground Vehicles”, Artech House, 2011.
3. A. R. ha, “ Theory, design and applications of Unmanned Aerial Vehicles”, 2016
4. Hong Cheng, “Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation”, Springer, 2011.
5. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, “Global Navigation Satellite Systems, Inertial Navigation, and Integration”, Third Edition, John Wiley & Sons, 2013.
6. Kenzo Nonami, Muljiowidodo Kartidjo, “Autonomous Control Systems and Vehicles”, Intelligent Unmanned Systems, Springer, 2013.
7. Anthony Finn, Steve Scheding, “Development and challenges for Autonomous Unmanned Vehicles”, A compendium, Springer, 2010

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	1	1
CO2	2	1	3	2	1	1
CO3	3	1	2	3	1	1
CO4	2	1	3	2	1	1
CO5	3	1	2	3	1	1
CO6	3	1	3	3	1	1

IF3060 OPEN SOURCE TECHNOLOGIES L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Need for Free and Open Source Software – Overview of Linux – Distributions – Licensing Schemes – Versions – Collaborative Version Control Systems – Shell Commands

UNIT II PROCEDURAL PROGRAMMING 9

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

UNIT III WEB DEVELOPMENT WITH PYTHON 9

HTML – CSS – Bootstrap – Introduction to Flask – Templates – Models – Forms – Modules.

UNIT IV WORKING WITH DATABASES 9

Introduction to Document Databases – Working – Relational Database versus NoSQL – Modeling – Mapping Classes to MongoDB – Building Data layer with Mongo Engine.

UNIT V WORKING WITH CONTAINERS 9

Running software in containers - Installing Dockers - Working with databases such as Redis - Building Docker images - Deployment of applications with Docker

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TOTAL: 45 PERIODS

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COURSE OUTCOMES:

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

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

REFERENCES:

1. Jesus M. Gonzalez Barahona, Joaquin Seoane Pascual, Gregorio Robles, “Introduction to Free Software”, Third Edition, Free Technology Academy, 2009.
2. http://ftacademy.org/sites/ftacademy.org/files/materials/fta–m1–intro_to_FS–v1.pdf
3. Irv Kalb, Object-Oriented Python, O’Reilly, 2022
4. https://getbootstrap.com/
5. Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers, “How to Think Like a Computer Scientist”, Open Book, 2012.
6. Scott Chacon, Ben Straub, “Pro Git”, Free ebook under Creative Commons, Second Edition, Apress, 2016.
7. Miguel Grinberg, “Flask Web Development Developing Web Applications with Python”, O’Reilly, 2014.
8. Karl Seguin, “The Little Mongo DB Book”, https://github.com/karlseguin/the–little–mongodb–book.
9. Jeff Nickoloff and Stephen Kuenzli, Docker in Action, Second Edition, Manning Publications, 2020

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	--	3	3	3	2
CO2	3	-	3	3	3	3
CO3	3	--	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
CO6	3	-	3	3	3	2

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

UNIT I PROPOSITION LOGIC 9

Introduction to Logic - Foundation in mathematics - Natural Deduction - Formal language Syntax and Semantics - Normal Forms - Applications in AI.

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UNIT II PREDICATE LOGIC 9

Syntax and semantics - Natural Deduction rules - Expressiveness – Micromodels of software - Inference mechanisms in AI

UNIT III MODAL LOGIC 9

Higher order logic - Modal logic syntax - Semantics - Accessibility relation - Types of modal logic - Natural deduction

UNIT IV TEMPORAL LOGIC 9

Linear Temporal Logic - Syntax - Semantics - Model Checking - Computational Tree Logic - Syntax - Semantics - Application in Operating Systems and Distributed systems

UNIT V EPISTEMIC LOGIC 9

Logic of knowledge - Syntax - Semantics - Natural Deduction - Multi-agent reasoning - Applications in Distributed systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the mathematical underpinnings of Logic
CO2: Apply Proposition Logic to Computer Science domains
CO3: Understand the reasoning process of Predicate Logic
CO4: Understand the advantages of Higher Order Logic over Lower Order Logic
CO5: Apply Temporal Logic to Distributed Systems
CO6: Design Multiagent systems using Epistemic Logic

REFERENCES:

1. Michael Huth and Mark Ryan, Logic in Computer Science, Modelling and Reasoning about Systems, 2nd edition, Cambridge University Press, 2005
2. Johan van Benthem, Hans van Ditmarsch, Jan van Eijck, Jan Jaspars, Logic in Action, an open course and e-book inhttp://www.logicinaction.org/, 2016

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	3
CO2	3	-	3	3	3	3
CO3	3	-	3	3	3	3
CO4	3	-	3	3	3	3
CO5	3	-	3	3	3	3
CO6	3	-	3	3	3	3

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

UNIT I INTRODUCTION 9

Social Network Analysis: Definition and Features – The Development of Social Network Analysis – Basic Graph Theoretical Concepts of Social Network Analysis – Ties, Density, Path, Length,

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Distance, Betweenness, Centrality, Clique – Electronic Sources for Network Analysis – Electronic Discussion Networks, Blogs and Online Communities, Web-based Networks –Applications of Social Network Analysis.

UNIT II SOCIALNETWORK PROFILES 9

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

UNIT III SEMANTICS OF SOCIAL NETWORKS 9

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

UNIT IV SOCIAL NETWORK MINING 9

Detecting and Discovering Communities in Social Network: Evaluating Communities–Methods for Community Detection – Trust factor- Applications of Community Mining Algorithms –Ethical Practices in Social Network Mining – Understanding and Predicting Human Behavior for Social Communities–Decentralized Online Social Networks–Multi-Relational Characterization of Dynamic Social Network Communities – Inferential Methods in Social Network Analysis

UNIT V VISUALIZATIONAND APPLICATIONSOFSOCIALNETWORKS 9

Visualization of Social Networks Node-Edge Diagrams – Random Layout – Force-Directed Layout – Tree Layout – Matrix Representations –Matrix and Node-Link Diagrams – Hybrid Representations – Visualizing Online Social Networks – Applications – Covert Networks – Community Welfare – Collaboration Networks – Co-Citation Networks – Data Privacy in Social Networks

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Understand basic principles behind network analysis algorithms and develop practical skills in network analysis.
- **CO2:** Model and represent knowledge for social semantic Web.
- **CO3:** Apply datamining techniques on social networks.
- **CO4:** Use extraction and mining tools for analyzing Social networks.
- **CO5:** Develop secure social network applications.
- **CO6:** Develop personalized visualization for Social networks

REFERENCES:

1. Peter Mika, “Social Networks and the SemanticWeb”,Springer, 2007.
2. BorkoFurht,“Handbook of Social Network Technologies and Applications”, Springer,2010.
3. Song Yang, Franziska B.Keller, Lu Zheng, “Social Network Analysis: Methods and Examples”,Sage Publication,2016
4. GuandongXu,Yanchun Zhang, LinLi, “Web Mining and Social Networking Techniques and Applications”,Springer,2011.
5. MaxChevalier, Christine Julien, Chantal Soulé- Dupuy,“Collaborative and Social Information Retrieval and Access: Techniques for Improved User Modelling”,

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IGIGlobal,2009.
6. John G. Breslin, Alexandre Passant, Stefan Decker, “The Social Semantic Web”,Springer,2009.
7. John Scott, Peter J. Carrington, “The SAGE Handbook of Social Network Analysis”,SagePublication, 2011.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	1	1
CO2	3	-	2	2	1	1
CO3	3	-	2	2	1	2
CO4	3	-	2	2	1	2
CO5	3	-	2	2	1	2
CO6	3	-	1	2	1	2

DS3001 STREAMING ANALYTICS L T P C
3 0 2 4

UNIT I STREAMING TECHNOLOGY 9

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

UNIT II STREAM ANALYTICS 9

Stream Analytics - Concepts of Streams–. Streaming Analytics Architecture-Sources of Streaming Data -– Stream Computing –Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream –Estimating Moments – Counting Oneness in a Window.

UNIT III STREAMING DATA ANALYSIS 9

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

UNIT IV ADVANCED CONTENT DELIVERY, STREAMING, AND CLOUD SERVICES 9

Cloud-Based Content Delivery and Streaming-Live Streaming Ecosystems -Practical Systems for Live Streaming - Efficiency of Caching and Content Delivery in Broadband Access Networks – Anycast Request Routing for Content Delivery Networks - Cloud-Based Content Delivery to Home Ecosystems -Mobile Video Streaming.

UNIT V VISUALIZING STREAMING DATA 9

Streaming the Data-Processing Streaming Data for Visualization-Developing a Client- Presenting Streaming Data- Visualization Components- Streaming Analysis- Workflow Visualization - Streaming Data Dashboard-Machine Learning and Streaming Data Visualization – Collaboration– Exports.

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PRACTICAL EXERCISES: **30**

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

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand and apply various analytics on stream data.
CO2: Understand the fundamental concepts of streaming technology and data analytics.
CO3: Comprehend and work with streaming data analysis techniques.
CO4: Implement suitable data analysis for stream data.
CO5: Understand various advanced content delivery, streaming, and cloud services.
CO6: Describe and implement the basic and advanced techniques for visualizing streaming data.

REFERENCES:

1. Aragues, A, “Visualizing Streaming Data: Interactive Analysis Beyond Static Limits”,O'Reilly Media, Inc., 2018
2. Pathan, M., Sitaraman, R. K., & Robinson, D. (Eds.), “Advanced content delivery, streaming, and cloud services”, John Wiley & Sons, 2014
3. Austerberry, D. “The technology of video and audio streaming”, Routledge, 2013
4. Ellis, B, “Real-time analytics: Techniques to analyze and visualize streaming data”,John Wiley & Sons, 2014

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	2	3
CO2	3	3	2	2	2	3
CO3	3	3	2	2	2	3
CO4	3	3	2	2	2	3
CO5	3	3	2	2	2	3
CO6	3	3	2	2	2	3

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DS3002 **COGNITIVE COMPUTING** **L T P C**
3 0 2 4

UNIT I FOUNDATION OF COGNITIVE COMPUTING 9

Cognitive Computing - Uses of Cognitive Systems - Understanding Cognition - Elements of a Cognitive System - Building the Corpus - Bringing Data into the Cognitive System - Hypotheses Generation and Scoring - Presentation and Visualization Services.

UNIT II KNOWLEDGE REPRESENTATION 9

Developing a Cognitive System - Defining Taxonomies and Ontologies - Models for Knowledge Representation – Taxonomies – Ontologies - Simple Trees - Importance of Persistence and State.

UNIT III NEURAL AND COGNITIVE COMPUTING 9

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

UNIT IV NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEM 9

Role of NLP in a Cognitive System – Importance of Context - Understanding Linguistics - Language Identification and Tokenization - Syntax and Syntactic Analysis - Construction Grammars - Techniques for Resolving Structural Ambiguity - Semantic Web - Attention models, context learning, LSTM, Bidirectional Encoder Representations fromTransformers (BERT), optimization of neural models.

UNIT V CASE STUDIES 9

Cognitive Systems in health care – Cognitive Computing in Government - Cognitive Assistant for visuallyimpaired –Video Analysis/Generation – Deep Fake- Speech Recognition using Deep Learning Architectures, Dialog Management - Natural Language Generation - Security and Threat Detection.

PRACTICAL EXERCISES: 30

1. Implement Long Term Memory encoding approach.
2. Implement Models of semantic memory.
3. Implement Decision Making models.
4. Implement Machine Learning algorithms for cognitive computing and observe the results like hyper parameters, learning curves, analysis, model/dataset comparison.
5. Implement a simple bag-of-word classifier for sentence classification.
6. Implement a neural n-gram model based on a simple MLP and an autoregressive model based on a LSTM for Language Modelling.
7. Implement a part-of-speech tagger.

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the foundationconcepts of cognitive computing.

CO2: Identify and design an ontology for the representation of knowledge and make an association with semantic web.

CO3: Analyze and evaluate the various ANN Models that can be adopted for different cognitive systems.

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CO4: Apply theoretical knowledge in developing computational models for cognitive modeling, language understanding and decision support.
CO5: Explore and critically analyze recent research on cognitive modeling.
CO6: Assess the current state of the art in Cognitive Systems and develop a perception about its future direction.

REFERENCES:

1. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive Computing and Big DataAnalytics", Wiley Publisher, 1st Edition, 2015,
2. Mehrotra, Mohan, and Ranka, "Elements of Artificial Neural Networks", PenramInternational Publishing, Second Edition, 2009.
3. Charu C. Aggarwal**.** "Neural Networks and Deep Learning", 2018, Springer
4. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences", The MIT Press, 1999.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	1
CO2	2	2	2	2	2	2
CO3	2	2	2	3	2	2
CO4	2	3	2	3	3	2
CO5	2	2	2	3	2	2
CO6	2	2	2	3	2	2

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

UNIT I INTRODUCTION 9

Agents as a paradigm for software engineering - Agents as a tool for understanding human societies- Intelligent Agent: Agents and Objects - Agents and Expert Systems - Agents as Intentional Systems - Abstract Architectures for Intelligent Agents - Instructions to agents.

UNIT II LEARNING IN AGENTS 9

Proportional case - Handling variables and qualifiers - Dealing with intractability- - Reasoning with horn clauses - Procedural control of reasoning - Rules in production – Reasoning with Higher order Logics.

UNIT III COMMUNICATION AND COOPERATION IN AGENTS 9

Software tools for ontology - OWL - XML - KIF - Speech acts - Cooperative Distributed Problem Solving - Task Sharing and Result Sharing - Result Sharing - Combining Task and Result Sharing - Handling Inconsistency - Coordination - Multi agent Planning and Synchronization.

UNIT IV DEVELOPING INTELLIGENT AGENT SYSTEMS 9

Situated Agents: Actions and Percept's - Proactive and Reactive Agents: Goals and Events - Challenging Agent Environments: Plans and Beliefs - Social Agents - Agent Execution Cycle - Deciding on the Agent Types - Grouping functionalities - Review Agent Coupling - Acquaintance Diagrams - Develop Agent Descriptors.

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UNIT V APPLICATIONS **9**

Agent for workflow and business process management- Mobile agents - Agents for distributed systems - agents for information retrieval and management - Agents for electronic commerce - agent for human- computer interface - agents for virtual environments - agents for social simulation

PRACTICAL EXERCISES: **30**

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

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Build an architecture for intelligent agents.

CO2: Apply the reasoning mechanisms of proposition and predicate logic to agents.

CO3: Use the learning mechanisms for an artificial agent.

CO4: Execute different communication and co-operation methodologies in a multi-agent setup.

CO5: Distinguish the agent types.

CO6: Develop intelligent agents' applications.

REFERENCES:

1. Michael Wooldridge, An Introduction to Multi Agent Systems, Second Edition, John Wiley and Sons, 2009.
2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Pearson Education, 2009.
3. Lin Padgham, Michael Winikoff, Developing Intelligent Agent Systems: A Practical Guide, Wiley publications, 2005.
4. Ronald Brachman, Hector Levesque "Knowledge Representation and Reasoning", Morgan Kaufmann, 2004
5. Arthur B. Markman, "Knowledge Representation", Lawrence Erlbaum Associates,1998

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	2	-	-
CO2	2	2	2	2	-	-
CO3	2	2	2	2	-	-
CO4	2	1	1	1	-	-
CO5	2	1	2	2	-	Attested

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CO6	2	2	2	2	-	-

DS3004 TEXT AND SPEECH ANALYTICS L T P C
3 0 2 4

UNIT I NATURAL LANGUAGE BASICS 9

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text Representation – Bag of Words model- Bag of N-Grams model – TF-IDF model – Extracting Features from Documents – Document similarity – Topic Models

UNIT II TEXT CLASSIFICATION 9

Advanced Feature Models – Word2Vec Model – Glove Model – Fast Text Model – Text Classification – Traditional Classification Models – SVM – Overview of Deep Learning Models– RNN – Transformers – Overview of Text Summarization and Topic Models.

UNIT III QUESTION ANSWERING AND DIALOGUE SYSTEMS 9

Information Retrieval – Relation Extraction – Extraction of Time – Extracting Events – IR-Based Question Answering – Knowledge-Based Question Answering – Language Models for QA – Classic QA Models – Evaluation of Factoid Answers Properties of Human Conversation – Chatbots – Dialogue-State Architecture – Evaluating Dialogue Systems – Design of Dialogue Systems

UNIT IV TEXT-TO-SPEECH SYNTHESIS 9

Overview - Text Normalization -Letter-to-Sound –Prosody -Data Collection -Evaluation. Signal Processing -Concatenative and Parametric Approaches - Wavenet and Other Deep Learning-Based TTS Systems

UNIT V AUTOMATIC SPEECH RECOGNITION 9

Speech Recognition - Acoustic Modeling - Deep Neural Network - Acoustic Modeling –HMM - HMM-DNN Systems -Feature Extraction -Connectionist Temporal Classification –Listen -Attend and Spell -Multi-Task Objectives for End-to-End ASR – ASR Evaluation -Word Error Rate

PROGRESS THROUGH KNOWLEDGE

PRACTICAL EXERCISES: 30

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

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Explain existing and emerging deep learning architectures for text and speech processing
CO2: Apply deep learning techniques for NLP tasks, language modelling and machinetranslation
CO3: Explain co-reference and coherence for text processing

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CO4: Build question-answering systems, chatbots and dialogue systems
CO5: Apply deep learning models for building speech recognition and text-to-speech systems
CO6: Design an automatic speech recognition system

REFERENCES:

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: AnIntroduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.
2. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018.
3. Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
4. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
5. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’Reilly , 2009

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	2	2	2
CO2	2	3	3	2	3	2
CO3	2	2	2	2	2	2
CO4	3	2	3	2	2	2
CO5	3	3	3	3	3	3
CO6	3	3	2	2	3	3

DS3005 REINFORCEMENT LEARNING L T P C
3 0 2 4

UNIT I INTRODUCTION TO REINFORCEMENT LEARNING 9

Introduction To Reinforcement Learning–Elements of Reinforcement Learning–Limitations and Scope – History of Reinforcement Learning– The Agent-Environment Interface - An-Armed Bandit Problem.

UNIT II MARKOV DECISION PROCESS AND DYNAMIC PROGRAMMING 9

Markov Decision Process – Action Space – Policy – Episode – Return and Discount Factor - The Markov Property – Markov Decision Processes – Bellman Equation – Dynamic Programming – Value Iteration and Policy Iteration.

UNIT III MONTE CARLO METHODS AND TEMPORAL METHODS 9

Understanding Monte Carlo Method – Prediction and Control Tasks – Monte Carlo Prediction – First and Every Visit – Monte Carlo Control – Understanding Temporal Difference Learning – TD Prediction – On-Policy TD Control – SARSA – Off-Policy TD Control – Q-Learning.

UNIT IV DEEP Q NETWORKS AND ITS VARIANTS 9

DQN – replay Buffer – Loss functions – Target Function – Architecture of DQN – Double DQN –

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DQN with prioritized Experience replay – Dueling DQN – Deep Recurrent Method.

UNIT V FUNCTIONAPPROXIMATION 9

Getting Started with Policy Gradient Methods – Policy Gradient Intuition – Variance Reduction Methods – Actor – Citic Methods – A2C , A3C , A3C – Deep Gradient Policy Gradient – Twin Delayed DDPG – Trust Region Policy Approximation – TRPO -Proximal Policy Optimization .

PRACTICAL EXERCISES: 30

1. Write a python program to implement Markov chain for simple prediction.
2. Write a python program to implement Markovian decision process.
3. Write a python program to implement Q-Learning algorithm.
4. Implement SARSA algorithm.
5. Implement Monte-Carlo and Temporal learning algorithm.
6. Implement A small GRID game with reinforcement learning.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand different terminologies of RL and Concepts of Probability.

CO2: Illustrate Markov Decision Process and Bellman Equation for learning.

CO3: ApplydynamicprogrammingtechniquesonMarkovdecisionprocessandMonteCarlo methods.

CO4: Implement Time difference learning for real world problems.

CO5: Apply Approximation methods of learning and Q-Learning Technique.

CO6: Understand the need for function approximation algorithms.

REFERENCES:

1. Richard S.Sutton and Andrew G.Barto, “Reinforcement learning: An introduction”, Second Edition, MIT Press, 2019.
2. Sudharsan Ravichandiran, “Deep Reinforcement Learning with Python” , Second Edition, Packet Publishing, 2020.
3. Kevin P Murphy, “Machine Learning: A Probabilistic Perspective“, Second Edition, MIT Press, 2022.
4. Csaba Szepesvari, “Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning)”, Morgan & Claypool Publishers, 2010.
5. Laura Graesser and Wah Loon Keng, “Foundations of Deep Reinforcement learning: theory and Practice in Python”, Pearson, 2022.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	1
CO2	3	2	1	1	2	1
CO3	3	2	2	1	2	2
CO4	3	2	2	1	2	2
CO5	3	2	2	2	2	2
CO6	3	1	1	2	2	1

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IF3059 MOBILE APPLICATION DEVELOPMENT AND DEPLOYMENT L T P C
3 0 2 4

UNIT I INTRODUCTION 9

Introduction to Mobile Computing – Characteristics and Benefits – Mobile Software Engineering– Mobile Application Development Environment –– Application Models – Infrastructure and Managing Resources – Mobile Device Profiles – Frameworks and Tools.

UNIT II USER INTERFACE 9

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

UNIT III APPLICATION DESIGN 9

Memory Management – Design Patterns for Limited Memory - Work Flow for Application Development – Java API - Dynamic Linking - Plugins and Rule of Thumb for using Dlls - Concurrency and Resource Management – File Management – Data Base Management: Sqlite.

UNIT IV APPLICATION DEVELOPMENT I 9

Mobile OS: Android, IOS – Android Application Architecture - Android Basic Components- Intents and Services – Storing and Retrieving Data – Packaging and Deployment – Security and Hacking.

UNIT V APPLICATION DEVELOPMENT II 9

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

PRACTICAL EXERCISES: 30

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

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Design the right user interface for mobile application
CO2: Implement mobile application using UI toolkits and frameworks
CO3: Design mobile applications that is aware of the resource constraints of mobile devices
CO4: Develop web based mobile application that accesses internet and location data
CO5: Implement android application to use telephony for SMS communication

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CO6: Implement android application with multimedia support

REFERENCES:

1. Reto Meier, “Professional Android 4 Application Development”, Wiley India Pvt Ltd, 2012.
2. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, “Programming Android”, O‟Reilly, 2011.
3. Alasdair Allan, “iPhone Programming”, O‟Reilly, 2010.
4. Reza B'Far, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", Cambridge Press University, 2009.
5. Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, Fourth Edition, Payload media, 2011.
6. Ben Shneiderman and Catherine Plaisant, “Designing the User Interface: Strategies for Effective Human Computer Interaction”, Fifth Edition, Addison– Wesley, 2009.

CO-PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	1	1
CO2	2	1	3	2	1	1
CO3	3	1	2	3	1	1
CO4	2	1	3	2	1	1
CO5	3	1	2	3	1	1
CO6	3	1	3	3	1	1

IF3053 BLOCKCHAIN TECHNOLOGIES L T P C
3 0 2 4

UNIT I INTRODUCTIONTOBLOCKCHAIN 9

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

UNIT II BITCOIN AND CRYPTOCURRENCIES 9

History and Origins of Bitcoin; Bitcoin Technology and Architecture - Transactions and Scripting Language- Bitcoin Wallets; Bitcoin Mining - Bitcoin Transactions and Network; Alternative Coins - Bitcoin Limitations - Name Coin – Prime Coin – Zcash –Bitcoin Smart Contracts – Ricardian Contracts.

UNIT III ETHEREUM 9

Ethereum and its features ; Ethereum Architecture : Ethereum Virtual Machine -The Ethereum Network –Runtime Byte Code, Blocks and Blockchain - Fee Schedule– Ethereum Programming Languages - Smart Contracts Development - Ethereum Scaling Solutions - Ethereum DApps and Use Cases - Ethereum Community and Ecosystem.

UNIT IV WEB3 AND HYPERLEDGER 9

Web3 – Web3 concepts and Architecture- Benefits and Features of Web3- Web3 Development Tools and Frameworks –Hyperledger Projects and Frameworks - Hyperledger Fabric - Hyperledger Sawtooth - Hyperledger Indy - Hyperledger Iroha - Hyperledger Besu- Hyperledger Tools.

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UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple- Rootstock – Quorum – Tendermint Interoperability and Cross-Chain Communication - Scalability – Privacy – Tokenization and Digital Assets - Cryptocurrency Regulations and Legal Frameworks - Cryptocurrency Use Cases-Notable Projects – Miscellaneous tools.

PRACTICAL EXERCISES: 30

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

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the technology components of Blockchain and how it works behind-the scenes.

CO2: Aware of different approaches to developing decentralized applications.

CO3: Understand the Bitcoin and its limitations by comparing with other alternative coins.

CO4: Establish deep understanding of the Ethereum model, its consensus model, code execution.

CO5: Understand the architectural components of a Hyperledger and its development framework.

CO6: Know the Alternative blockchains and emerging trends in blockchain.

REFERENCES:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing,2018.
2. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands-On Approach”, VPT, 2017.
3. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly Publishing, 2014.
4. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing Platform, 2016.

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5. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
6. Alex Leverington, “Ethereum Programming”, Packt Publishing, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	-	-
CO2	3	3	3	3	1	2
CO3	3	3	3	3	3	-
CO4	3	2	3	3	-	-
CO5	3	3	3	3	3	3
CO6	3	3	3	3	2	2

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

UNIT I INTRODUCTION 9

Evolution of the Internet – Things/Real World Objects – Smart Objects – Technology Enablers of Iot – Device Layer – Role of Wsns In IoT - Edge/Fog Layer – Role of Cloud In IoT – Possible IoT Reference Models - M2M Communication – Domain Specific IoTs – Complexity and Levels of IoT Based Systems – IoTand Industry 4.0.

UNIT II DEVICE LAYER 9

Microprocessors Vs. Microcontrollers – Open-Source Movement in Hardware – Engineering Vs Prototyping – Software Development Lifecycle for Embedded Systems – Arduino IDE – Programming and Developing Sketches – Arduino Rest Apis – Raspberry PI– Interfaces – Python Packages of Interests for IoT – Emerging Microcontrollers and Platforms for Building IoT Systems.

UNIT III DEVELOPING IOT SYSTEMS 9

Requirements and Process Specifications – Domain Model and Information Model – Service and Level Specifications – Functional View and Operational View – Device-Component Integration – Application Development – Models of Communication – HTTP, Coap, MQTT and Websocket Protocols – SDN and NFV for IoT.

UNIT IV CLOUD OFFERINGS AND ANALYTICS 9

Cloud Storage Models and Communication API – WAMP Autobahn – Xively Cloud – Python Web Application Framework – Django–IBM Watson – AWS for IoT - Map Reduce Programming Model, Job Execution and Work Flow, Cluster Setup – Lambda Architecture – Apache Hadoop – REST Based and Websocket Based Approaches in Apache Storm.

UNIT V IoT MANAGEMENT & CASE STUDIES 9

IoT Systems Management – SNMP – NETCONF – YANG – Case Studies: Home Automation, Smart Cities, Weather Monitoring System, Forest Fire Monitoring, Air Pollution Monitoring – Smart Irrigation.

PRACTICAL EXERCISES: 30

1. Develop a BLINK sketch in Arduino.
2. Develop an Arduino sketch that repeats an LED to glow brightly, decrease the brightness,

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switches off the LED, increases the brightness and LED glows with maximum intensity (a sketch for fading).

3. Develop an Arduino sketch that takes sensor readings for five seconds during the startup, and tracks the highest and lowest values it gets. These sensor readings during the first five seconds of the sketch execution define the minimum and maximum of expected values for the readings taken during the loop (a sketch for calibrating a sensor).
4. Develop an Arduino sketch that reads the value of a variable resistor as an analog input and changes blink rate of the LED.
5. Develop an Arduino sketch to use a piezo element to detect the vibration.
6. Develop a Python program to control an LED using Rapberry Pi.
7. Develop a Python program to interface an LED with a switch using Rapberry Pi.
8. Miniproject.

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the evolution of the Internet and the impact of IoT in the society.
CO2: Design portable IoT devices using Arduino IDE/ Raspberry Pi with Python.
CO3: Apply appropriate protocols in various parts of IoT based systems.
CO4: Use cloud offerings and big data tools in IoT based systems.
CO5: Implement Map-Reduce based programs using Apache frameworks.
CO6: Design, deploy and manage complex IoT based systems.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A Hands-On Approach”, Universities Press, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.
3. David Hanes, Gonzalo Salguerio, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for Internet of Things”, Cisco Press, 2017.
4. Perry Lea, “Internet of Things for Architects”, PACKT, 2018.
5. Andy King, “Programming the Internet of Things: An Introduction to Building Integrated, Device to Cloud IoT solutions”, O’REILLY’, 2021

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	1	1	1
CO2	2	2	3	2	3	2
CO3	2	2	3	2	2	1
CO4	2	2	3	3	2	2
CO5	2	1	3	3	3	1
CO6	3	3	2	2	3	3

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IF3063 VISUALIZATION METHODS AND TECHNIQUES L T P C
3 0 2 4

UNIT I INTRODUCTION 9

Presentation-Explorative Analysis-Confirmative Analysis-Mental Model-Scientific Visualization-Reference Model-Designing a Visual Application-Linear Data Representation – Perception-Issues.

UNIT II VISUAL REPRESENTATION 9

Information Visualization Process - Representation Techniques - Human Factor and Interaction-Relation and connection-Multivariate Analysis – Trees – Graphs -Network and Hierarchies - World Wide Web Manipulable and Transformable Representation.

UNIT III MULTIMODAL PRESENTATION 9

Human Vision – Presentation in Space- Temporal Consideration- Space and Time – Techniques for Spatial Data, Geospatial Data, Time-oriented Data- Text Document- Data Analysis using Tableau and R language.

UNIT IV INTERACTION TYPES 9

Interaction Concepts and Techniques – Problem of Information Overload – Interaction Types-Human Computer Interaction-Norman's Action Cycle-Interaction for: Information Visualization – Navigation – Models – Involuntary - Interactive Medical Application- Tactile Maps for Visually Challenged People.

UNIT V ADVANCE DESIGN TECHNIQUES 9

Designing Effective Visualization, Comparing and Evaluating- Research Directions –Systems-Personal view –Attitude-Idea Generation – Convergence – Sketching- Evaluation Criteria – Analytic and Empirical Method – Case Study – Interactive Calendars –Selecting One from Many-Animation Design for Simulation.

PRACTICAL EXERCISES: 30

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

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the concepts and techniques used in Visualization Techniques.
CO2: Implement different techniques of information representation.
CO3: Implement various presentations of information.
CO4: Apply different interaction types used to present information.
CO5: Design and implement effective Visualization.

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CO6: Create and evaluate interactive data Visualization real-time problem.

REFERENCES:

1. O.Ward, Georges Grinstein and Daniel Keim," Interactive Data VisualizationFoundations, Techniques, and Applications", Second Edition, A K Peters,2021.
2. Robert Spence, "Information Visualization An Introduction", Third Edition, Pearson Education, 2014.
3. Colin Ware, "Information Visualization Perception for Design", Third Edition, Morgan Kaufmann Publishers, 2012.
4. Jason Gregory, "Game Engine Architecture", Third Edition, A K Press, 2015.
5. RiccardoMazza, "Introduction to Information Visualization", Springer.2009
6. JoergOsarek, "Virtual Reality Analytics", Gordon's Arcade, 2016.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	1	1
CO2	3	1	3	3	1	1
CO3	3	1	3	3	1	1
CO4	3	1	3	3	1	1
CO5	3	1	3	3	1	1
CO6	3	1	3	3	1	1

IF3056 IMAGE PROCESSING AND COMPUTER VISION L T P C
3 0 2 4

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction – Applications of Image Processing – Steps in Image Processing Applications – Human vision and color perception- Digital Imaging System – Imaging sensors-Sampling and Quantization – Pixel Connectivity – Distance Measures – Colour Fundamentals and Models – File Formats – Image Operations.

UNIT II IMAGE ENHANCEMENT AND TRANSFORMS 9

Image Transforms: Discrete Fourier Transform – Fast Fourier Transform – – Wavelet Transforms -Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing –Spatial Filtering – Smoothing And Sharpening – Frequency Domain: Filtering in Frequency Domain.

UNIT III RESTORATION AND BOUNDARY DETECTION 9

Image Restoration – Image Degradation Model – Noise Modeling – Blur – Order Statistic Filters – Image Restoration - Morphological Operations- Dilation-Erosion-Opening-Closing- Edge Detection-Corner Detection - Detection Of Discontinuities Edge Linking and Boundary Detection.

UNIT IV IMAGE SEGMENTATION AND FEATURE EXTRACTION 9

Image Segmentation — Thresholding – Region based Segmentation – Image Features and Extraction – Image Features – Types of Features – Feature extraction – SIFT ,SURF– Feature reduction algorithms- PCA.

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UNIT V IMAGE CLASSIFIER AND APPLICATIONS 9

Image Classifiers – Supervised Learning – Maximum Likely Hood-Minimum Distance – Parallopiped-Support Vector Machines, Image Clustering – Unsupervised Learning – K-means-Hierarchical and Partition Based Clustering Algorithms –ANN – Deep Learning Image Classifier.

PRACTICAL EXERCISES: 30

1. Implementation of Reading and Writing of Images in Matlab and OpenCV/Octave/SciLab.
2. Implementation of simple spatial filters like Low Pass Filters and High Pass Filters in Matlab/OpenCV.
3. Implementation of Histogram Techniques in Matlab/Octave/OpenCV.
4. Implementation of noise modeling in Matlab/Octave/SciLab.
5. Implementation of Fourier and Wavelet Transforms in Matlab/Octave.
6. Implementation of SIFT, SURF in Matlab/Octave/SciLab/ Opencv.
7. Implementation of PCA in Matlab/Octave/ Opencv.
8. Implementation of Image Classifier using SVM in Matlab/Octave/ OpenCV..
9. Implementation of Image Clustering algorithms in Matlab/Octave/ Opencv.
10. Implementation of Feature extraction in images using Matlab/Octave / Opencv

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Implement basic image processing operations.

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

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

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

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

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

REFERENCES:

1. Rafael Gonzalez, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018
2. S. Sridhar, “Digital Image Processing”, Second Edition, Oxford University Press, 2016.
3. Forsyth and Ponce, “Computer Vision – A Modern Approach”, Second Edition, Prentice Hall, 2011.
4. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall Information , 2011
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”, Fourth Edition, Cengage India, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	2	1
CO2	3	-	3	3	2	1
CO3	3	-	3	3	2	1
CO4	3	-	3	3	2	1
CO5	3	-	3	3	2	1
CO6	3	1	3	3	2	2

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IF3058	MIXED REALITY TECHNIQUES	L T P C 3 0 2 4

UNIT I INTRODUCTION TO MIXED REALITY 9

Introduction to Virtual Reality (VR) - Augmented Reality (AR) -Mixed Reality (MR)– History – MR Use Cases &Designing For MR Platforms – Mixing Virtual With Real - MR Hardware And Devices – The Input – The Output – Optical See-Through Displays – Eye Tracking- Computer Vision For MR.

UNIT II INTERACTION DESIGN IN MIXED REALITY 9

Integrating Framework for MR –Embedded MR Environment - Tangible Interaction – Auditory-Induced Presence – Exertion in MR Systems – Mixed Interaction in MR.

UNIT III MIXED REALITY SYSTEMS 9

Outdoor MR Systems – Multimodal Excitatory Interfaces – Tracking in Mixed Reality – Authoring Immersive MR – Collaborative AR – Software Engineering Method for MR.

UNIT IV MIXED REALITY AND HUMAN-ROBOT INTERACTION 9

Mixed Reality for Robots – User-centered HRI – Mental Transformation in HRI – Computational Cognitive Modeling – Evaluating the usability of the virtual environment – Security Robot.

UNIT V APPLICATIONS OF MIXED REALITY 9

MR in healthcare and medical simulations – Teleoperation interface for MR Robot - MR in psychological experimentation – MR in Sports – MR Prototypes to support early creative design – MR Companion Robots.

PRACTICAL EXERCISES: 30

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

TOTAL:75 PERIODS

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COURSE OUTCOMES:

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

CO1: Demonstrate knowledge and understanding of VR, AR, and MR concepts, technologies, and applications.

CO2: Apply design principles and considerations specific to Mixed Reality platforms.

CO3: Understand interaction design principles in Mixed Reality.

CO4: Apply software design and implementation skills for Mixed Reality systems.

CO5: Demonstrate knowledge of the intersection of Mixed Reality and Human-Robot Interaction (HRI).

CO6: Analyze and evaluate the integration of Mixed Reality technologies and principles into real-world applications

REFERENCES:

1. O'Connell, Kharis, “Designing for Mixed Reality”, O'Reilly Media, Inc, 2016.
2. Dubois E, Gray P, Nigay L, “The engineering of mixed reality systems” Springer Science & Business Media, 2009.
3. Wang, Xiangyu, “Mixed reality and human-robot interaction”. Vol. 47. Springer Science & Business Media, 2011.
4. Benyon, D, “Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design”. Third Edition, Pearson Education Limited, 2013

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	3	-
CO2	3	-	2	3	3	-
CO3	2	-	3	3	3	-
CO4	3	1	3	3	3	1
CO5	3	-	2	3	3	-
CO6	3	2	3	3	3	2

DS3006 FRAMEWORK FOR ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING WITH PYTHON

L T P C
3 0 2 4

PROGRESS THROUGH KNOWLEDGE

UNIT I PYTHON BASICS **9**

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

UNIT II FILE HANDLING AND ARRAYS **9**

Files processing - NumPy - Array Indexing - Array Slicing - Reshaping - Concatenation - Splitting - Aggregation - Broadcasting - Sorting - Vectorizing - Matrix operations.

UNIT III DATA PROCESSING **9**

Pandas - Series object - Use of Data frames - importing and exporting data to csv/ other formats - Data indexing and selection - Handling missing data - Replacing data items - Combining datasets - Pivot Tables - working with time series.

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UNIT IV DATA VISUALIZATION **9**

Importing matplotlib and seaborn libraries - setting styles - simple line plots - Scatter plots - visualizing errors - density and contour plots - histograms - legend - colorbars - subplots - three-dimensional plotting.

UNIT V STATISTICAL LEARNING **9**

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

PRACTICAL EXERCISES: **30**

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

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Develop and execute programs with loops and other data structures.
CO2: Work with files and arrays using numpy.
CO3: Work with data using Pandas.
CO4: Write programs for visualization using matplotlib and seaborn.
CO5: Develop separate functions for statistical learning.
CO6: Develop computer applications for data science/ machine learning projects.

REFERENCES:

1. Eric Matthes, Python Crash Course, 2nd Edition, No Starch Press, 2019
2. Jake Vander Plas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media, Inc, 2016
3. Wes McKinney, Python for Data Analysis, 3rd Edition, O' Reilly, 2022
4. Bobby Iliev, Introduction to Git and Github, MIT License, https://github.com /bobbyiliev/introduction-to-git-and-githubebook/raw/main/ebook/en/export/introduction-to-git-and-github-dark.pdf, 2021.
5. https://scikit-learn.org/stable/tutorial/statistical_inference/index.html.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	2	2	2
CO2	2	2	2	2	2	2
CO3	1	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	3	3	3	3	3	3
CO6	3	3	3	3	3	3

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DS3007	EXPLAINABLE AI	L T P C 3 0 2 4

UNIT I FUNDAMENTALS **9**

Introduction - Machine Learning - Interpretability - Taxonomy - Scope - Evaluation - Properties of Explanations - Human friendly explanations – Datasets.

UNIT II INTERPRETABLE MODELS **9**

Regression - Linear - Logistic - GLM - GAM - Decision tree - Decision rule - Rulefit - Model Agnostic methods - Global – Local.

UNIT III TABULAR DATA EXPLAINABILITY **9**

Permutation feature importance - Permutation Feature Importance from Scratch
-Permutation Feature importance from python library Scikit learn - Shapley Values - Partial Dependence Plots and Related Plots.

UNIT IV IMAGE DATA EXPLAINABILITY **9**

Integrated gradients - XRAI - Working and implementation - Grad CAM - LIME implementation - Guided Backpropagation and guided Grad CAM.

UNIT V TEXT DATA EXPLAINABILITY AND RECENT TRENDS **9**

Tokenization - Word embeddings - LIME working with text - Gradient x Input - Layer integrated gradients - Language interpretability tool - Emerging topics - Time series data - Multimodal data - Interacting with Explainable AI.

PRACTICAL EXERCISES: **30**

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

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the different types of learning models with interpretation mechanisms
CO2: Apply different computation interpretable techniques to ML models
CO3: Automate the AI explanation mechanism to Tabular data
CO4: Automate the AI explanation to Image data
CO5: Apply the AI explainable techniques to text data
CO6: Explore the recent AI computation tools

REFERENCES:

1. Christoph Molnar, Interpretable Machine Learning - A Guide for making Black Box Models Explainable, Second edition, https://christophm.github.io/interpretable-ml-book/, 2023

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2. Michael Munn, David Pitman, Explainable AI for Practitioners, O'Reilly Media, Inc., 2022
3. https://www.amazon.in/Hands-Explainable-XAI-Python-trustworthy/dp/1800208138
4. https://github.com/PacktPublishing/Applied-Machine-Learning-Explainability-Techniques
5. http://machinelearningstories.blogspot.com/2020/06/exhaustive-literature-study-on-xai.html

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	3	3
CO2	3	2	3	3	3	3
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	2	3	3	3	3
CO6	3	2	3	3	3	3

DS3008 FINANCIAL TECHNOLOGIES L T P C
3 0 2 4

UNIT I FINTECH 9

Reshaping the banking and payments industry -Analyze the source of banks' vulnerability FinTech Transformation, FinTech Evolution, Collaboration between Financial Institutions and Startups, FinTech Typology, Emerging Economics: Opportunities and Challenges.

UNIT II INNOVATIONS OF FINTECH 9

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

UNIT III FINTECH REGULATIONS AND DATA REGULATION 9

FinTech Regulations - Evolution of RegTech - RegTech Ecosystem: Financial Institutions, Startups, Challenges, Regulators, Regulatory Sandboxes, Smart Regulation. DataRegulation Data in Financial Services-European Big-Bang: PSD2 / GDPR / MIFID2 –Digital Identity- Regulation 1.0 to 2.0 (KYC to KYD). Regulation of Mobile Money, Legal and Regulatory Implications of Cryptocurrencies.

UNIT IV DIGITAL FINANCE AND ALTERNATIVE FINANCE 9

History of Financial Innovation, Digitization of Financial Services, FinTech & Funds – Method of AI used to Transform the Future of FinTech, Ensuring Compliance from the Start: Suitability and Funds, Alternative Lending and Crowdfunding Platforms-Peer-to-Peer (P2P) Lending, Crowdfunding, Online Small Business Loans, Microfinance Platforms - Regards, Charity and Equity, P2P and Market place Lending, The Rise of new Tech Fins - New Models and New Products.

UNIT V BUILDING & MANAGING A SUCCESSFUL FINTECH STARTUP 9

Understanding the impact of Macro & Micro factors on the Business Dynamics- Art & Science of Design Thinking- Managing Growth, Fund Raising-Developing the Minimum Viable Products and Exits. Implementing Effective Marketing and Growth Strategies ;Managing Risk and Ensuring

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Compliance ; Disruptive Technology Cases in FinTech

PRACTICAL EXERCISES: **30**

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

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the concepts and computational basics in the real-world financial market scenario

CO2: Formulate trading strategies by identifying the patterns in trading and market price movements

CO3: Evaluate portfolios through systematic technical and fundamental analysis

CO4: Collaborate and compete with trading groups in a simulated environment and extend to the real investment scenarios

CO5: Demonstrate decision dynamics to attain the investment objectives in a stock market environment

CO6: Learn to assess the future of fintech and think strategically about challenges faced by financial companies

REFERENCES:

1. Financial Technology Handbook for Investors, Entrepreneurs and Visionaries", 2016.
2. John Hill, Fintech and the Remaking of Financial Institutions, Elsevier Publication, First Edition ISBN: 978- 0128-134-979, 2018.
3. Osterwalder, A. – Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, And Challengers. New York: John Wiley& Sons, 2010.
4. Van der Kleij, E. Tech Giants Becoming Non-Bank Banks. In: The FinTech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, 2016.
5. Bhandari, M. India and the Pyramid of Opportunity. In: The FinTech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, 2016.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	3	1
CO2	3	3	2	3	3	1
CO3	1	1	3	2	3	2
CO4	3	3	3	3	3	1

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CO5	1	1	3	2	3	1
CO6	2	1	3	2	3	1

DS3009 **QUANTUM AI** **L T P C**
3 0 2 4

UNIT I QUANTUM COMPUTING **9**

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

UNIT II QUANTUM COMPUTATION AND ALGORITHMS **9**

Quantum Computation – Quantum Circuits, Quantum Algorithms – Quantum Search (Search and Quantum Oracle, Lower Bound (pn) for Uf -based Search, Grover's Amplification, Circuit Representation, speeding up the Traveling Salesman Problem, The Generate-and-Test Method), Quantum Search Algorithms, (Reversible Computation, Reversible Circuits) Quantum Information-Quantum Noise and Quantum Operations, Distance Measures for Quantum Information, Quantum Error Correction, Entropy, Data Compression.

UNIT III ADVANCED QUANTUM COMPUTING: INTERFERENCE AND ENTANGLEMENT **9**

Quantum statistics – Interference, Noisy Intermediate-Scale Quantum Devices, Quantum Error Correction, Bell Inequalities and Quantum Computing, Practical Applications of Entanglement: NIST Randomness Beacon.

UNIT IV QUANTUM ML and QUANTUM DL **9**

Quantum Naïve Bayes, Quantum Computing, Quantum Cognition (Quantum Probability, Decision Making, Unpacking Effects) Quantum Bayesian Networks, Bayesian Inference Quantum Machine Learning-Machine Learning-Supervised Machine Learning, Unsupervised Machine Learning, Quantum Deep Learning - Information Geometry, and Geometric Deep Learning, Standardized Methods for Quantum Computing. Reinforcement Learning, Bayesian Methods in Machine Learning.

UNIT V QUANTUM BLOCKCHAIN **9**

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

PRACTICAL EXERCISES:

1. Implementation of Quantum Algorithms.
2. Demonstrating the Quantum Complexity.
3. Experiment on Quantum Key Distribution.
4. Experiments on Optical Quantum Information Processing.
5. Experiments on Quantum Cryptography.
6. Case studies like Seismic Sensing Using Quantum Cryptography Network.

TOTAL:75 PERIODS

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COURSE OUTCOMES:

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

CO1: Gain understanding of the QAI's fundamentals.

CO2: Learn more about quantum computation and algorithm development.

CO3: Understand how to use artificial intelligence, machine learning, and deep learning to extract value from large amounts of data.

CO4: Understand and be fluent on the concepts of advanced quantum computing.

CO5: Learn to assess the use QAI to develop the Quantum Blockchain.

CO6: Learn Quantum statistics.

REFERENCES:

1. Wichert, A,"Principles of quantum artificial intelligence: quantum problem solving and machine learning", 2020.
2. Swan. M, Dos Santos, R. P, and Witte. F, Quantum Computing: Physics, Blockchains and Deep Learning Smart Networks. 2020.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	3
CO2	3	-	3	3	3	3
CO3	3	-	3	3	3	3
CO4	3	-	3	3	3	3
CO5	3	-	3	3	3	3
CO6	3	-	3	3	3	3

DS3010 **RECOMMENDER SYSTEMS** **L T P C**
3 0 2 4

UNIT I INTRODUCTION **9**

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

UNIT II COLLABORATIVE FILTERING **9**

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

UNIT III CONTENT-BASED RECOMMENDATION **9**

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

UNIT IV KNOWLEDGE- BASED RECOMMENDATION **9**

Knowledge representation and reasoning – Constraint-based recommenders – Case-based recommenders - Hybrid approaches: Opportunities for hybridization - Monolithic hybridization design - Parallelized hybridization design - Pipelined hybridization design.

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UNIT V EVALUATING RECOMMENDER SYSTEM 9

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

PRACTICAL EXERCISES: 30

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

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

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

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

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

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

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

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

REFERENCES:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed. 2.
2. C.C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
3. F. Ricci, L Rokach, B. Shapira and P.B. Kantor, Recommender systems handbook, Springer 2010.
4. Schutze, Hinrich, Christopher D. Manning, and Prabhakar Raghavan. Introduction to information retrieval. Cambridge University Press, 2008.
5. Leskovec, Jure, Anand Rajaraman, and Jeffrey David Ullman. Mining of massive data sets. Second Edition, Dreamtech Press, 2016.
6. T.V.Geetha and S.Sendhilkumar, Machine Learning: Concepts,Techniques and Applications, First Edition, CRC Press, Taylor and Franics, 2023

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	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	3	-
CO2	2	-	3	3	3	-
CO3	3	2	2	3	1	-
CO4	3	2	3	3	3	2
CO5	3	1	2	3	-	1
CO6	3	-	2	3	3	-

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

UNIT I ARTIFICIAL NEURAL NETWORK 9

Neural computation-History of Neural Systems Development – Fundamental Concepts and Models of Artificial Neural Systems : Biological Neurons and Their Artificial Models – Models of Artificial Neural Networks – Neural Processing – Learning and Adaptation – Neural Network Learning Rules – Single Layer Perception Classifiers

UNIT II MULTILAYER FEEDFORWARD NETWORKS 9

Linearly Nonseparable Pattern Classification - Delta Learning Rule for Multiperceptron Layer - Generalized Delta Learning Rule - Feedforward Recall and Error Back-Propagation Training - Learning Factors - Classifying and Expert Layered Networks - Functional Link Networks.

UNIT III SINGLE-LAYER FEEDBACK NETWORKS 9

Basic Concepts of Dynamical Systems - Mathematical Foundations of Discrete-Time Hopfield Networks - Mathematical Foundations of Gradient-Type Hopfield Networks - Transient Response of Continuous-Time Networks - Relaxation Modeling in Single-Layer Feedback Networks

UNIT IV ASSOCIATIVE MEMORIES 9

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

UNIT V APPLICATIONS OF NEURAL ALGORITHMS AND SYSTEMS 9

Linear Programming Modeling Network - Character Recognition Networks - Neural Networks Control Applications - Networks for Robot Kinematics - Connectionist Expert Systems for Medical Diagnosis - Self-organizing Semantic Maps– Interactive Calendars –Selecting one from many-Animation Design for Simulation.

PRACTICAL EXERCISES: 30

1. Study about Biological Neural Network & Artificial Neural Network
2. Write a MATLAB program to plot a few activation functions that are being used in neural networks
3. Implement a logic gate (AND,OR,NOT,NAND,NOR), using McCulloh - Pitts model.
4. Implement a Perceptron model
5. With a suitable example simulate the perceptron learning network and separate theboundaries. Plot the points assumed in the respective quadrants using differentsymbols for identification.

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6. Implement a Hopfield model
7. Implement a Back propogation learning algorithm.
8. Implement a Multi layer perceptron
9. Create a network that learns to take eight-bit patterns and reproduce them on the output layer after re-coding them in a three-unit hidden layer
10. Mini Project

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamental concept behind neural network
CO2: Implement the feed forward network
CO3: Understand the working of feedback neural network
CO4: Explore the memory architecture using neural networks.
CO5: Design and develop applications using neural networks
CO6: Explore the recent advances in neural networks

REFERENCES:

1. Jacek M.Zuarda, “Introduction to Artificial Neural Networks”, West Publishing Company.1994
2. Simon Haykin, Neural Networks & Learning Machines, Third Edition, Pearson, 2009

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	-
CO2	3	2	3	3	1	1
CO3	3	2	3	3	3	-
CO4	3	2	3	3	3	-
CO5	3	2	3	3	3	2
CO6	3	2	3	3	1	2

PROGRESS THROUGH KNOWLEDGE

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