ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2019
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, a firm 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.

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M.TECH INFORMATION TECHNOLOGY
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1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO#	Programme Educational Objectives
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#	Programme Outcome
1	An ability to independently carry out research/investigation and development work to solve practical problems.
2	An ability to write and present a substantial technical report/document.
3	An ability to demonstrate a degree of mastery over Artificial Intelligence and Data Science.
4	An ability to apply multimedia tools and techniques to provide simple, and elegant solutions to complex real-world problems in multidisciplinary domains.
5	An ability to become a leader/entrepreneur/software developer and developer in the domain of Artificial Intelligence and Data Science.
6	An ability to work individually and in teams with social obligation, ethical and environmental consciousness.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs):

1. Ability to apply programming principles and practices for the design of software solutions in an AI-enabled world of business and social activities.
2. Ability to identify the resources to build and manage the IT infrastructure using AI and Data science to solve real-world problems with an understanding of the Tradeoffs involved in the design choices.
3. Ability to plan, design and execute projects for the development of intelligent systems with a focus on the future.

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4. PEO / PO Mapping

Programme Educational Objectives	Programme Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	✓	✓	✓	✓	✓	
PEO2	✓	✓	✓	✓	✓	
PEO3	✓	✓	✓	✓	✓	✓
PEO4		✓				✓
PEO5	✓			✓	✓	✓

5. Mapping of Course Outcome and Programme Outcome

Year	Semester	Course Name	PO1	PO2	PO3	PO4	PO5	PO6
Year 1	Sem 1	Probability and Statistical Methods						
		Advanced Data Structures and Algorithmics	✓	✓	✓	✓	✓	✓
		Introduction to Artificial Intelligence	✓	✓	✓	✓	✓	✓
		Foundations of Data Science	✓		✓	✓	✓	
		Research Methodology and IPR	✓					✓
		Audit Course I	✓					✓
		Advanced Data Structures and Algorithms Laboratory	✓		✓	✓	✓	✓
		Data Science Laboratory	✓	✓	✓	✓	✓	✓
		Web Technologies Laboratory	✓	✓	✓	✓	✓	✓
	Sem 2	Machine Learning	✓	✓	✓	✓	✓	
		Big Data Analytics	✓	✓	✓	✓	✓	
		Program Elective I						
		Program Elective II						
		Audit Course II	✓					✓
		Mini Project with Seminar	✓	✓	✓	✓	✓	✓
		AI Applications Laboratory	✓	✓	✓	✓	✓	✓
Year 2	Sem 3	Program Elective III						
		Program Elective IV						
		Program Elective V						
		Dissertation I	✓	✓	✓	✓	✓	✓
	Sem 4	Dissertation II	✓	✓	✓	✓	✓	✓

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CURRICULUM AND SYLLABUS FOR I – IV SEMESTER
SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5156	Probability and Statistical Methods	FC	3	1	0	4	4
2.	IF5151	Advanced Data Structures and Algorithmics	PCC	3	0	0	3	3
3.	DS5101	Foundations on Data Science	PCC	3	0	0	3	3
4.	DS5102	Introduction to Artificial Intelligence	PCC	3	0	2	5	4
5.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
7.	IF5161	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
8.	DS5111	Data Science Laboratory	PCC	0	0	4	4	2
9.	DS5112	Web Technologies Laboratory	PCC	0	0	2	2	1
			TOTAL	**16**	**1**	**12**	**29**	**21**

*Audit course is optional

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	DS5201	Machine Learning	PCC	3	0	2	5	4
2.	DS5202	Big Data Analytics	PCC	3	0	2	5	4
3.		Program Elective I	PEC	3	0	0	3	3
4.		Program Elective II	PEC	3	0	2	5	4
5.		Open Elective I	OE	3	0	0	3	3
6.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
8.	DS5211	AI Applications Laboratory	PCC	0	0	2	2	1
9.	DS5212	Mini Project with Seminar	EEC	0	0	2	2	1
			TOTAL	**17**	**0**	**10**	**27**	**20**

*Audit course is optional

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SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective III	PEC	3	0	2	5	4
2.		Program Elective IV	PEC	3	0	2	5	4
3.		Program Elective V	PEC	3	0	2	5	4
PRACTICALS								
4.	DS5311	Dissertation I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**18**	**27**	**18**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	DS5411	Dissertation II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS: 71

LIST OF FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MA5156	Probability and Statistical Methods	FC	3	1	0	4	4

LIST OF RESEARCH METHODOLOGY AND IPR COURSE (RMC)

S. NO	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2

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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.	IF5151	Advanced Data Structures and Algorithmic	PCC	3	0	0	3	3
2.	DS5101	Foundations on Data Science	PCC	3	0	0	3	3
3.	DS5102	Introduction to Artificial Intelligence	PCC	3	0	2	5	4
4.	IF5161	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
5.	DS5111	Data Science Laboratory	PCC	0	0	4	4	2
6.	DS5112	Web Technologies Laboratory	PCC	0	0	2	2	1
6.	DS5201	Machine Learning	PCC	3	0	2	5	4
7.	DS5202	Big Data Analytics	PCC	3	0	2	5	4
8.	DS5211	AI Applications Laboratory	PCC	0	0	2	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	DS5212	Mini Project with Seminar	EEC	0	0	2	2	1
2.	DS5311	Dissertation I	EEC	0	0	12	12	6
3.	DS5411	Dissertation II	EEC	0	0	24	24	12

LIST OF PROFESSIONAL ELECTIVES (PEC)

S. NO	COURSE CODE	COURSE TITLE	CATA GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
ELECTIVES I								
1.	DS5001	Artificial life and Robotics	PEC	3	0	0	3	3
2.	DS5002	Streaming Analytics	PEC	3	0	0	3	3
3.	DS5003	Ethics for AI and Robotics	PEC	3	0	0	3	3
4.	DS5004	Cognitive Computing	PEC	3	0	0	3	3
5.	DS5005	Agent based Systems	PEC	3	0	0	3	3
6.	IF5081	Information Retrieval	PEC	3	0	0	3	3
ELECTIVES II								
1.	DS5006	Text and Speech Analytics	PEC	3	0	2	5	4
2.	DS5007	Reinforcement Learning	PEC	3	0	2	5	4
3.	DS5008	Image Processing and Computer Vision	PEC	3	0	2	5	4
4.	DS5009	Artificial Neural Networks	PEC	3	0	2	5	4

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S. NO	COURSE CODE	COURSE TITLE	CATA GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
5.	DS5010	Programming for AI/ML with Python	PEC	3	0	2	5	4
6.	IF5073	Autonomous Ground Vehicle systems	PEC	3	0	2	5	4
7.	MM5072	Mixed Reality	PEC	3	0	2	5	4
ELECTIVES III, IV, V								
1.	DS5011	Deep Learning	PEC	3	0	2	5	4
2.	DS5012	Financial Technologies	PEC	3	0	2	5	4
3.	DS5013	Quantum Artificial Intelligence	PEC	3	0	2	5	4
4.	DS5014	Social network analysis and mining	PEC	3	0	2	5	4
5.	DS5015	Predictive Analytics	PEC	3	0	2	5	4
6.	DS5016	Conversational systems	PEC	3	0	2	5	4
7.	DS5017	Mobile Apps Design Development	PEC	3	0	2	5	4
8.	DS5018	Recommender Systems	PEC	3	0	2	5	4
9.	IF5004	Cryptography and Information security	PEC	3	0	2	5	4
10.	IF5006	Soft Computing and its Applications	PEC	3	0	2	5	4
11.	IF5008	Text mining	PEC	3	0	2	5	4
12.	IF5015	Blockchain Technologies	PEC	3	0	2	5	4
13.	IF5017	Advanced Database systems	PEC	3	0	2	5	4
14.	IF5074	Building Internet of Things	PEC	3	0	2	5	4
15.	IF5078	Distributed and Cloud Computing	PEC	3	0	2	5	4
16.	IF5085	Video Processing and Analytics	PEC	3	0	2	5	4
17.	IF5087	Visualization techniques	PEC	3	0	2	5	4

LIST OF OPEN ELECTIVE COURSES (OEC)

*(out of 6 courses one course must be selected)

S. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OE5091	Business Data Analytics	OEC	3	0	0	3	3
2.	OE5092	Industrial Safety	OEC	3	0	0	3	3
3.	OE5093	Operations Research	OEC	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	OE5095	Composite Materials	OEC	3	0	0	3	3
6.	OE5096	Waste to Energy	OEC	3	0	0	3	3

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LIST OF AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AX5091	English for Research Paper Writing	AC	2	0	0	2	0
2.	AX5092	Disaster Management	AC	2	0	0	2	0
3.	AX5093	Sanskrit for Technical Knowledge	AC	2	0	0	2	0
4.	AX5094	Value Education	AC	2	0	0	2	0
5.	AX5095	Constitution of India	AC	2	0	0	2	0
6.	AX5096	Pedagogy Studies	AC	2	0	0	2	0
7.	AX5097	Stress Management by Yoga	AC	2	0	0	2	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	AC	2	0	0	2	0

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MA5156	PROBABILITY AND STATISTICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- This course provides a sound and rigorous treatment of the basic principles for a proper understanding of the subject matter and for confidence in applying these principles to practical problem solving
- This course provides a solid undergraduate foundation in both probability theory and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving problems in the real world
- To introduce the basic concepts of one dimensional and two-dimensional Random Variables
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis

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 HYPOTHESIS 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

OUTCOMES:

On completion of the course, the students will be able to:

1. Use the appropriate and relevant, fundamental, and applied mathematical and statistics knowledge and methodologies in solving practical problem.
2. Bring together and flexibly apply knowledge to characterize, analyse and solve a wide range of problems.
3. Understand the balance between the complexity/accuracy of the

mathematical/statistical models used and the timeliness of the delivery of the solution.
4. Steeped in research methods and rigor.
5. Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.
6. To know the relevance of Probability and Statistics for Data science

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

IF5151	ADVANCED DATA STRUCTURES AND ALGORITHMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the usage of algorithms in computing.
- To understand and learn the algorithm design techniques.
- To learn and use hierarchical data structures and its operations.
- To learn the usage of graphs and its applications.
- To study about NP Completeness of problems.

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.

Suggested Activities:

- Flipped classroom on divide & conquer strategy (Merge Sort, Quick Sort).
- External learning – Solving recurrence relations using Master’s method.
- Formulation of recurrence relations for various recursive algorithms (such as Tower of Hanoi, Staircase problem).
- Assignment on finding order of growth for exponent and logarithmic time algorithms.

Suggested Evaluation Methods:

- Assignments on formulation of recurrence relations, Master’s method, finding order of growth for algorithms.

- Quizzes on divide and conquer strategy.

UNIT II ALGORITHM DESIGN TECHNIQUES 8

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.

Suggested Activities:

- Flipped classroom on basics of algorithm design strategies.
- External learning – String edit distance and Knapsack problem.
- Assignment on applying suitable algorithm design technique for solving real time problems/scenario such as Checkerboard/Sequence Alignment/Puzzle Solving/Data Compression.
- Assignment on analysis of time complexity for memorization algorithms and Huffman Coding.

Suggested Evaluation Methods:

- Assignments on Knapsack problems.
- Quizzes on algorithm design strategies.
- Demonstration for practical learning.

UNIT III HIERARCHICAL DATA STRUCTURES 10

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 – Min Max Heaps – Leftist Heaps – Binomial Heaps: Structure – Mergeable-Heap Operations

Suggested Activities:

- Flipped classroom on AVL trees and binary heap concepts.
- External learning – Fibonacci heap operations.
- Assignment on choosing and apply a suitable tree/heap structure for solving a given real time problem/scenario such as the implementation of trees/heaps/PDF document creation.
- Assignment on analysis of time complexity for B-Trees and Binomial Heaps.

Suggested Evaluation Methods:

- Assignments on binomial heap operations.
- Quizzes on AVL trees, binary heaps, time complexity of trees.
- Demonstration of practical learning.

UNIT IV GRAPH ALGORITHMS 9

Graphs: Representations of Graphs – 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.

Suggested Activities:

- Flipped classroom on basics of graphs and graph operations.
- External learning – Applications of graphs and DFS.
- Analysis of time complexity for Dijkstra's algorithm and Floyd Warshall algorithm.
- Practical – To choose and apply a suitable graph algorithm for solving a real time problem/scenario such as network routing/shortest path updation in maps/relationship mining in graphs

Suggested Evaluation Methods:

- Assignments on analysis of time complexity for Dijkstra's algorithm and Floyd Warshall algorithm.
- Quizzes on graph operations.
- Demonstration of practical learning.

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.

Suggested Activities:

- Flipped classroom on basics of approximation algorithms.
- External learning – Subset sum problem.
- Assignments on solving traveling salesman problem using approximation technique.
- Exploration of any two NP-complete problems with proofs.

Suggested Evaluation Methods:

- Assignments on NP-complete problems with proofs, traveling salesman problem using approximation techniques.
- Quizzes on approximation algorithms.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Apply suitable algorithms in real time computing.
2. Apply suitable design strategies to solve problems in an efficient manner.
3. Apply suitable hierarchical data structures to solve practical problems.
4. Design algorithms using graph structures to solve real-life problems.
5. Solve NP Complete problems efficiently.
6. Design data structures and algorithms that are appropriate for real time problems.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, Prentice-Hall, 2011.
2. S. Sridhar, "Design and Analysis of Algorithms", Second Edition, Oxford University Press, 2014.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2006.
4. Robert Sedgewick, Kevin Wayne, "Algorithms", Fourth Edition, Pearson Education, 2011.

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

DS5101 FOUNDATIONS ON DATA SCIENCE L T P C
3 0 0 3

OBJECTIVES:

- To know the fundamental concepts of data science.
- To study various programming tools for data science
- To apply analytics on stream data.
- Get a know-how in math and programming which is required for data science applications.
- To understand various advanced content delivery, streaming, and cloud services.
- To learn the basic and advanced features of visualizing streaming data.

UNIT I INTRODUCTION 9

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

Suggested Activities

- Survey of Python tools for data science
- External Learning : Web scraping

Suggested Evaluation Methods

- Quiz on python tools
- Seminar on web scraping

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

Suggested Activities:

- Flipped classroom on qualitative and quantitative datasets
- Tutorial on Sampling and Frequency
- Problem solving using central tendency measures
- Tutorial on Data reduction techniques

Suggested Evaluation Methods:

- Quiz on the type of datasets
- Assignment on determining central tendency measures
- Programming exercise on correlation analysis on a large set of data

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.

Suggested Activities:

- Tutorial on the different types of plots
- Representation of data from Unit II in different types of graphs
- Analysis and inference from the graph

Suggested Evaluation Methods:

- Quiz on the different types of visualization methods
- Programming assignment on the different plots

UNIT IV MODEL CONSTRUCTION AND MODEL 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

Suggested Activities:

- Implement linear regression models using python
- Implementation of KNN models
- Construct a contingency table for classifier evaluation

Suggested Evaluation Methods:

- Seminar on Regression models
- Quiz on evaluation measures

UNIT V DATA SCIENCE APPLICATIONS 9

Banking - Fraud Detection, Personalized Services, Finance-Tax Evasion, Stock Market;

Entertainment Industry -Personalized Recommendation System, Content Development using Data Analytics, Marketing Industry - Analytics for Campaigns - Targeted marketing through Customer Segmentation, Medical Image Analysis and Diagnosis, Drug Discovery, Genetics & Genomics, Virtual Assistance, Patient data management, Retail - Customer Sentiment Analysis, Personalized Marketing, Personalized Customer Shopping Experience, Travel Industry - Travel Fare Optimization, Natural Language Processing for Review Analysis, Smart Pricing using Predictive Analytics, Chatbots.

Suggested Activities:

- Survey of AI Applications
- Role of AI in healthcare

Suggested Evaluation Methods:

- Seminar on AI in Banking
- Seminar on AI in Marketing

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course, the students will be able to:

- Be able to clearly explain the data collection methods.
- Collect, investigate, clean, munge, and alter data.
- Use Data Visualization techniques to explore data.
- Use regression and classification models and evaluate it
- Use Python-based toolkits to create data science applications.
- 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

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	2	1	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	2	3	3	3	2	1

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DS5102 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	2	4

OBJECTIVES:

- To know the underlying structure behind intelligence mathematically.
- To know the logical implications in computational intelligence.
- To understand the reasoning and learning methods based on Bayes model
- To know the automated learning techniques.
- To explore Artificial Intelligence techniques in real–time scenarios.

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

Suggested Activities:

- Analysis of different Searches with computational complexity
- Game search of examples like Tic-Tac-Toe
- Real world example analysis for Constraint Satisfaction Problem

Suggested Evaluation Methods:

- Assignment on intelligent agents and PEAS formulation.
- Quizzes on agents
- Programming assignment on search techniques
- Programming assignment on Game search

UNIT II KNOWLEDGE AND REASONING **9**

Logical Agents - Proposition 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 Categories - Reasoning with Default Information

Suggested Activities:

- Flipped classroom on Boolean logic
- In class activity - solve puzzles using proposition logic
- Tutorial on Knowledge representation and Ontological engineering

Suggested Evaluation Methods:

- Exercises on propositional logic inference mechanisms
- Assignment on first order logic formulation from English statements and vice versa
- Exercises on forward chaining, backward chaining, and resolution
- Exercises on application of logic in Semantic networks

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

Suggested Activities:

- Flipped classroom on the fundamentals of probability
- Exercises on Gaussian distribution
- Tutorial on Naive Bayes classifier using numerical data
- Programming activities on Bayes model implementation

Suggested Evaluation Methods:

- Tutorial – Inference methods.
- Assignments on Bayesian network.
- Quizzes on basics of probability and Bayes rule.
- Practical – Programming exercises for HMM

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

Suggested Activities:

- Flipped classroom on decision process.
- Assignments on derivation of value iteration.

Suggested Evaluation Methods:

- Tutorial – Observable MDP.
- Assignments on policy iteration.
- Practical – Programming exercises on planning with MDP.

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.

Suggested Activities:

- Flipped classroom on theoretical study of learning methods
- Assignment on solving problem in statistical learning
- Practical – Programming exercises using Python/ other programming languages.

Suggested Evaluation Methods:

- Tutorial – Learning methods.
- Assignments on statistical methods in learning.
- Quizzes on learning methods.
- Practical – Programming exercises on Statistical learning.

PRACTICAL EXERCISES: **30**

1. Search implementation on BFS and DFS with computational complexity
2. Search implementation on Greedy and A* algorithm
3. Implementation of Game search
4. Programming exercises on inference using proposition/ predicate logic
5. Implementation of Bayes network
6. Implementation of bandit problem
7. Programming exercises on statistical learning
8. Implementation of ensemble learning with multiple learning models
9. Implementation of reinforcement learning in a chosen scenario
10. Chatbot development with Dialogflow

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Relate the type of agents and environments in the real-world scenarios
2. Analyze different search techniques with computational complexity
3. Understand the working of Bayesian techniques to solve AI problems
4. Use the decision-making process to solve simple and complex problems
5. Understand the different learning techniques
6. Apply relevant AI techniques in the real-world applications

REFERENCES:

1. Stuart J. Russell, Peter Norvig, Artificial Intelligence – A Modern Approach, Pearson, 4th Edition, 2021
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, Third Edition, Tata McGraw-Hill, 2008.
3. Dheepak Khemani, “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
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7. https://www.tensorflow.org/tutorials/images/cnn

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

RM5151	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis, and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICAL WRITING /PRESENTATION 6

Effective technical writing, how to write a report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.

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5. Ranjit Kumar, Second Edition, “Research Methodology: A Step-by-Step Guide for beginners” 2010

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

IF5161 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To learn the design strategies of various algorithms.
- To learn how to analyze the complexities of algorithms.
- To learn and understand the usage of advanced tree structures.
- To familiarize with the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS:

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.
7. Basic heaps operations.
8. Binomial heap operations.
9. Representation of graphs and graph traversals
10. A spanning tree for a given graph using Prim’s algorithm.
11. Shortest path of a given graph using Dijkstra’s algorithm and Bellman Ford algorithm.
12. All pair shortest path of a given graph using Floyd Warshall’s algorithm.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Design and implement iterative and recursive algorithms with minimum complexity.
2. Design and develop efficient algorithms for practical problems by adopting suitable algorithm design strategies.
3. Design and implement basic and advanced data structures extensively.
4. Apply suitable hierarchical data structures based on real time problems.

5. Design algorithms using graph structures.
6. Implement real world applications by proper usage of data structures and algorithms

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

DS5111 **DATA SCIENCE LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To understand the usage of computational toolkits
- To understand the mathematical foundations of data science
- To know the descriptive and inferential data analytics
- To have a bird's eye view of machine learning algorithms

LIST OF EXPERIMENTS:

1. Installation of toolkits such as NLTK and libraries such as NumPy, Scikit-learn, TensorFlow and Matplotlib
2. Working with arrays and tensors using NumPy and TensorFlow
3. Construction a statistical model and visualizing it using Matplotlib
4. Correlation analysis on a real-world dataset
5. Regression analysis on a real-world dataset
6. Construction of a logistic regression model for a real-world dataset
7. Construction of a simple KNN classifier for a real-world dataset
8. Exploratory analysis with different visualization methods

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Work with different toolkits and libraries of AI/ML in python
2. Apply mathematical concepts of linear algebra, probability in Data Science/ AI
3. Perform descriptive analytics in data science problems
4. Work with inferential statistics
5. Understand the functions of different machine learning algorithms
6. Solve analytics problems using different statistical techniques

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	1	-
CO2	3	3	3	1	1	-
CO3	3	3	3	1	1	-

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CO4	3	3	3	1	1	1
CO5	3	3	3	1	1	1
CO6	3	3	3	1	1	1

DS5112 **WEB TECHNOLOGIES LABORATORY** **L T P C**
0 0 2 1

OBJECTIVES:

- To develop simple Java programs using object-oriented concepts.
- To program using files and threads for concurrent operations.
- To design attractive GUI using framework
- To create more dynamic web pages using CSS, JavaScript, and AJAX.
- To develop mobile based web applications in cloud environment.

LIST OF EXPERIMENTS:

1. Simple Java programs using arrays and lists.
2. Implementing Inheritance and Polymorphism concepts in java.
3. Simple association using objects (pass & return by reference).
4. Simple GUI application development using applet and SWING.
5. Developing java multithreading programs for concurrent operations.
6. Implementing file handling in Java.
7. Implementing Java generics and collections.
8. Developing Client Server network application using java sockets.
9. Dynamic web page creation using JavaScript, CSS, jQuery and AJAX.
10. Developing servlet application with JDBC access.
11. Implementing Session management in JSP.
12. Creating simple Node JavaScript functions for server.
13. Developing Android application for location-based service.
14. Developing cloud-based web application.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Implement object-oriented concepts using Java language
2. Develop GUI application by including I/O streams and threads.
3. Create web pages with proper client-side features
4. Design dynamic web pages with server-side and other technologies
5. Develop simple android based mobile application
6. Deploy web applications in a cloud-based environment.

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

DS5201 **MACHINE LEARNING** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the concepts of machine learning.
- To appreciate Regression and Information-Based classification algorithms
- To know the concepts of Neural networks and SVM
- To understand the theoretical and practical aspects of Probabilistic Graphical Models.
- To appreciate the concepts of clustering algorithms.

UNIT I INTRODUCTION **9**

Machine Learning – Basic Concepts in Machine Learning – Types of Machine Learning – Basics of Learning Theory – Concept Learning - Hypothesis space - Heuristics space search - Find - S algorithm - Version spaces - Induction Biases - Bias-Variance Tradeoffs - Modelling in Machine learning - Learning Frameworks - PAC Framework - Vapnik-Chervonenkis Dimension

Suggested Activities:

- Implement Find-S algorithm
- External Learning - Overfitting and Underfitting

Suggested Evaluation Methods:

- Quiz on machine learning concepts.
- Seminar on version spaces
- Quiz of python tools available for implementing machine learning applications

UNIT II SUPERVISED LEARNING - I **9**

Linear Regression – Multiple variable regression – Logistic regression – Regularization techniques - LASSO, Ridge and Elastic Net Regression - Decision Tree Learning- ID3 - C4.5 – CART

Suggested Activities:

- Practical – Implement ID3 algorithm
- Seminar - Decision tree design techniques

Suggested Evaluation Methods:

- Quiz on Regression models
- Group discussion on basics of classification and regression.

UNIT III SUPERVISED LEARNING II **9**

Neural Networks – Perceptron - Feed-Forward Networks for binary and multi-class classification- Support Vector Machines – Support Vector Regression - Ensemble Methods – Bagging –Random Forest - Boosting – AdaBoost.

Suggested Activities:

- Practical – Develop an SVM model for a two-class problem, whose training points are distributed in a 2D plane and improve the performance of the model by applying kernel methods.
- Practical – Implement a bagging and boosting approach for some case studies.
- Practical – Implement a Perceptron and Multi-Layer Perceptron model.

Suggested Evaluation Methods:

- Quiz on SVM and Kernel methods.
- Evaluation of the practical implementations of neural network models using the appropriate test dataset.
- Group discussion on Ensemble methods.

UNIT IV PROBABILISTIC GRAPHICAL MODELS **9**

Introduction to Graphs – Inference in Graphical Models – Markov Models – Hidden Markov Models – Inference – Learning - Generalization – Undirected Graphical Models – Markov Random Fields – Conditional Independence Properties – Parameterization of MRFs – Conditional Random Fields - Classification using HMM.

Suggested Activities:

- Assignment on solving the numerical problem using HMM.

Suggested Evaluation Methods:

- Group discussion on graphical models.

UNIT V UNSUPERVISED LEARNING **9**

Clustering– K-means – Hierarchical Clustering – EM – Mixtures of Gaussians –– Model Selection for Latent Variable Models – Evaluation of Clustering methods

Suggested Activities:

- Implement k means algorithm for a data set.

Suggested Evaluation Methods:

- Tutorial on model selection and validation.
- Evaluation of the practical implementation using an appropriate test set.

PRACTICAL EXERCISES: **30**

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 and CART algorithms.
4. Develop a system to implement a classifier using SVM
5. Implement a classifier using Neural Networks.
6. Develop a system that can extract the word from the given sentences using the Hidden Markov model.
7. Develop a system that can automatically group articles by similarity using K–Means Clustering
8. Implement EM algorithm for clustering

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Disseminate the basic concepts of machine learning and apply simple linear models.
2. Implement probabilistic discriminative and generative algorithms for an application and analyze the results.
3. Implement a neural network model for an appropriate application using an available tool.
4. Use a tool to implement typical clustering algorithms for different types of applications.
5. Design and implement an HMM for a sequence model type of application and implement a PGM for any real time application using an open-source tool.
6. Identify applications suitable for different types of machine learning with suitable justification.

REFERENCES:

1. Sridhar S, Vijayalakshmi M, “Machine Learning”, First Edition, Oxford University Press, 2022.
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, First Edition, Springer, 2006.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4. Ethem Alpaydin, “Introduction to Machine Learning”, 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. Daphne Koller, N. Friedman, Francis Bach, “Probabilistic Graphical Models – Principles and Techniques”, MIT Press,2009.

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

DS5202	BIG DATA ANALYTICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the computational approaches to Analytical Modeling
- To understand the need and application of Map Reduce.
- To understand the various analytical algorithms applicable to Big Data.
- To learn about techniques to analyze and interpret streaming data.
- To learn how to handle large data sets in main memory.
- To learn the various similar items mining and clustering techniques applicable to Big Data.

UNIT I INTRODUCTION TO BIG DATA AND LARGE-SCALE FILES 9

Big data: Introduction – Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Analytic Processes and Tools - Introduction to data mining, statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining – Distributed File Systems– Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

Suggested Activities:

- Case studies on real world data mining problems
- Solving numerical problems in sampling, hypothesis testing
- Converting traditional relational algebraic operations to equivalent map reduce tasks

Suggested Evaluation Methods:

- Student assignment on hypothesis testing
- Group presentation on big data applications with societal need
- Quiz

UNIT II SIMILAR ITEMS 9

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

Suggested Activities:

- Case studies on real world similar items mining
- Solving numerical problems using distance/similarity measures, nearest neighbor search and locality sensitive functions

Suggested Evaluation Methods:

- Student assignment on similar items mining
- Provide data sets in Cartesian coordinate system and apply distance measures and compare and contrast all metrics
- Quiz

UNIT III MINING DATA STREAMS 9

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows

Suggested Activities:

- Case studies about usage of stream analytics in popular search engines
- Solving simple numerical problems involving moments and skewness, counting distinct elements

Suggested Evaluation Methods:

- Assignment: Given a problem scenario identify suitable stream analytical technique(s)
- Quiz

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS 9

Page Rank –Efficient Computation – Topic Sensitive Page Rank – Link Spam – Market Basket Model – Apriori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

Suggested Activities:

- Discussion involving implementation of page rank algorithm and its effectiveness
- Real time Case studies about link analysis and market basket analysis
- Solving numerical problem on frequent itemset mining using Apriori algorithm and its variations

Suggested Evaluation Methods:

- Create groups and provide different transactional data to identify frequent itemsets and association rules and do peer evaluation
- Quiz

UNIT V CLUSTERING 9

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non – Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems

Suggested Activities:

- Solving numerical problems on clustering techniques
- Case studies and discussion about real time recommendation systems

Suggested Evaluation Methods:

- Mini projects involving real time stream data and clustering
- Quiz

PRACTICAL EXERCISES 30

1. Download and Install R and Python. Explore the various packages, in-build methods, and commands for performing descriptive data analysis.
2. Download and install Hadoop in Windows and Linux environments.
3. Write and implement simple word count problems and matrix multiplication using map reduce functions.
4. Write map reduce methods for implementing various relational algebraic expressions and compare its time complexity.
5. Write a python program for implementing the nearest neighbor search algorithm.
6. 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.
7. Write and implement a program in python for estimating 1st, 2nd and nth order moments from a sample stream data.
8. Implement a page-rank algorithm for a sample set of web pages collected from web logs.

9. Write a program for finding frequent k-itemsets from a given transactional data set in any programming language. Implement the same using map-reduce function in Hadoop environment. Compare and analyze the running time of both the algorithms.
10. Write and implement the following clustering algorithms: (i) k-mean, (ii) DIANA, (iii) CURE and (iv) ProClus using sample data sets collected from UCI repository.

TOTAL: 75 PERIODS

OUTCOMES:

Upon Completion of the Course, the Student will be able to

1. Design algorithms by employing Map Reduce technique for solving Big Data problems.
2. Identify similarities using appropriate measures.
3. Point out problems associated with streaming data and handle them.
4. Discuss algorithms for link analysis and frequent itemset mining.
5. Design solutions for problems in Big Data by suggesting appropriate clustering techniques.
6. Identify apt big data framework and techniques for real world problems.

REFERENCES:

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, Heikki Mannila and Padhraic Smyth, “Principles of Data Mining”, MIT Press,2001.

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

DS5211 **AI APPLICATIONS LABORATORY** **L T P C**
0 0 2 1

OBJECTIVES:

- To understand the working of version control system in continuous integration, delivery, and deployment
- To familiarize with MLOPS cycle
- To build an end-to-end ML application

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LIST OF EXPERIMENTS:

1. Working with version control system such as Git on a machine learning code
2. Working with Kubernetes
3. Development of ML training model
4. Creation of user interface for the trained model
5. Working with KubeFlow or other equivalent tools
6. Deployment of ML application using Kubeflow and version control system
7. Monitoring of deployed ML application
8. Hyper parameter tuning
9. Development of application with additional settings
10. Deployment and monitoring

TOTAL: 30 PERIODS

COURSE OUTCOMES

On completion of the course, the students will be able to:

1. Work with version control system
2. Develop a learning model
3. Work with containers
4. Work with MLOPS tool
5. Deploy and monitor the ML model
6. Create an end-to-end ML application using MLOPS

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

DS5001 ARTIFICIAL LIFE AND ROBOTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand artificial life in terms of Artificial Intelligence systems.
- To understand the fundamentals of Robotics in computing.
- To study Robotic sensors and path planning.
- To learn the usage of Robotics in Computer Vision and Robot programming.
- To understand the real time applications of Robotics.
- To gain in-depth knowledge of Artificial Intelligence and Robotics.

UNIT I ARTIFICIAL LIFE **9**

The Artificial Life - Roots of Artificial Intelligence - Introduction - Building Artificial Systems -

Behavior systems – Emergent behavior- Approaches for Designing the Behavior Programs - Modeling Adaptive Autonomous Agents - Characteristics of Agent Architectures - Example Autonomous Agents

Suggested Activities:

- Flipped classroom on basics of artificial life and autonomous agents.
- External learning - applications of autonomous agents.
- Assignment on artificial life route towards AI.
- Exploration on current research in Artificial Life.

Suggested Evaluation Methods:

- Quizzes on behavior systems.
- Assignment on adaptive autonomous agents in the real world.

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

Suggested Activities:

- Flipped classroom on basics of Robotics.
- External learning - Current applications and future trends of Robotics.
- Assignment on Machine and Human intelligence.
- Exploration on Collaborative Robots.

Suggested Evaluation Methods:

- Quizzes on fundamentals of Robotics
- Assignment on Scope and Importance of Robotics in real world.

UNIT III ROBOTIC SENSORS AND TRAJECTORY PLANNING 9

Sensors - Characteristics – Sensor Utilization- Position Sensors- Velocity Sensors- Acceleration Sensors- Proximity Sensors- Force and Torque Sensors - Range finders - Voice recognition devices - Basics of Trajectory planning - Joint-Space Trajectory Planning - Continuous Trajectory Recording – Path Planning.

Suggested Activities:

- Flipped classroom on different types of sensors
- External learning - Real world applications of trajectory planning
- Assignment - Sensors used in obstacle avoiding Robot. Demonstrate advantages and disadvantages.
- Exploration on Mobile Robots.

Suggested Evaluation Methods:

- Assignments on applications of Robotic sensors
- Practical Learning - Determine movement speed and direction of robot using sensors

UNIT IV COMPUTER VISION IN ROBOTICS AND ROBOT PROGRAMMING 9

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 - Artificial Intelligence and robot programming

Suggested Activities:

- Flipped classroom on basics of Computer Vision and Robot programming
- External Learning - To estimate depth with vision systems
- Assignments on applications of object recognition using Robotics
- Practical - To analyse different Robot programming languages based on real time applications

Suggested Evaluation Methods:

- Quizzes on basics of OpenCV
- Assignments on different Robot programming languages.
- Demonstration of practical learning on Robot programming.
- Practical Learning - Object detection using Mobile Robots

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.

Suggested Activities:

- Flipped classroom on applications of Robotics.
- External learning - Humanoid Robotics
- Assignment - Study the impact of Robots in industries.
- Exploration on current and future technologies of Robotics and automation.

Suggested Evaluation Methods:

- Assignments on Futuristic trends of Robotics
- Quizzes on Cognitive Robotics
- Practical demonstration on design of chatbots.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Design and implement an intelligent autonomous agent for problem solving.
2. Demonstrate and illustrate the fundamentals of Robotics.
3. Develop robotic design with proper navigation to solve real time problems.
4. Apply programmable automation in different subfields of robotics.
5. Develop vision-based systems for robot guidance.
6. Design and implement a robot for few real time applications.

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2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, “Robotic Engineering – An integrated approach”, PHI Publication
3. S. B. Nikku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
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6. Gomes, P. (Ed.), Medical robotics: Minimally invasive surgery. Elsevier,2012.
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PO/CO	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

DS5002 STREAMING ANALYTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the fundamental concepts of streaming technology and data analytics.
- To study various analytics on stream data.
- To learn fundamental streaming data analysis.
- To understand various advanced content delivery, streaming, and cloud services.
- To learn the basic and advanced features of visualizing streaming data.

UNIT I STREAMING TECHNOLOGY **9**

Basics-Video formats, Video compression, Audio compression. 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.

Suggested Activities:

- External learning - Associated Technologies and Applications.
- Assignments on Video encoding, Audio encoding, Preprocessing, Stream serving, Live webcast.

Suggested Evaluation Methods:

- Quiz on all topics covered in Streaming and Associated Technologies

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- Evaluating the assignments on video and audio compression.

UNIT II STREAM ANALYTICS 9

Stream Analytics - Concepts of Streams– 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 – Decaying Window. Streaming Analytics Architecture -Designing Real-Time Streaming Architectures - Stream Data Model and Architecture -Service Configuration and Coordination.

Suggested Activities:

- Case studies on the usage of stream analytics in popular search engines.
- External learning - Real time sentiment analysis, stock market predictions.
- Assignments on solving simple numerical problems involving moments and skewness

Suggested Evaluation Methods:

- Evaluating the assignment on a given a problem scenario identify suitable stream analytical technique(s).
- Quiz on all topics covered in stream analytics.

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

Suggested Activities:

- Practical - Perform univariate analysis on UCI datasets.
- Solve numerical problems in correlation and regression using sample real time data.
- Practical - Implement univariate, bivariate and multivariate analysis using R Studio.
- Given a data set, explore the features using data analysis in R.

Suggested Evaluation Methods:

- Evaluating assignments on Graphical Presentation of Data.
- Evaluating assignment on univariate, bivariate and multivariate analysis.
- Demonstrate implementation of univariate, bivariate and multivariate analysis using R Studio.
- Evaluating assignment on Statistical Approximation of Streaming Data.
- Evaluating assignment on Approximating Streaming Data with Sketching

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

Suggested Activities:

- Flipped classroom on Live Streaming Ecosystems.
- External learning - Anycast Request Routing for Content Delivery Networks

Suggested Evaluation Methods:

- Implementation demonstration of Mobile Video Streaming
- Implementation demonstration of practical exercises.
- Mini project (individual) - Cloud-Based Content Delivery to Home Ecosystems

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

Suggested Activities:

- Case studies on Streaming Data for Visualization
- Design and develop Streaming Data Dashboard-Machine Learning and Streaming Data Visualization

Suggested Evaluation Methods:

- Mini Project (Group) - Real time data collection, storing, implement analytical techniques and result projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Understand and apply various analytics on stream data.
2. Understand the fundamental concepts of streaming technology and data analytics.
3. Comprehend and work with streaming data analysis techniques.
4. Implement suitable data analysis for stream data.
5. Understand various advanced content delivery, streaming, and cloud services.
6. 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.
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PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	3	1
CO2	3	3	2	3	2	1

CO3	2	3	3	3	3	1
CO4	3	2	3	3	3	1
CO5	2	3	2	3	2	2
CO6	2	3	3	3	3	2

DS5003 ETHICS FOR AI AND ROBOTICS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT I INTRODUCTION **9**

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

Suggested Activities:

- Flipped classroom on Live Streaming to show how AI changes the environment and lifestyle.
- External learning - AI impact on human psychology

Suggested Evaluation Methods:

- Assignment on case studies to identify AI impact on normal human activities
- Group discussion to evaluate individual opinion and understanding on AI ethics

UNIT II ETHICAL INITIATIVES IN AI **9**

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.

Suggested Activities:

- Flipped classroom on international ethics and ethical harms.
- External learning - Robots in any other field than healthcare and war field for human assistance.

Suggested Evaluation Methods:

- Implementation demonstration of any simple AI application with ethics
- Assignment on robots used in warfare and weaponization to show how ethics are implemented in Robots

UNIT III AI STANDARDS AND REGULATION **9**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations -Standard for Child and Student Data Governance - Standard for Transparent Employer Data Governance - Standard for Personal Data Artificial Intelligence (AI) Agent -Ontological

Standard for Ethically Driven Robotics and Automation Systems- Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems - Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems - Standard for the Process of Identifying and Rating the Trustworthiness of News Sources - Standard for Machine Readable Personal Privacy Terms.

Suggested Activities:

- Flipped classroom on Autonomous systems.
- Group discussion on ethically driven robots in usage.
- External learning for study about the design of autonomous systems.

Suggested Evaluation Methods:

- Implementation demonstration of Autonomous system for human daily usage
- Submit case study on standard for machine readable personal privacy terms.

UNIT IV ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS **9**

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

Suggested Activities:

- Flipped classroom on Roboethics.
- External learning on taxonomy of Roboethics

Suggested Evaluation Methods:

- Assignment on ethical issues in an ICT society
- Case study on Roboethics with its social implications.

UNIT V AI AND ETHICS- CHALLENGES AND OPPORTUNITIES **9**

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

Suggested Activities:

- Flipped classroom on societal issues and applications of AI.
- Group discussion on applications of AI in industries

Suggested Evaluation Methods:

- Mini project on social-responsibility ethical decision-making system.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Learn about morality and ethics in AI
2. Acquire the knowledge of real time application ethics, issues, and its challenges.
3. Understand the ethical harms and ethical initiatives in AI

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4. Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
5. Understand the concepts of Roboethics and Morality with professional responsibilities.
6. Learn about the societal issues in AI with National and International Strategies on AI

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1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield," The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
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4. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020.
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PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	2	2	3
CO2	2	2	2	3	3	3
CO3	1	3	2	3	3	3
CO4	2	3	3	2	3	3
CO5	2	2	3	2	3	3
CO6	-	2	2	3	3	3

DS5004 **COGNITIVE COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition.

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UNIT I PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE 9

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn – The Philosophy of Science – The Mind in Cognitive Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science –Science of Information Processing – Neurosciences: Cognitive Neuroscience – Perception –Decision – Learning and Memory – Language Understanding and Processing.

Suggested Activities:

- Flipped classroom on logic and sciences in the mind.
- Case study on how philosophy (western and eastern), psychology and neuroscience
- (Thought process in normal persons, children and differently-abled) helps in cognition.
- Mind map of cognition with various attributes such as mind, logic, information processing.
- Discussion and debate on cognition.

Suggested Evaluation Methods:

- Quiz on logic and sciences in the mind.
- Active discussion on the case study and how the factors such as learning and Memory affect cognition.
- Essay writing on how various factors influence cognition.

UNIT II COMPUTATIONAL INTELLIGENCE 9

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Decision making under Uncertainty – Learning – Language – Vision – Robotics.

Suggested Activities:

- Flipped classroom on knowledge-based systems.
- Mind map on different methods of cognition in computational domain.
- Discussion on the influence of human cognition systems with a link to computational domain.

Suggested Evaluation Methods:

- Quiz on knowledge-based systems.
- Collaborative wiki editing of computational tools linking with cognition.
- Essay writing on the computational cognitive systems with the background of human cognitive systems.

UNIT III PROBABILISTIC PROGRAMMING LANGUAGE 9

WebPPL Language – Syntax – Using JavaScript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration – Other basic computation

Suggested Activities:

- Flipped classroom on JavaScript libraries.
- Exploring the existing mathematical models.
- Practical - Programming the common mathematical functions using PPL

Suggested Evaluation Methods:

- Quiz on the basics of JavaScript and WebPPL.
- Practical - Programming assignment on developing miniature programs using
- WebPPL for inference mechanisms.
- Evaluation of the programming assignments.

UNIT IV IMPLEMENTING THE INFERENCE MODELS OF COGNITION 9

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

Suggested Activities:

- Flipped classroom on dependence.
- Perform sample calculation of models manually.

Suggested Evaluation Methods:

- Quiz on statistical dependence
- Practical - Automate the mathematical functions through WebPPL.
- Practical - Programming assignments on analyzing data through cognitive models with WebPPL.
- Evaluation of the programming assignments.

UNIT V IMPLEMENTING THE LEARNING MODELS OF COGNITION 9

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's Razor – Learning (Deep) Continuous Functions – Mixture Models.

Suggested Activities:

- Flipped classroom on mixture models.
- Perform sample calculation of models manually.

Suggested Evaluation Methods:

- Quiz on mixture models.
- Practical - Programming assignment on learning models for continuous functions.
- Evaluation of the programming assignments.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of the course, the students will be able to:

1. Understand the underlying theory behind cognition.
2. Connect to the cognition elements computationally.
3. Implement mathematical functions through WebPPL.
4. Develop a cognitive inference model.
5. Develop a cognitive learning model.
6. Analyze the cognitive learning models.

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2. Vijay V Raghavan, Venkat N.Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: Volume 35 (Handbook of Statistics), 2016
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PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	-	-
CO2	2	2	1	2	-	-
CO3	2	1	1	1	-	-
CO4	2	2	2	2	-	-
CO5	2	2	2	2	-	-
CO6	2	2	2	2	-	-

DS5005 **AGENT BASED SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To explore the structure of agents
- To know about the learning mechanisms of agents
- To understand the communication and cooperation within agents
- To develop intelligent agent systems
- To know about various agent applications

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.

Suggested Activities:

- Flipped classroom on Architectures of intelligent agents.
- Discussion on modes of instructions to agents.

Suggested Evaluation Methods:

- Quiz on Architectures of intelligent agents.
- Assignment on 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.

Suggested Activities:

- Flipped classroom on Agent Reasoning methods.
- Construction of production rules.

Suggested Evaluation Methods:

- Quiz on Agent Reasoning.
- Assignment on reasoning through Constructed production rules.

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

Suggested Activities:

- Flipped classroom software tools for ontology
- Discussion on Multi agents planning and synchronization.

Suggested Evaluation Methods:

- Assignment on software tools for ontology.
- Quiz on Multi agents 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

Suggested Activities:

- Flipped classroom on Agent environments.
- Discussion on agent goals and events.

Suggested Evaluation Methods:

- Mind map on Agent Environments
- Case study with agent goals and events.

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

Suggested Activities:

- Flipped classroom on agent applications.
- Discussion on mobile agents.

Suggested Evaluation Methods:

- Agent application case studies.

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- Quiz on mobile agents.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Build an architecture for intelligent agents.
- Apply the reasoning mechanisms of proposition and predicate logic to agents.
- Use the learning mechanisms for an artificial agent.
- Execute different communication and co-operation methodologies in a multi-agent setup.
- Distinguish the agent types.
- Develop intelligent agents' applications.

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3. Lin Padgham, Michael Winikoff, Developing Intelligent Agent Systems: A Practical Guide, Wiley publications, 2005.
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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	-	-
CO6	2	2	2	2	-	-

IF5081 **INFORMATION RETRIEVAL** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the basics of Information Retrieval with pertinence to modelling, Query operations and indexing.
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of Information Retrieval giving emphasis to Multimedia IR and Web Search.
- To understand the concepts of digital libraries.
- To learn the procedure for recommendation system.

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UNIT I INTRODUCTION **9**

Introduction – Goals and History of IR – The Impact of the Web on IR – The Role of Artificial Intelligence (AI) in IR – Basic IR Models Boolean and Vector Space Retrieval Models – Ranked Retrieval – Text Similarity Metrics – TF-IDF (term frequency/inverse document frequency) Weighting – Cosine Similarity

Suggested Activities:

- Install Lucene, LingPipe, and Gate.

Suggested Evaluation Methods:

- Group discussion on applications of vector space model.

UNIT II PREPROCESSING **9**

Basic Tokenizing – Indexing and Implementation of Vector Space Retrieval – Simple Tokenizing – Stop Word Removal and Stemming – Inverted Indices – Efficient Processing with Sparse Vectors – Query Operations and Languages – Relevance Feedback – Query Expansion – Query Languages

Suggested Activities:

- Construct manually a frequency table for the collection of documents after removing stop words.
- Index the frequency table using Latent semantic indexing techniques.

Suggested Evaluation Methods:

- Apply query document information and nalyzi manually the performance of the retrieval.

UNIT III METRICS **9**

Experimental Evaluation of IR Performance Metrics Recall, Precision and F Measure – Evaluations on Benchmark Text Collections – Text Representation – Word Statistics – Zipf's law – Porter Stemmer – Morphology – Index Term Selection using Thesauri –Metadata and Markup Languages – Web Search Engines – Spidering – Meta Crawlers – Directed Spidering – Link Analysis Shopping Agents.

Suggested Activities:

- Assignments on problems on precision and recall like the following:
- An IR system returns 8 relevant documents and 10 non-relevant documents. There are a total of 20 relevant documents in the collection. What is the precision of the system on this search and what is its recall?

Suggested Evaluation Methods:

- Group discussion on metrics.

UNIT IV CATEGORIZATION AND CLUSTERING **9**

Text Categorization and Clustering – Categorization Algorithms – Naive Bayes – Decision Trees and Nearest Neighbor – Clustering Algorithms – Agglomerative Clustering – K Means – Expectation Maximization (EM) – Applications to Information Filtering – Organization and Relevance Feedback.

Suggested Activities:

- Categorize documents by topic using classifiers and build groups of self-organized documents using clustering algorithms.

Suggested Evaluation Methods:

- Analyze the algorithm by changing the input set

UNIT V EXTRACTION AND INTEGRATION **9**

Recommender Systems – Collaborative Filtering – Content Based Recommendation of Documents and Products – Information Extraction and Integration – Extracting Data from Text – XML – Semantic Web – Collecting and Integrating Specialized Information on the Web.

Suggested Activities:

- External learning – Survey on recommendation process that takes place in various online shopping portals.

Suggested Evaluation Methods:

- Group discussion on recommendation process in a real time scenario.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Build an Information Retrieval system using the available tools.
2. Identify and design the various components of an Information Retrieval system.
3. Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
4. Analyze the Web content structure.
5. Analyze the approaches used for recommendation systems.
6. Design an efficient search engine

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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

DS5006	TEXT AND SPEECH ANALYTICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- Understand neural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

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

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT II TEXT CLASSIFICATION 9

Advanced Feature models – Word2Vec model – Glove model – FastText model – Text Classification – Traditional Classification models – SVM – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers

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

Suggested Activities:

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

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

Suggested Activities:

- Flipped classroom on Speech signal processing
- Exploring Text normalization
- Data collection
- Implementation of TTS systems

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on WaveNet, deep learning-based TTS systems
- Finding accuracy with different TTS systems

UNIT V AUTOMATIC SPEECH RECOGNITION 9

Speech recognition: Acoustic modeling. Deep neural network (DNN) acoustic modeling. HMM, HMM-DNN systems. Feature extraction; Connectionist Temporal Classification (CTC). Listen, Attend & Spell (LAS). Multi-task objectives for end-to-end ASR – ASR Evaluation: Word Error Rate

Suggested Activities:

- Flipped classroom on Speech recognition.
- Exploring Feature extraction
- Error rate prediction with different speech recognition

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on acoustic modelling
- Comparing error rates with different speech recognition systems

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

OUTCOMES:

On completion of the course, the students will be able to

- Explain existing and emerging deep learning architectures for text and speech processing
- Apply deep learning techniques for NLP tasks, language modelling and machine

translation

- Explain coreference and coherence for text processing
- Build question-answering systems, chatbots and dialogue systems
- Apply deep learning models for building speech recognition and text-to-speech systems
- Design an automatic speech recognition system

REFERENCES:

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction 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.

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

DS5007 REINFORCEMENT LEARNING **L T P C**
3 0 2 4

OBJECTIVES:

- To introduce a range of topics related to Reinforcement Learning and probability concepts.
- To gain knowledge on the Markov Decision Process.
- To understand the dynamic programming methods of Reinforcement Learning.
- To know about the Monte Carlo Prediction and Time Difference Learning.
- To gain knowledge on Function Approximation methods and Q-learning.

UNIT I INTRODUCTION TO REINFORCEMENT LEARNING 9

Introduction to Reinforcement Learning – Elements of Reinforcement Learning – Limitations and Scope – Tic-Tac-Toe example – History of Reinforcement Learning – Probability concepts – Axioms of probability – Concepts of random variables – PMF, PDFs, CDFs, Expectation – Concepts of joint and multiple random variables – Joint, conditional, and marginal distributions – Correlation and independence – An-Armed Bandit Problem – Action-Value Methods.

Suggested Activities:

- Installation of Code Standards and Libraries used in RL (Python/Keras/Tensorflow).
- Practical – Implement Tic-tac-toe and Armed Bandit Problem.

Suggested Evaluation Methods:

- Quiz on basic concepts of probability.

UNIT II MARKOV DECISION PROCESS 9

The Agent-Environment Interface – Goals and Rewards-Returns – Unified Notation for Episodic and Continuing Tasks – The Markov Property – Markov Decision Processes – Value Functions – Optimal Value Functions – Optimality and Approximation – Bellman expectation equations – Bellman optimality equations – Markov Reward Process.

Suggested Activities:

- Practical – Develop Dynamic programming algorithms for solving MDPs, Policy Evaluation, Policy Iteration, Policy Improvement and Value Iteration.

Suggested Evaluation Methods:

- Evaluation of the practical implementation with appropriate input set.

UNIT III DYNAMIC PROGRAMMING FOR MDP 9

Overview – Definition and formulation of planning in MDPs – principle of optimality – Policy Evaluation – Policy Improvement – Policy Iteration – Value Iteration – Generalized Policy Iteration – Efficiency of Dynamic Programming – Banach fifed point theorem – Proof of convergence of policy evaluation and value iteration algorithms.

Suggested Activities:

- Practical – Monte Carlo Prediction, Monte Carlo Off-Policy Control with Importance Sampling and SARSA (On Policy TD Learning).

Suggested Evaluation Methods:

- Evaluation of the practical implementation with appropriate input set.

UNIT IV MONTE CARLO PREDICTION 9

Monte Carlo Estimation of Action Values – Monte Carlo Control – Off-policy Prediction via Importance Sampling – Incremental Implementation – Off-Policy Monte Carlo Control – Temporal-Difference Learning: TD Prediction – Advantages of TD Prediction Methods – Optimality of TD (0) – TD (1) – TD(λ) – SARSA: On-Policy TD Control – Q-Learning: Off-Policy TD Control – Unified view of DP, MC and TD evaluation methods.

Suggested Activities:

- Practical – Implement Q-Learning (Off Policy TD Learning), Q-Learning with Linear Function Approximation and Deep Q-Learning for Atari Games.

Suggested Evaluation Methods:

- Implementation evaluation by testing the code.

UNIT V FUNCTION APPROXIMATION 9

Getting started with the function approximation methods – Revisiting risk minimization – gradient descent from Machine Learning – Gradient MC and Semi-gradient TD(0) algorithms – Linear Methods – Eligibility trace for function Approximation – Control with function Approximation – Least squares, Experience replay in deep Q-Networks – Naive

REINFORCE algorithm – Bias and variance in Reinforcement Learning – Actor-Critic Methods.

Suggested Activities:

- Practical – Develop Policy Gradient: REINFORCE with Baseline, Actor Critic with Baseline, Actor Critic with Baseline for Continuous Action Spaces

Suggested Evaluation Methods:

- Evaluation of the practical implementation.

PRACTICAL EXERCISES:

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

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Understand different terminologies of RL and Concepts of Probability.
2. Illustrate Markov Decision Process and Bellman Equation for learning.
3. Apply dynamic programming techniques on Markov decision process and Monte Carlo methods.
4. Implement Time difference learning for real world problems.
5. Apply Approximation methods of learning and Q-Learning Technique.
6. 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. Kevin P Murphy, Machine Learning: A Probabilistic Perspective,2nd Edition, MIT Press, 2022.
3. Csaba Szepesvari, Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning), Morgan & Claypool Publishers, 2010.
4. Laura Graesser and Wah Loon Keng, Foundations of Deep Reinforcement learning: theory and Practice in Python, Pearson India, New Delhi, 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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

DS5008 IMAGE PROCESSING AND COMPUTER VISION

L	T	P	C
3	0	2	4

OBJECTIVES:

- To provide knowledge about computer vision algorithms.
- To understand the basic concepts of camera calibration, stereoscopic imaging, and higher-level image processing operations.
- To familiarize the student with the image processing facilities in MATLAB and its equivalent open-source tools like OpenCV.
- To appreciate the use of compute vision in Industrial applications and to understand the role of computer vision.
- To understand and implement Object detection and Object tracking Algorithms.

UNIT I FUNDAMENTALS OF VISION 9

Image Formation and Representation–Intensity and Range Images – Camera models – Camera parameters – Light and colour – Image Noise – Image Filtering (spatial domain) – Mask based filtering – Image Smoothing –Sharpening.

Suggested Activities:

- Installation of OpenCV.
- Numerical Problems on Filtering, Masking, Smoothing and sharpening.

Suggested Evaluation Methods:

- Quizzes on various camera models and its effect.
- Practical – Programming assignments on types of filters for different applications

UNIT II IMAGE SEGMENTATION and CAMERA CALLIBRATION 9

Point and Line Detection – Hough Transform and Shape detection – Edge Detection – Corner Detection – Harris Detector- Stereopsis – Correspondence Problem –RANSAC and Alignment –Epipolar Geometry.

Suggested Activities:

- Flipped classroom on importance of segmentation.
- External learning – Various camera calibration methods.

Suggested Evaluation Methods:

- Quizzes on various segmentation methods.
- Practical – Programming assignments on edge and shape detection methods.

UNIT III FEATURE DETECTION AND TRACKING 9

Image Features – Textures – Deformable Contours – Features Reduction – Principal Component analysis – Feature Descriptors – SIFT and SURF– Motion field of rigid objects – Notation of Optical flow – Estimation Motion Field – Horn and Schunck Algorithm – Lucas and Kanade Algorithm.

Suggested Activities:

- Flipped classroom on various feature reduction methods.
- External learning – Optical flow algorithms.

Suggested Evaluation Methods:

- Quizzes on various feature detection methods.
- Practical – Programming assignments on object tracking algorithms.

UNIT IV SHAPE FROM CUES AND OBJECT DETECTION 9

Shape from Shading and shape from Texture Model based Vision – Smooth Surfaces and their Outlines–Aspect Graphs and Range Data – Localization – Classification and Evaluation – AdaBoost – Random Decision Forests – Pedestrian Detection.

Suggested Activities:

- Flipped classroom on pedestrian detection methods.
- Assignments on numerical problems on Shading and Texture Model based Vision.
- Assignments on numerical problems on AdaBoost and Random Decision Forests.

Suggested Evaluation Methods:

- Quizzes on methods to identify the shape of an object in an image.
- Practical – Programming assignments on algorithms and methods used for identification of objects

UNIT V COMPUTER VISION APPLICATION 9

Emotion Recognition – Real Time Object Detection – Gesture Recognition – Face Detection

Suggested Activities:

- External learning – Exploring advancement in computer vision.
- Discussion on Emotion Recognition methods.

Suggested Evaluation Methods:

- Quizzes on various real time computer vision application.
- Group discussion on methods to solve the real-world problems in computer vision applications.

PRACTICAL EXERCISES:

1. Write a program in OpenCV/Matlab to implement low pass and high pass filters for noise removal.
2. Implement Image sharpening filters in OpenCV.
3. Implement Image segmentation algorithms like Hough Transform in OpenCV
4. Implement SIFT and SURF feature extraction algorithms from Images to perform a simple image matching.
5. Implement Optical flow algorithms in OpenCV
6. Implement a simple application for Gesture Detection in OpenCV

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Have a clear impression of the breadth and practical scope of digital image processing and have arrived at a level of understanding that is the foundation for most of the work currently underway in this field.
2. Critically analyze the role of video in modern technologies.
3. Implement basic image and video processing algorithms.
4. Design and develop various applications that incorporate different techniques of Image and video processing.

5. Apply and explore new techniques in the areas of Image and video Processing.
6. Implement image and video-based applications

REFERENCES:

1. Rafael C.Gonzalez and Richard E.Woods, Digital Image Processing, Third Edition, Pearson Education, 2008, New Delhi.
2. S.Sridhar, Digital Image Processing", 2nd edition, Oxford University Press, 2016, New Delhi.
3. Alan C Bovik, The Essential Guide to Video Processing, Academic Press, Second Edition, 2009.
4. Oges Marques, Practical Image and Video Processing Using MATLAB, Wiley - IEEE Press, 2011.

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

DS5009 ARTIFICIAL NEURAL NETWORKS

L	T	P	C
3	0	2	4

OBJECTIVES:

- To connect Biology with Computers
- To understand components of artificial neural networks
- To understand supervised learning network paradigms
- To understand RBF and Recurrent networks
- To understand unsupervised learning network paradigms

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Basics of Artificial Neural Networks (ANN) – A brief history of neural networks – Biological neural networks – The vertebrate nervous system – Peripheral nervous system – Cerebrum, cerebellum, Diencephalon, Brainstem The Neuron – Components – Electrochemical processes – Receptor cells- Various types – Information processing within nervous system – Light Sensing organs – Neurons in living organisms – Transition to technical neurons.

Suggested Activities:

- Practical – installing Anaconda, a scientific python library which includes scikit-learn, all of its dependencies, matplotlib and more for building, debugging, testing, and executing neural network application

Suggested Evaluation Methods:

- Evaluation of practical implementation.

UNIT II COMPONENTS OF ANN 9

Components of artificial neural networks – The concept of time in neural networks – Connections – Propagation function, Activation – Threshold value – Activation function – Common activation functions – Output function – Learning strategies – Network topologies – Feed forward networks – Recurrent networks – Completely linked networks – Bias neuron – Representing Neurons – Orders of Activation – Synchronous activation – Asynchronous activation – Input and output of data.

Suggested Activities:

- Practical – Implement feed-forward network using Python Library.
- Practical – Implement the model by changing the activation functions

Suggested Evaluation Methods:

- Evaluation of the practical implementation.
- Tutorial – Solve the numerical problem on feed forward networks with various action functions.

UNIT III SUPERVISED LEARNING 9

Learning and training samples – Paradigms of Learning – Using training samples – Gradient Optimization Procedure – Hebbian learning rule – Supervised learning network paradigms – The perceptron – Backpropagation and its variants – Single layer perceptron – Linear Separability – Multilayer perceptron – Backpropagation of error – Selecting learning rate – Resilient Backpropagation – Adaption of Weights – Variations in Backpropagation – Variations in Backpropagation

Suggested Activities:

- Practical – Implement backpropagation using Python
- Practical - Analyze by adding or removing hidden layers and also change learning rates, regularization, and other learning settings.

Suggested Evaluation Methods:

- Evaluation of the practical implementation.
- Quizzes on different Supervised learning networks

UNIT IV RADIAL BASIS FUNCTIONS 9

Radial basis functions – Information processing of an RBF network – Training of RBF networks – Growing of RBF networks – Compare multilayer perceptron and RBF – Recurrent perceptron-like networks – Jordan networks – Elman networks – Training recurrent networks – Unfolding in time – Teacher forcing – Recurrent backpropagation – Evolutionary algorithms- Hopfield Networks

Suggested Activities:

- Flipped classroom on demonstrating the operations on the RBF network.

Suggested Evaluation Methods:

- Quizzes on operation of associate memory and recurrent neural networks.

UNIT V UNSUPERVISED LEARNING 9

Unsupervised learning network paradigms – Structure of a self-organizing map(SOM) – Functionality, Training – Topology function – Decreasing Learning Rate – Variations of

SOMs – Neural gas – Multi-SOM – Multi-neural gas – Growing neural gas – Adaptive resonance theory(ART) – Task and structure of an ART network – Resonance – Learning process of an ART network.

Suggested Activities:

- Flipped classroom on basics of SOM, and ART concepts.
- Practical – Implement an Unsupervised neural network using Python

Suggested Evaluation Methods:

- Quizzes on the basic operation of SOM and ART
- Demonstration for practical learning.

PRACTICAL EXERCISES **30**

1. Implement a feed forward network with two input layers and one hidden layer on any standard dataset and
2. Analyze the performance of the model implemented in exercise 1 by varying activation functions and loss functions.
3. Implement a feed forward network with multiple hidden layers on any standard dataset Experiment with logistic activation functions for the hidden nodes and linear activation for the output.
4. Implement a backpropagation network on any standard dataset to determine a set of suitable weights and analyze the performance of the model by varying activation functions and loss functions.
5. Implement the SOM algorithm and check its performance by varying the learning rate.
6. Implements the ART algorithm and checks whether the input data fits into one of the already stored clusters or create a new cluster.
7. Visualizing a above implemented neural network model by choosing difference activation function, learning rate and other hyper parameters.
8. Improve the performance of neural network by identifying the misclassifications being made by the above model.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Know the purpose of Artificial Neural Networks.
2. Apply the concepts for training a neural network.
3. Work with a supervised learning network paradigm.
4. Work with Associative memory and Recurrent neural networks
5. Work with an unsupervised learning network paradigm.
6. Learn procedures of various neural networks to generalize and associate data.

REFERENCES:

1. S. Sivanandam and S.Sumathi, Introduction to Artificial Neural Networks, McGraw Hill, New Delhi, 2017.
2. James A Freeman, David M Skapura, Neural Networks: Algorithms, Applications, and Programming Techniques, Pearson India, New Delhi, 2012.
3. Simon O. Haykin, Neural Networks and Learning Machines, 3rd Edition, Pearson Education India, 2016.

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

DS5010 PROGRAMMING FOR AI/ML WITH PYTHON

L	T	P	C
3	0	2	4

OBJECTIVES:

- To define functions and use function calls in python
- To understand the problem-solving aspects using conditionals and loops
- To use python data structures such as list, tuples, and dictionaries
- To understand the operation of arrays using NumPy
- To explore data manipulation using pandas
- To visualize data with matplotlib and seaborn

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

Suggested Activities:

- Simple programs on print statements, arithmetic operations
- Simple programs on function calls
- Working with git commands on python programs

Suggested Evaluation Methods:

- Assignment on variables and arithmetic operators
- Conversion of programs to functions
- Auto grading using git and GitHub

UNIT II FILE HANDLING AND WORKING WITH ARRAYS **9**

Working with files - NumPy - Array Indexing - Array Slicing - Reshaping - Concatenation - Splitting - Aggregation - Broadcasting - Sorting - Vectorizing - Matrix operations

Suggested Activities:

- Importing, reading a file and writing/ appending to files
- Programming assignment on matrix operations and broadcast
- Program on vectorizing the data and analyzing the time of computation

Suggested Evaluation Methods:

- Programming assignment on above activities
- External learning with real dataset with NumPy
- Collaborative learning with git

UNIT III WORKING WITH DATA **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

Suggested Activities:

- Installation of Pandas and creation of a data frame
- Conversion of dictionary to data frame and vice versa
- Explore real world dataset from UCI repository and perform operations on those datasets

Suggested Evaluation Methods:

- Programming assignment on the above activities
- Creation of a dataset
- External learning

UNIT IV 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

Suggested Activities:

- For the programs in Unit IV activities, draw relevant plots with matplotlib and seaborn libraries
- Customize the plot with legend, text and additional colors

Suggested Evaluation Methods:

- Programming assignment on the above activities
- Tutorials and quiz
- Number of commits in GitHub repository

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

Suggested Activities:

- Installation of Scikit-learn
- For the programs for cross-validation.

Suggested Evaluation Methods:

- Programming assignment on the above activities
- Tutorials and quiz
- Number of commits in GitHub repository

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

OUTCOMES:

On completion of the course, the students will be able to:

- Develop and execute programs with loops and other data structures
- Work with files and arrays using numpy
- Work with data using Pandas
- Write programs for visualization using matplotlib and seaborn
- Develop separate functions for statistical learning
- 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-github-ebook/raw/main/ebook/en/export/introduction-to-git-and-github-dark.pdf, 2021.
5. https://scikit-learn.org/stable/tutorial/statistical_inference/index.html

PO/CO	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

IF5073 AUTONOMOUS GROUND VEHICLE SYSTEMS

L	T	P	C
3	0	2	4

OBJECTIVES:

- To learn the fundamentals of autonomous driving.
- To study the different ways of sensing internal states of Autonomous Ground Vehicles (AGVs).
- To learn the environment perception for autonomous driving.
- To explore the navigation techniques of AGVs.
- To learn the fundamentals of vehicle control systems and connected vehicles

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).

Suggested Activities:

- Flipped classroom on autonomous driving system architecture.
- External learning – Building blocks of typical Unmanned Aerial Vehicles.
- Flipped classroom on robot operating system.
- External learning – Applications of autonomous vehicles (aerial, under water, ground vehicles).
- Assignment on the design requirement specifications of autonomous vehicles (aerial, under water, ground vehicles).

Suggested Evaluation Methods:

- Viva voce on assignment topics.
- Quizzes on Advanced Driver Assistance Systems (ADAS).
- Group Discussion on Google's self-driving car.

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

Suggested Activities:

- Flipped Classroom on sensor characteristics.
- External learning – Working principle of IMU/GPS/RADAR sensors.
- External learning – Exploring Velodyne Lidar sensor dataset in Veloview software

Suggested Evaluation Methods:

- Practical-Experiments on interfacing IMU sensor to Raspberry Pi board and recording the acceleration of a dummy vehicle.
- Practical-Experiments on interfacing Lidar/RADAR sensor to Raspberry Pi board and recording the distances to the nearby objects.
- Practical-Experiments on interfacing camera to Raspberry Pi board and capturing images/videos.

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.

Suggested Activities:

- Flipped classroom on Basic Mean Shift Algorithm.
- External learning – Lane detection algorithm.
- Flipped classroom on vehicle tracking.

Suggested Evaluation Methods:

- Practical – Implementation of Mean Shift Clustering / Mean Shift Segmentation Algorithm.
- Practical – Experiments on stationary obstacle detection algorithm using Lidar sensor.

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.

Suggested Activities:

- Flipped classroom on GPS orbits/GPS Signals.
- External learning – Indian Regional Navigation Satellite System (IRNSS).
- Assignment on the working principles of Google Map.

Suggested Evaluation Methods:

- Quizzes on GNSS signal structure.
- Viva Voce on assignment topics.
- Practical – Simulation of Waypoint Navigation Algorithm.

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.

Suggested Activities:

- Flipped classroom on cruise control.
- External learning – Study on proportional integral derivative (PID) control.
- Assignment – Communication protocols for connected vehicles.

Suggested Evaluation Methods:

- Viva Voce on assignment topic.
- Practical – Experiment on simple velocity control.
- Practical – Experiment on simple longitudinal motion control

PRACTICAL EXERCISES: **30**

Implement the following exercise using python libraries on UCI Machine Learning Repository.

1. Write a python program to read Lidar sensor data and write it in a text file.
2. Write an Arduino sketch to operate DC motors through motor driver.
3. Write a python program on Raspberry Pi board to control the movement of pan-tilt platform with 5v dc motors.
4. Write a python program to read the IMU sensor values through I2C bus in Raspberry Pi board.
5. Develop an Arduino application to drive a simple rover with four wheels in a random path.
6. Write a python program to send the location of a rover with GPS to Firebase real- time database.
7. Develop a Lidar sensor assisted application to implement 2D collision cone-based obstacle avoidance for rovers.
8. Develop an application using python program to control the pan-tilt motion of a camera and to take pictures/videos in the field of view of the camera.
9. Develop a convolutional neural network model to detect cars in videos.
10. Develop a convolutional neural network model to detect road lanes in videos.
11. Mini Project

TOTAL: 75 PERIODS

OUTCOMES:

1. On completion of the course, the students will be able to:
2. Identify the requirements and design challenges of AGVs.
3. Select suitable sensors to sense the internal state and external world of AGVs.
4. Implement lane detection, road detection & vehicle detection algorithms.
5. Simulate/implement ground vehicle navigation algorithms.
6. Simulate/implement ground vehicle control systems.

REFERENCES:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, “Creating Autonomous Vehicle Systems”, Morgan & Claypool, 2018.
2. UmitOzguner, TankutAcarman, Keith Redmill, “Autonomous Ground Vehicles”, Artech House, 2011.
3. Hong Cheng, “Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation”, Springer, 2011.
4. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, “Global Navigation Satellite Systems, Inertial Navigation, and Integration”, Third Edition, John Wiley & Sons, 2013.

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CO1	3	3	2	2	2	1
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CO4	3	3	2	2	3	1
CO5	3	2	2	2	3	1
CO6	3	2	2	2	3	3

MM5072 MIXED REALITY

L	T	P	C
3	0	2	4

OBJECTIVES:

- To impart the fundamental aspects and principles of mixed reality technologies.
- To know the internals of the hardware and software components involved in the development of mixed reality enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about mixed reality application development.
- To know the technologies involved in the development of mixed reality-based applications

UNIT I INTRODUCTION **9**

Introduction to Virtual Reality and Mixed Reality – Definition – Introduction to Trajectories and Hybrid Space – Three I"S of Virtual Reality – Virtual Reality vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies – Input Devices – 3D Position Trackers – Performance Parameters – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices. Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

Suggested Activities:

- Flipped classroom on Uses of MR applications.
- Videos-Experience the virtual reality effect.
- Assignment on comparison of VR with traditional multimedia applications.

Suggested Evaluation Methods:

- Tutorial - Applications of MR.
- Quizzes on the displayed video and the special effects.

UNIT II MR COMPUTING ARCHITECTURE 9

Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering – PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – SGI Infinite Reality Architecture – Distributed VR Architectures – Multipipeline Synchronization – Collocated Rendering Pipelines – Distributed Virtual Environments – MR architecture.

Suggested Activities:

- Flipped classroom on basic graphics pipeline.
- External learning - Different types of Graphics architectures and workstations.
- Practical - GPU programming on simple modeling and rendering.

Suggested Evaluation Methods:

- Tutorial - Graphics pipelines.
- Brainstorming session on GPU architecture.
- Quizzes on graphical architectures.
- Demonstration of GPU related simple modeling and rendering programs

UNIT III MR MODELING 9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management

Suggested Activities:

- Flipped classroom on modeling three dimensional objects.
- External learning - Collision detection algorithms.
- Practical - Creating three dimensional models.

Suggested Evaluation Methods:

- Tutorial - Three-dimensional modeling techniques.
- Brainstorming session on collision detection algorithms.
- Demonstration of three-dimensional scene creation

UNIT IV PROGRAMMING AND APPLICATIONS 9

VR Programming – Toolkits and Scene Graphs – World Tool Kit – Java 3D – Comparison of World Tool Kit and Java 3D - GHOST – People Shop – Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications –

Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – MR in Business – MR in entertainment – MR in education.

Suggested Activities:

- External learning - Different types of programming toolkits and learn different types of available VR applications.
- Practical - Create VR scenes using any toolkit and develop applications.

Suggested Evaluation Methods:

- Tutorial - VR tool comparison.
- Brainstorming session on tools and technologies used in VR.
- Evaluate the developed VR application.
- Demonstration of the created VR applications.

UNIT V MIXED REALITY TECHNOLOGIES 9

Synchronizing Time – Tangible & Ubiquitous –Vision Based Tracking – Sensing Technologies – Seamful Design – Assembling Interaction – Trajectories through Mixed Reality Performance –Mobile Interface Design – Wearable Computing-Games

Suggested Activities:

- External learning - Different types of sensing and tracking devices for creating mixed reality environments.
- Practical - Create MR scenes using any toolkit and develop applications.

Suggested Evaluation Methods:

- Demonstration and evaluation of the developed MR application.
- Tutorial - Mobile interface design.
- Brainstorming on efficient usage of various MR technologies.

PRACTICAL EXERCISES: 30

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection methods by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E- learning environment, Virtual walkthroughs, and visualization of historic places.
9. Develop MR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Familiarize with the basic concepts of mixed reality.
- Understand the tools and technologies related to Mixed Reality.
- Know the working principle of mixed reality related Sensor devices.
- Develop the Virtual Reality applications in different domains.
- Design of various models using modeling techniques.
- Expose the concept of Virtual Reality and Mixed reality Programming with toolkits.

REFERENCES:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create Compelling VR Experiences for Mobile”, Packt Publisher, 2018
2. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003.

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

DS5011 DEEP LEARNING

L	T	P	C
3	0	2	4

OBJECTIVES:

- To understand the basic ideas and principles of Neural Networks
- To understand the basic concepts of Big Data and Statistical Data Analysis
- To familiarize the student with The Image Processing facilities like Tensorflow and Keras
- To appreciate the use of Deep Learning Applications
- To understand and implement Deep Learning Architectures

UNIT I BASICS OF NEURAL NETWORKS 9

The basic concept of Neurons – Relationship between Artificial Intelligence, Deep Learning and Machine Learning - Activation Functions - Perceptron – McCulloh Pitts model - OR, AND Gate Implementation - Learning Rate - Introduction to feedforward and feedback networks.

Suggested Activities:

- Discuss the history of AI and Neural Networks.
- External learning – Turing Test.
- Practical – Installation of TensorFlow and Keras.

Suggested Evaluation Methods:

- Tutorial – Perceptron.

- Assignment problems on Hebbian and perceptron learning rule
- Quizzes on Neural Networks.

UNIT II INTRODUCTION TO DEEP LEARNING 9

Training Deep Neural Networks – Initialization, Activation functions – Optimizers - Gradient Descent – Momentum based optimization methods - Loss Functions – Types of Loss functions - Cross Entropy - Regularization Techniques - Dropout - Applications in Regression and Classification problems - Binary and multi-class classification

Suggested Activities:

- Discussion of the role of Gradient Descent in Deep Learning.
- External learning – Convolutional learning and feature learning.
- Survey of Deep Learning Development Frameworks.
- Discussion of Regularization methods.

Suggested Evaluation Methods:

- Tutorial – Optimizers in deep learning.
- Assignment problems in optimization.
- Quizzes on deep learning regularization and optimization.

UNIT III CONVOLUTIONAL NEURAL NETWORKS 9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning- Object Detection Frameworks – R-CNN, YOLO and SSD - Applications in image classification and Object Detection.

Suggested Activities:

- Discussion of the role of Convolutional Networks in Machine Learning.
- External learning – Concept of convolution and need for Pooling.

Suggested Evaluation Methods:

- Tutorial – Image classification and recurrent nets.
- Assignment problems in image classification performances.
- Quizzes on Convolutional Neural Networks.

UNIT IV RECURRENT NEURAL NETWORK 9

RNN - Sequence modelling - RNN as graphical models - Modeling Sequence - Bidirectional RNN - LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Applications in Text Processing

Suggested Activities:

- Discussion of the role of Deep Learning architectures.
- External learning – Compression of features using Autoencoders.

Suggested Evaluation Methods:

- Tutorial – LSTM and Autoencoders.
- Assignment problems in deep generative models, Deep Belief Networks.
- Quizzes on deep learning architectures.

UNIT V GENERATIVE ADVERSARIAL NETWORKS 9

Generative Adversarial Networks - Discriminator model - Generator model - Training GAN - Minmax function - Evaluating GAN Models - Inception Score - Fréchet inception distance (FID) - Applications - Text-to-photo synthesis - Image to image translation

Suggested Activities:

- Discussion of the role of Deep Learning in Image and NLP applications.
- External learning – NLP concepts.

Suggested Evaluation Methods:

- Tutorial – Image segmentation.
- Assignment problems in parsing and sentiment analysis.
- Quizzes on deep learning architectures.

PRACTICAL EXERCISES:

1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras.
8. Implement Opinion Mining in Recurrent Neural network.
9. Implement an Object Detection using CNN.
10. Mini Project

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Understand the internal architecture of a neuron and the role of activation functions
2. Apply a feedforward neural network for classification problems with appropriate optimization techniques
3. Design and implement convolution neural networks for image classification
4. Understand the architecture of recurrent neural networks and their variants
5. Design the deep neural network with Generative Adversarial models
6. Apply relevant deep learning architectures for real-world applications

REFERENCES:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Deep Learning: A visual Approach, Andrew Glassner, No Starch Press, San Francisco, 2021.
3. Deep Learning Illustrated, A visual and Interactive Guide to Artificial Intelligence, Jon Krohn, Pearson Education, 2020.
4. Eugene Charniak, Introduction to Deep Learning, MIT Press, 2018
5. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
6. Mohamed Elgendy, Deep learning for Vision Systems, Manning Publications, O’ Reilly, 2020
7. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.

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

DS5012 FINANCIAL TECHNOLOGIES

L	T	P	C
3	0	2	4

OBJECTIVES:

- To learn the fundamentals of the financial technologies, and Investment analysis
- To study the different ways of raising money with fintech
- To learn how to harness data with artificial intelligence and machine learning
- To understand and describe the digital finance and alternative finance and the Future of Fintech.
- Developing the capability in terms of the applications of tools and techniques in analyzing and solving problems related to investment

UNIT I FINTECH **9**

Reshaping the banking and payments industry -Analyze the source of banks' vulnerability FinTech Transformation, FinTech Evolution 1.0,2.0,3.0,3.5, Collaboration between Financial Institutions and Startups, FinTech Typology, Emerging Economics: Opportunities and Challenges

Suggested Activities:

- Flipped classroom on basics of FinTech Typology.
- External learning - The Future of FinTech and the Technologies impacting it.

Suggested Evaluation Methods:

- Quizzes on FinTech.
- Assignment on Emerging Economics.

UNIT II INNOVATIONS OF FINTECH **9**

Banks' disintermediation of credit, Individual Payments, Mobile Money, Regulation of Mobile Money, RTGS Systems, ABCDs of Alternative Finance, Building a New stack Cryptocurrencies, Legal and Regulatory Implications of Cryptocurrencies, Blockchain, The Benefits from New Payment Stacks (Applications of Ripple)

Suggested Activities:

- Flipped classroom on basics of Mobile Money.
- External learning - Legal and Regulatory Implications of Cryptocurrencies

Suggested Evaluation Methods:

- Quizzes on ABCDs of Alternative Finance.
- Demonstration of the practical implementations of Blockchains.

UNIT III FINTECH REGULATIONS AND DATA REGULATION 9

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

Suggested Activities:

- Flipped classroom on basics of data regulations of various countries.
- External learning - Transforming Personal Finance with Fintech
- External learning - Application of AI in Smart Regulation (Mindbridge)
- Read: Dhar, V., Robots Will Soon Do Your Taxes: Bye Bye Accounting Jobs, Wired, Feb 2017 https://www.wired.com/2017/02/robots-will-soon-taxes-bye-byeaccounting-jobs/
- Read: https://www.predictiveanalyticstoday.com/artificial-intelligence-platforms/

Suggested Evaluation Methods:

- Quizzes on FinTech Regulations.
- Assignments on automation in the investment management industry, Balancing Innovation and Regulation Challenges.
- Industry Showcase: Cybersecurity Industry, PSD2: Open Banking API for Startups (Gini), Application of Data Analytics in Finance.

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, Crowdfunding - Regards, Charity and Equity, P2P and Marketplace Lending, The Rise of new TechFins - New Models and New Products.

Suggested Activities:

- Flipped classroom on basics of Digitization of Financial Services.
- External learning - Ensuring Compliance from the Start

Suggested Evaluation Methods:

- Quizzes on Financial Innovation.
- Assignments on Method of AI used to Transform the Future of FinTech.

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 and Exits. Disruptive Technology Cases in FinTech

Suggested Activities:

- Flipped classroom on basics of TechFin.
- External learning – reconfiguring of FinTech financial services business models. Key disruption points. Success of FinTech
- External learning – Limits, risks, and broader policy and social implications of FinTech.

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Suggested Evaluation Methods:

- Assignments on automation in the investment management industry.
- Case Studies- Revolut, Alibaba, Aadhaar, Credit Karma, Digibank

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

OUTCOMES:

On completion of the course, the students will be able to

1. Apply the concepts and computational basics in the real-world financial market scenario
2. Formulate trading strategies by identifying the patterns in trading and market price movements
3. Evaluate portfolios through systematic technical and fundamental analysis
4. Collaborate and compete with trading groups in a simulated environment and extend to the real investment scenarios
5. Demonstrate decision dynamics to attain the investment objectives in a stock market environment
6. 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, 1st 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.

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CO1	3	1	3	3	3	1
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CO4	3	3	3	3	3	1
CO5	1	1	3	2	3	1
CO6	2	1	3	3	3	1

DS5013 QUANTUM ARTIFICIAL INTELLIGENCE L T P C
3 0 2 4

OBJECTIVES:

- To gain an understanding of the QAI's fundamentals.
- To learn more about quantum computation and algorithm development.
- To understand how to use artificial intelligence, machine learning, and deep learning to extract value from large amounts of data.
- To better understand and be fluent on the concepts of advanced quantum computing.
- To learn how to use QAI to develop the Quantum Blockchain

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

Suggested Activities:

- Flipped classroom on Working with Qubits, Working with Multiple Qubits.
- External learning - Quantum Hardware Approaches

Suggested Evaluation Methods:

- Quizzes on Quantum States.
- Assignments on 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

Suggested Activities:

- Flipped classroom on basics of Quantum Information.
- External learning - Quantum Noise and Quantum Operations,
- External learning - Distance Measures for Quantum Information,
- External learning - Quantum Error Correction

Suggested Evaluation Methods:

- Quizzes on Data Compression.
- Demonstration of the practical implementations of Quantum Algorithms, Quantum Search, Reversible Algorithms.

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.

Suggested Activities:

- Flipped classroom on Quantum Error Correction.
- External learning – Interference and Entanglement

Suggested Evaluation Methods:

- Quizzes on Quantum statistics
- Assignments on Practical Applications of Entanglement

UNIT IV ARTIFICIAL INTELLIGENCE 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

Suggested Activities:

- Flipped classroom on Quantum Naïve Bayes.
- External learning - Quantum Cognition

Suggested Evaluation Methods:

- Quizzes on Information Geometry, and Geometric Deep Learning, Standardized Methods for Quantum Computing
- Assignments on Reinforcement 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.

Suggested Activities:

- Flipped classroom on basics of Quantum Internet, Quantum Networks.
- External learning –Quantum Cryptography and Quantum Key Distribution
- External learning – Limits, risks, and broader policy and social implications of Blockchain Risk of Quantum Attack, Quantum-Resistant Cryptography for Blockchains

Suggested Evaluation Methods:

- Assignments on Quantum Security and automation.
- Case Studies- Quantum Cryptography

PRACTICAL EXERCISES: **30**

- Implementation of Quantum Algorithms
- Demonstrating the Quantum Complexity
- Experiment on Quantum Key Distribution
- Experiments on Optical Quantum Information Processing
- Experiments on Quantum Cryptography
- Case studies like Seismic Sensing Using Quantum Cryptography Network

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Gain understanding of the QAI's fundamentals.
2. Learn more about quantum computation and algorithm development.
3. Understand how to use artificial intelligence, machine learning, and deep learning to extract value from large amounts of data.
4. Understand and be fluent on the concepts of advanced quantum computing.
5. Learn to assess the use QAI to develop the Quantum Blockchain
6. Learn Quantum statistics

REFERENCES:

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

PO/CO	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
CO5	1	1	3	2	3	1
CO6	2	1	3	3	3	1

DS5014	SOCIAL NETWORK ANALYSIS AND MINING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To learn the graph theoretical basics of social networks and its applications
- To understand knowledge representation in social networks
- To know the basics of media and community mining in social networks
- To learn about techniques for understanding human behavior in social networks
- To understand the importance of security, privacy in social networks and visualization.

UNIT I INTRODUCTION TO SOCIAL NETWORKS 9

Social Network Analysis: Definition and Features – The Development of Social Network Analysis – Representation of Social Networks: Graph and Matrix Representations – Graph Concepts in Network Analysis – Ties, Degree, Density, Path, Length, Geodesic, Eccentricity, Between – Ness, Centrality, Clique – Overview of Electronic Discussion Networks, Blogs and Online Communities

Suggested Activities:

- Given a social graph derive the various graph metrics.
- Group discussion on pros and cons of various online discussion forums.
- Convert a graph into equivalent matrix representation.

Suggested Evaluation Methods:

- Assignment on graph metrics.
- Report submission on features of online social forums.
- Quizzes on graph and matrix representations.

UNIT II KNOWLDEGE REPRESENTATION IN SOCIAL NETWORKS 9

Introduction to Ontology– OWL–Web Ontology Language– Basic OWL– Bibliographic Ontology (BIBO) – FOAF Good Relations– CIDOC's Conceptual Reference Model (CRM) – Digital Public Library (DPLA) – RDF Parser/Serializer– RDF Store – Querying the Semantic Web– SPARQL–Query Language for RDF–Advanced Features of SPARQL – RDF and Inference.

Suggested Activities:

- Group activity – Defining concepts and relations for sample scenarios using benchmark ontology.
- Practical – Developing ontology using tools.
- Assignment on inferring the entities involved from a sample RDF schema.

Suggested Evaluation Methods:

- Report submission on benchmark ontology.
- Quizzes and assignments on RDF/FOAF and other related vocabulary

UNIT III SOCIAL MEDIA MINING AND COMMUNITY MINING 9

Discovering Mobile Social Networks by Semantic Technologies – Online Identities and Social Networking – Concept Discovery and Categorization for Video Searching –

Discovering Communities in Social Networks – Recommender Systems.

Suggested Activities:

- Group discussion on the pros and cons of communities in social networks.
- Charting the metrics for evaluating real time online communities.

Suggested Evaluation Methods:

- Group assignment on evaluating real time social network communities.
- Assignment on scenario based comparative analysis of community discovery.
- Open book quizzes on Recommender Systems for specific social networking scenarios.

UNIT IV UNDERSTANDING HUMAN BEHAVIOR IN SOCIAL NETWORKS 9

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

Suggested Activities:

- User interaction data collection from real time social network applications.
- Comparison of behavior models in social networks using sample data.

Suggested Evaluation Methods:

- Tutorial – Scenarios to identify suitable web accessibility testing.
- Group projects – Use open-source data collection tools and predict user behavior.

UNIT V PRIVACY IN SOCIAL NETWORKS AND VISUALIZATION 9

Introduction to Security and Privacy in Online Social Networks – Key Player Problem – Intrusion Detection on Social Networks – Security Requirements for Social Networks – Visualizing Online Social Networks – Novel Visualizations and Interactions for Social Networks Exploration.

Suggested Activities:

- Case studies on applications of social network analysis.
- In-class activities – Network visualization using benchmark data and network visualization tools.

Suggested Evaluation Methods:

- Assignments on chart work for modeling social networks using node-edge diagrams.
- Mini project on applications of social network analysis.

PRACTICAL EXERCISES: 30

1. Download and install open-source social network analysis tools like UCINET, Net Miner, Smart Network Analyzer, Pajek, Gephi and explore the visualization and analytical features of that tool using sample real world data.

2. Construct any graph representing a real-life social network scenario, feed the same as a matrix input to any tool and explore the graph theoretical metrics of the graph and note down your observations and inferences on those values.
3. Download any RDF schema on tourism and explore various tags in the schema. To analyzing, open them using a Word Editor. Highlight the subject, predicate, and object in each file. if necessary, use the RDF validator service by W3C to obtain the triplets.
4. Download and install any open-source RDF/Ontology editing tool like protégé, Onto Studio, etc. Try the following in that tool: (i) Load existing RDF schema and visualize and (ii) Add, modify, and delete RDF
5. Do the following using W3C RDF Validator: (i) Enter a URI or paste an RDF/XML document and parse the RDF and (ii) Visualize the RDF/XML as Triples and/or Graph.
6. Download any benchmark FOAF ontology/RDF and study the various FOAF classes used in that RDF/Ontology.
7. Download and install Gephi tool and explore importing graph file formats from (i) Spreadsheet import wizard, (ii) Database import. Also use the statistics and metrics framework in Gephi to calculate the following: Betweenness Centrality, Closeness, Diameter, Clustering Coefficient, Page Rank.
8. Load different social network data into Gephi tool and perform community detection using the features available and also compute the shortest path.
9. Explore various forced layout and random forest algorithms in Gephi tool to create a network layout. Compare the outputs of various layouts algorithms.
10. Study of various bibliometric RDFs and visualization of citation networks.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Convert a social network data into its equivalent graph data and derive social graph metrics.
2. Develop social blogs with necessary tags.
3. Design and develop ontology for various domains.
4. Predict human behavior in social web and related communities using community prediction and mining algorithms.
5. Design and develop trust models for social networks.
6. Visualize social network data and quantify its structural properties.

REFERENCES:

1. Peter Mika, “Social Networks and the Semantic Web”, Springer 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 2010.
3. Guandong Xu ,Yanchun Zhang, Lin Li, “Web Mining and Social Networking – Techniques and Applications”, Springer, 2011.
4. Dion Goh, Schubert Foo, “Social Information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively”, IGI Global Snippet, 2008.

5. Max Chevalier, Christine Julien, Chantal Soulé-Dupuy, “Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling”, IGI Global Snippet, 2009.
6. John G. Breslin, Alexander Passant, Stefan Decker, “The Social Semantic Web”, Springer, 2009.

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CO3	1	1	2	3	2	1
CO4	1	2	1	2	2	1
CO5	1	3	3	3	2	1
CO6	1	2	2	2	2	2

DS5015 PREDICTIVE ANALYTICS L T P C
3 0 2 4

OBJECTIVES:

- To introduce the concept of Analytics
- To learn data cleaning and processing
- To learn, how to develop models to predict categorical and continuous outcomes
- To apply cluster and principal components analysis to enhance supervised learning
- To apply time series forecasting on models

UNIT I INTRODUCTION TO ANALYTICS 9

Introduction to Analytics, Analytics in Decision Making, Predictive Analytics in the World – Exploring Structured and Unstructured Data - Complexities of data – Predictive analytics process

Suggested Activities:

- Flipped classroom on decision-making models.
- External learning – Data types and their relevance in predictive analytics

Suggested Evaluation Methods:

- Quiz and discussion on discussion models.
- Quiz on Data types

UNIT II WORKING WITH WORDS AND PIXELS 9

Working with Unstructured data – Working with Text – Extracting Features from textual data – Images – Cleaning Image Data – Thresholding – Dimensionality Reduction – Predictive models for text and Images

Suggested Activities:

- Flipped classroom on cleaning images.

- External learning – Unstructured data and its relevance in predictive analytics

Suggested Evaluation Methods:

- Quiz and discussion on textual features.
- Quiz on Image basics

UNIT III TIME SERIES DATA **9**

Additive & Multiplicative models, Exponential smoothing techniques, Forecasting Accuracy, Auto-regressive and moving average models, Arima, Measures of Forecast Accuracy.

Suggested Activities:

- Survey of uses of Times series.
- External learning – Formulation of problems in Forecasting

Suggested Evaluation Methods:

- Quiz on the identification of time series problems.
- Seminar on problem formulation in time series

UNIT IV Development and Evaluation of Predictive model **9**

Evaluation of models – Model Evaluation of regression and classification using metrics – Confusion matrix – ROC curves – Tuning of model performance - Model Validation - Automating Models for Categorical and Continuous targets, Comparing and Combining Models, Evaluation Charts for Model Comparison

Suggested Activities:

- Discussion of client/server architecture.
- External learning – Role of Tuning

Suggested Evaluation Methods:

- Quiz on ROC curve.
- Seminar on model performance.

UNIT V Model Deployment **9**

The architecture of a prediction service – Server/Client – Logistic regression service as a case study – Implementing a model with Dash - Iterating through A/B Testing – Deploying model as a web application

Suggested Activities:

- Discussion of web applications.
- External learning – Deploying models

Suggested Evaluation Methods:

- Quiz on wen applications
- Quiz on model deployment

PRACTICAL EXERCISES: **30**

1. Using Python programming to explore structured and unstructured data.
2. Write a Python program for share market prediction using time series
3. Write a Python program for text classification
4. Write a python program for image noise-cleaning

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5. Mini Project: Implementation of Logistic regression service

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

1. Understand the process of formulating data objectives, data selection/collection and preparation.
2. Apply the concepts of supervised and unsupervised in prediction.
3. Compare the underlying predictive modelling techniques.
4. To successfully design, build, evaluate and implement predictive models for a given application.
5. Know about the relevance of time series problems
6. Develop a classification application of predictive analytics in Python

REFERENCES:

1. Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl. Data Mining for Business Analytics: Concepts, Techniques and Applications in R
2. Alvaro Fuentes - Hands-On Predictive Analytics with Python: Master the complete predictive analytics process, from problem definition to model deployment, Packt Publishing, 2018.
3. Cristopher Bishop, “Pattern Recognition and Machine Learning”, First Edition, Springer, 2006.
4. T. Hastie, R. Tibshirani, J. Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008.
5. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, CRC Press, 2009.

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

DS5016 CONVERSATIONAL SYSTEMS

L	T	P	C
3	0	2	4

OBJECTIVES:

- Enable attendees to acquire knowledge on chatbots and its terminologies
- Work with ML Concepts and different algorithms to build custom ML Model
- Better understand on Conversational experiences and provide better customer experiences
- Know about the relevance of Chatbots
- Know about the conversational systems and Metrics

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UNIT I FUNDAMENTALS OF CONVERSATIONAL SYSTEMS 9

Introduction: Overview, Case studies, Explanation about different modes of engagement for a human being, History and impact of AI. Underlying technologies: Natural Language Processing, Artificial Intelligence and Machine Learning, NLG, Speech-To-Text, Text-To-Speech, Computer Vision etc. Introduction to Top players in Market – Google, MS, Amazon &Market trends. Messaging Platforms (Facebook, WhatsApp) and Smart speakers – Alexa, Google Home and other new channels. Ethical and Legal Considerations in AI Overview.

Suggested Activities:

- Understand the concepts of NLP.
- External learning – Understanding the types of roles of Chatbots.

Suggested Evaluation Methods:

- Group discussion on Chatbots.
- Quiz on NLP.

UNIT II FOUNDATIONAL BLOCKS FOR PROGRAMMING AND NATURAL LANGUAGE PROCESSING 9

Introduction: Brief history, Basic Concepts, Phases of NLP, Application of chat bots etc. General chatbot architecture, Basic concepts in chatbots: Intents, Entities, Utterances, Variables and Slots, Fulfillment. Lexical Knowledge Networks (WordNet, Verbnet, PropBank, etc). Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis, Semantic Analysis, Word Sense Disambiguation. Information Extraction, Sentiment Analysis.

Suggested Activities:

- Understand the concepts of Chatbot using flipped classroom.
- External learning – Understanding the roles of Sentiment analysis.

Suggested Evaluation Methods:

- Group discussion on application of Chatbots.
- Quiz on Sentiment analysis.

UNIT III BUILDING A CHAT BOT / CONVERSATIONAL AI SYSTEMS 9

Fundamentals of Conversational Systems (NLU, DM and NLG) - Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, Natural Language Generation. UX design, APIs and SDKs, Usage of Conversational Design Tools. Introduction to popular chatbot frameworks – Google Dialog flow, Microsoft Bot Framework, Amazon Lex, RASA Channels: Facebook Messenger, Google Home, Alexa, WhatsApp, Custom Apps. Overview of CE Testing techniques, A/B Testing, Introduction to Testing Frameworks - Botium /Mocha, Chai. Security & Compliance – Data Management, Storage, GDPR, PCI.

Suggested Activities:

- Understand the concepts of Chatbot framework using flipped classroom.
- External learning – Understanding the testing frameworks.

Suggested Evaluation Methods:

- Group discussion on conversational design tools.

- Quiz on Chatbot frameworks.

UNIT IV ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES AND CONTACT CENTERS 9

Brief Understanding on how Conversational Systems uses ML technologies in ASR, NLP, Advanced Dialog management, Language Translation, Emotion/Sentiment Analysis, Information extraction, Introduction to Contact centers – Impact & Terminologies. Case studies & Trends, How does a Virtual Agent/Assistant fit in here?

Suggested Activities:

- Understand the concepts of Chatbot dialog management using flipped classroom.
- External learning – Understanding the emotion/Sentiment analysis.

Suggested Evaluation Methods:

- Group discussion on Chatbot design.
- Quiz on Virtual agents/Assistants.

UNIT V CONVERSATIONAL ANALYTICS AND FUTURE 9

Conversation Analytics : The need of it - Introduction to Conversational Metrics - Summary, Robots and Sensory Applications overview - XR Technologies in Conversational Systems , XR-Commerce - Future technologies and market innovations overview.

Suggested Activities:

- Flipped classroom for conversational metrics.
- External learning – Understanding the technologies of Chatbots.

Suggested Evaluation Methods:

- Group discussion on Chatbot XR technologies.
- Quiz on conversational metrics

PRACTICAL EXERCISES: 30

1. A python program to identify morphological features of a word by analysing it.
2. A python program to generate word forms from root and suffif information.
3. A python program to do sentiment analysis for the given dataset and to classify sentences based on their categories.
4. A python program to know the importance of context and size of training corpus in learning Parts of Speech and understand the concept of chunking and get familiar with the basic chunk tag set.
5. A python program to build a Neural Network to recognize handwritten digits using MNIST dataset.
6. Project 1: Case Study to build a learning chatbot
7. Project 2: Case Study to build a ML Model using LSTM/any RNN and integrate with chatbot
8. Project 3: Building a user friendly Chatbot with many features.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Familiarize in the NLTK tool kit and the pre-processing techniques of natural language processing.
- Familiarize with the basic technologies required for building a conversational system.
- Build a Chabot for any application and deploy it
- Involve AI in building conversational system and build advanced systems that can be cognitively inclined towards human behaviour.
- Build a real time working conversational system for social domain that can intelligently process inputs and generate relevant replies.
- Implementation of a Chatbot

REFERENCES:

1. Michael McTear, "Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots", Second Edition, Moran and Claypool Publishers, 2020.
2. Cathy Pearl, "Designing Voice User Interfaces: Principles of Conversational Experiences", O'REILLY, 2016.
3. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2019.
4. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.

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CO6	2	1	1	2	2	1

DS5017 MOBILE APPS DESIGN DEVELOPMENT L T P C
3 0 2 4

OBJECTIVES:

- To understand the need and characteristics of mobile applications.
- To design the right user interface for mobile applications.
- To understand the design issues in the development of mobile applications.
- To understand the development procedures for mobile applications.
- To develop mobile applications using various tools and platforms.

UNIT I FUNDAMENTALS OF MOBILE APPLICATION DEVELOPEMET 9

Mobile applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Device Profiles – Frameworks and Tools. Generic UI development – Designing the right UI – Simple UI Design- Complex UI Design-Multimodal and Multichannel UI – Screen Elements and Layouts

Suggested Activities:

- Flipped classroom on survey on mobile application models.
- External learning - mobile application design using frameworks and tools.

Suggested Evaluation Methods:

- Quiz - questionnaire related to mobile application models.
- Assignment - evaluate the right UI using designing strategies.

UNIT II BACKEND INTEGRATION 9

Memory Management – Design Patterns for Limited Memory – Workflow for Application Development- Networking: API- nodejs - npm package- express js-REST services- Firebase: Firestore- push notification-Stream-Authentication, Native features, and plugins

Suggested Activities:

- Flipped classroom on discussion on memory constraints for mobile application design.
- External learning - survey on services, native features, and plugins for simple mobile applications.

Suggested Evaluation Methods:

- Quizzes on various API and its usage
- Practical – Programming assignments on REST services.

UNIT III APPLICATION DEVELOPMENT USING REACT NATIVE 9

Props and State management: JS/JXS - Component Lifecycle- Styling- Forms- Creating custom components-Navigation- React hooks- Data Management: Fetch-Axios- React Query-Apollo client- Packages -Authentication- Deployment

Suggested Activities:

- Simple customized form creation.
- Mobile application accessing the database to view the user data.

Suggested Evaluation Methods:

- Evaluation based on the demonstrated application functionality using emulators

UNIT IV APPLICATION DEVELOPMENT USING FLUTTER 9

Introduction to Dart- UI: Widgets- Assets, Data and Backend: Local-SQFLite-Remote- Network-dio-http- Firebase- Testing and Debugging- Native integration – Android- IOS- Deployment-Google play store-App store

Suggested Activities:

- Simple UI creation using Dart
- Mobile application accessing the database to view the user data.

Suggested Evaluation Methods:

- Evaluation based on the demonstrated application functionality using emulators

UNIT V CASE STUDY **9**

Communication via the Web – Notification and Alarms- – Location Based Services- E-com application- Management application: LMS, text to speech conversion, OCR

Suggested Activities:

- Application accessing Internet for communication like web application.
- Android application accessing GPS for location-based service.

Suggested Evaluation Methods:

- Evaluation based on the demonstrated application functionality using emulators

PRACTICAL EXERCISE: **30**

1. Develop an application that uses GUI components, Font and Colours.
2. Develop an application that uses Layout Managers and event listeners.
3. Develop a native calculator application.
4. Write a mobile application that creates an alarm clock.
5. Develop an application that makes use of databases.
6. Write an application that makes use of the internet for communication (mobile web app).
7. Develop a native application that uses GPS location information.
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message.
10. Develop a complete E-Commerce mobile application

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Understand the need and characteristic of application development.
2. Choose the right UI that can match the application.
3. Solve the design issues at the time of server connection.
4. Understand the development procedure in various frameworks.
5. Understand and develop native mobile applications.
6. Understand the industrial need and develop mobile applications for various platforms.

REFERENCES:

1. Reto Meier, “Professional Android 4 Application Development”, Wiley, 2012.
2. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, “Programming Android”, O’Reilly, 2011.
3. Alasdair Allan, “iPhone Programming”, O’Reilly, 2010.
4. APIprogramming:http://www.stepin-solutions.com/blog/api-programming-backbone-of-mobile-app-development/
5. https://blog.logrocket.com/using-axios-react-native-manage-api-requests/
6. https://reactnative.dev/docs/network
7. Flutter a complete tutorial: https://youtu.be/VPvVD8t02U8
8. Building a mobile application using Flutter: https://youtu.be/x0uinJvhNxI
9. Flutter an overview: https://youtu.be/9XMt2hChbRo
10. A complete mobile application development using Flutter: https://github.com/Jahidul007/Flutter_Roadmap

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

DS5018 **RECOMMENDER SYSTEMS** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

UNIT I INTRODUCTION **9**

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized **Recommender Systems - O**verview of data mining methods for recommender systems- similarity measures, classification, clustering, SVMs, dimensionality reduction - Overview of convex and linear optimization principles

Suggested Activities:

- Install python and explore the packages required for machine learning including NumPy, Pandas, scikit-learn, and matplotlib.
- Practical learning – Implement Data similarity measures.

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT II CONTENT-BASED RECOMMENDATION SYSTEMS **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, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.

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- Quiz of content-based filtering

UNIT III COLLABORATIVE FILTERING 9

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, and comparison, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection – Attacks on collaborative recommender systems.

Suggested Activities:

- Practical learning – Implement collaborative filtering concepts
- Assignment of security aspects of recommender systems

Suggested Evaluation Methods:

- Quiz on collaborative filtering
- Seminar on security measures of recommender systems

UNIT IV ADVANCED TOPICS 9

Network aspects of content Recommender Systems - Recommender systems for video content distribution - Implications of recommender systems in 5G wireless networks - Recommender Systems for optimizing wireless network performance. Case studies (i) Joint content recommendations and content caching in small cell wireless networks (ii) The interplay of Recommender Systems and User access point association.

Suggested Activities:

- Group Discussion on network aspects of recommender systems
- Study of impact of recommender systems in wireless networks

Suggested Evaluation Methods:

- Quiz on network aspects of recommender systems
- Seminar on selective case studies

UNIT V APPLICATIONS OF RECOMMENDER SYSTEMS 9

Recommender Systems for content media, social media and communities Music and video Recommender Systems. Datasets. Group recommender systems. Social recommendations. Recommending friends: link prediction models. Similarities and differences of Recommender Systems with task assignment in mobile crowd sensing, social network diffusion awareness in Recommender Systems.

Suggested Activities:

- Group Discussion on social network aspects of recommender systems
- Study of group recommendation systems

Suggested Evaluation Methods:

- Quiz on recommender systems applications
- Seminar on social recommendations

PRACTICAL EXERCISES **30 HOURS**

1. Implement Data similarity measures using Python
2. Implement SVM classifier for text documents
3. Implement dimension reduction techniques for recommender systems
4. Implement content-based recommendation systems
5. Implement collaborative filter techniques

OUTCOMES:

On completion of the course, the students will be able to:

1. Understand the basic concepts of recommender systems.
2. Implement machine-learning and data-mining algorithms in recommender systems data sets.
3. Implementation of Collaborative Filtering in Carry out performance evaluation of recommender systems based on various metrics.
4. Design and implement a simple recommender system.
5. Learn about advanced topics of recommender systems.
6. Learn about advanced topics of recommender systems applications

REFERENCES:

1. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Systems Handbook, Springer (2011), 1st ed.
3. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd Edition, Cambridge University Press, 2020.

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

IF5004 CRYPTOGRAPHY AND INFORMATION SECURITY

L	T	P	C
3	0	2	4

OBJECTIVES:

- To understand the mathematics behind Cryptography.
- To understand the standard algorithms used to provide confidentiality, Integrity, and authenticity.
- To understand Cryptographic theories and Systems.
- To get a working knowledge of layer wise security to build secure systems.

- To understand necessary approaches and techniques to build protection mechanisms to secure computer networks

UNIT I INTRODUCTION TO SECURITY AND MATHEMATICAL FOUNDATIONS 9

Introduction to Security –Security Triad- Mathematics of Security: Number theory – Modular Arithmetic – Extended Euclidean Theorem – Algebraic structures – Galois field – Primality test – Fermat and Euler's theorem – Legendre and Jacobi symbols – Chinese Remainder theorem – Discrete Logarithms – Elliptic Curves – Security Models: Bell La Padula, Biba Integrity Model, Chinese Wall Model

Suggested Activities:

- External learning – Evolution of computer systems, identification of benchmarks.
- Demonstration on Cryptool.

Suggested Evaluation Methods:

- Assignment problems on first three activities.
- Quiz on external learning.
- Group discussion on tool demonstration

UNIT II SYMMETRIC CRYPTOGRAPHY 9

Symmetric and Asymmetric cipher – Block and Stream Cipher – Feistel Ciphers – Non Feistel Ciphers – Data Encryption Standard – Linear and Differential cryptanalysis – Triple DES – Advanced Encryption Standard (AES) – RC4.

Suggested Activities:

- External learning – Attacks on DES and AES and Crptanalysis.
- Practical – Study of a various attacks related to symmetric key encryption.

Suggested Evaluation Methods:

- Assignment on problems on cryptographic algorithms.
- Quiz on DES and AES attacks.

UNIT III ASYMMETRIC KEY CRYPTOGRAPHY 9

Asymmetric Key Cryptography – RSA – El Gamal Public Key Cryptosystems – Diffie-Hellman Key Exchange – Elliptic Curve Cryptosystem- Hash Functions – Hash Algorithms-SHA256 – Message Authentication Codes – MD5 - Authentication protocols – Digital Signatures

Suggested Activities:

- External learning – Familiarizing with public and private key in asymmetric cryptography.
- Practical – Verify the message integrity using hashing techniques.

Suggested Evaluation Methods:

- Tutorial – ECC.
- Quiz on various hashing and authentication techniques

UNIT IV NETWORK SECURITY 9

Authentication applications – Kerberos – PKI – Digital Certificates: X.509 – Electronic Mail security – PGP-IP Security – Web Security – Transport layer Security: SSL, SET – Wireless

LAN Security – Configuration of WLAN Security – Security Administration – ISO and GLBA Standards– Access Control Models – ACL.- Malwares

Suggested Activities:

- Understand the components of x.509 certificate.
- Demonstration of email security.
- Practical – Experiment with SSL in web server.
- External learning – Understanding how the existing firewalls work and their usages.

Suggested Evaluation Methods:

- Group discussion on demonstration.
- Quiz on layer-wise security protocols

UNIT V SYSTEM SECURITY 9

Penetration testing – Vulnerability Assessment tools – OWASP Top Ten Vulnerabilities- Trusted Operating systems – Data Assurance –Database security – Multilevel databases – Multi–level security – Cloud Security – Ethical Hacking – Crypto Currency – Introduction to Blockchain

Suggested Activities:

- External learning – Designing trusted OS.
- Case study – Applications that use Blockchain technology.

Suggested Evaluation Methods:

- Group Discussion – various applications that use Block chain technology.
- Group discussion – The need for Ethical Hacking.

PRACTICAL EXERCISES: 30

1. Write a program to perform encryption and decryption using the following algorithms.
    1. Caesar cipher, Affine Cipher.
    2. Hill Cipher, Playfair Cipher.
    3. Transposition Cipher.
2. Perform Cryptographic attack on the ciphertext generated using any of the algorithm implemented in exercise 1.
3. Implementation of symmetric cryptographic algorithms such as DES, AES, etc.
4. Implementation of RSA algorithm and demonstration of the key generation and encryption process.
5. Generation of Keys between two end parties using Diffie Hellman Key Exchange.
6. Write a program to generate message digest for the given message using the SHA/MD5 algorithm and verify the integrity of message.
7. Write a program to sign and verify a document using DSA algorithm.
8. Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools in kali Linux.
9. Hands–on with Software and Hardware firewall configuration and intrusion detection using SNORT
10. Configuring and utilizing network protection components like VPNs, anti–virus software, anti–spyware, etc.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Understand the mathematical background required for Information Security and the Security Models.
- Know about the Symmetric Cryptographic protocols and to analyze them.
- Know about the Public Key Cryptographic protocols, and Key Sharing.
- Apply the various Authentication schemes and to simulate different network security applications.
- Understand various Security practices, System security standards, and state of art technologies like Ethical Hacking, Block chain.
- Design and develop a secure environment for any computing application

REFERENCES:

1. William Stallings, “Cryptography and Network security Principles and Practices”, Pearson Education/PHI, Seventh Edition, 2017.
2. Behourz Forouzan, Debdeep Mukhopadyay, “Cryptography & Network Security” Tata MCGraw-Hill Education, Third Edition, 2015
3. Charles P. Pfleeger, Shari L. Pfleeger, “Security in Computing”, Fifth Edition, PHI/Pearson Education, 2018.
4. Wenbo Mao, “Modern Cryptography Theory and Practice”, Pearson Education, 2008.

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

IF5006 SOFT COMPUTING AND ITS APPLICATIONS

L	T	P	C
3	0	2	4

OBJECTIVES:

- To learn fuzzy logic, fuzzification and defuzzification.
- To design a soft computing system required to address a computational task.
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems.
- To familiarize with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.
- To understand the hybrid system to revise the principles of soft computing in various applications

UNIT I FUZZY COMPUTING 9

Basic Concepts of Fuzzy Logic – Fuzzy Sets and Crisp Sets – Fuzzy Set Theory and Operations – Properties of Fuzzy Sets – Fuzzy and Crisp Relations – Fuzzy to Crisp Conversion – Membership Functions – Interference in Fuzzy Logic – Fuzzy IF-Then Rules – Fuzzy Implications and Fuzzy Algorithms – Fuzzification and Defuzzification – Fuzzy Controller – Industrial Applications

Suggested Activities:

- Practical – Install MATLAB Fuzzy Logic toolbox and ANN toolbox to design and simulate systems.

Suggested Evaluation Methods:

- Quiz on basic concepts of fuzzy logic and operations

UNIT II FUNDAMENTALS OF NEURAL NETWORKS 9

Neuron – Nerve Structure and Synapse – Artificial Neuron and its Model – Activation Functions – Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks – Recurrent Networks – Various Learning Techniques: Perception and Convergence Rule – Back Propagation Learning Methods – Auto-Associative and Hetero-Associative Memory.

Suggested Activities:

- Practical – Develop a supervised model to train neural net that uses the AND/OR/XOR two input binary/bipolar input and output data and learn linear models to understand the importance of initialization parameters

Suggested Evaluation Methods:

- Evaluation of the practical implementation with appropriate input set.

UNIT III COMPETETIVE NEURAL NETWORKS 9

Kohenen's Self Organizing Map–SOM Architecture – Learning procedure – Application – Learning Vector Quantization – Learning by LVQ – Adaptive Resonance Theory – Learning procedure – Applications

Suggested Activities:

- Practical – Develop an unsupervised model to train neural net that uses any dataset and plot the cluster of patterns.

Suggested Evaluation Methods:

- Evaluation of the practical implementation with appropriate input set.

UNIT IV GENETIC ALGORITHM 9

Basic Concepts – Working Principle – Procedures of GA – Flow Chart of GA – Genetic Representations – Initialization and Selection – Genetic Operators – Mutation – Generational Cycle –Applications – Multi-objective optimization problems – Multi-Objective Evolutionary Algorithm – Non-Pareto approaches to solve MOOPs – Pareto-based approaches to solve MOOPs – Some applications with MOEAs.

Suggested Activities:

- Practical – Implement GA for the Travelling Salesman problem to find the shortest path that visits all cities in a set exactly once.

Suggested Evaluation Methods:

- Implementation evaluation by testing the code on different route maps and checking the optimal solution.

UNIT V HYBRID SYSTEMS 9

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Integration of neural networks – fuzzy logic and genetic algorithms.

Suggested Activities:

- Practical – Develop adaptive neuro-fuzzy hybrid technique to train NAND gate with two binary and targets and observe the training performance.

Suggested Evaluation Methods:

- Group discussion on developing a hybrid system for solving a problem.
- Evaluation of the practical implementation

PRACTICAL EXERCISES: 30

1. Develop an application that fraud detection systems from data using fuzzy logic.
2. Develop a system to implement Neural Networks techniques to define predictive models for fraud detection.
3. Develop a system that can optimize the solution of the fraud detection system developed by fuzzy logic.
4. Implement Pareto-based approaches to solve MOOPs.
5. Develop a hybrid system by integrating neural networks, fuzzy logic and genetic algorithms for any real time application.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Identify and describe soft computing techniques and their roles in building intelligent machines.
- Recognize the feasibility of applying a soft computing methodology for a particular problem.
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
- Apply genetic algorithms to optimization problems.
- Design neural networks to pattern classification and regression problems using soft computing approach.
- Describe the importance of tolerance of imprecision and uncertainty to a design of robust and low-cost intelligent machines.

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1. S. Rajasekaran, G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Neural Networks, Fuzzy Systems and Evolutionary Algorithms : Synthesis and Applications, Prentice Hall, Second Edition, 2010, 2017
2. J. S. R. Jang, C. T. Sun, E. Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education, 2004.
3. S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, Second Edition, Wiley, 2007.
4. Siman Haykin, “Neural Networks”, Prentice Hall, 1999.
5. Timothy Ross, “Fuzzy Logic with Engineering Applications”, Wiley, 2016.
6. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson Education, 2008.
7. Frank Neumann, Carsten Witt, “Bioinspired Computation in Combinational Optimization – Algorithm and their Optimization Complexity”, Natural Computing Series, Springer, 2010.

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CO5	3	3	3	3	3	-
CO6	3	3	3	3	3	3

IF5008 **TEXT MINING** **L T P C**

3 0 2 4

OBJECTIVES:

- To understand the basic issues and needs of text mining.
- To appreciate the different aspects of text categorization and clustering.
- To understand the role played by text mining in Information retrieval and extraction.
- To appreciate the use of probabilistic models and its principles applicable in text mining.
- To appreciate the current trends in text mining on various systems.

UNIT I INTRODUCTION **9**

Overview of Text Mining – Definition – General Architecture – Algorithms – Core Operations – Preprocessing – Types of Problems – Basics of Document Classification – Information Retrieval – Clustering and Organizing Documents – Information extraction – Prediction and Evaluation – Textual Information to Numerical Vectors – Collecting Documents – Document Standardization – Tokenization – Lemmatization Vector Generation for Prediction – Sentence Boundary Determination – Evaluation Performance.

Suggested Activities:

- Develop a web application for search engine.
- Tokenize the given text information using any parser.
- Practical – Implement all the preprocessing steps needed for text mining.

Suggested Evaluation Methods:

- Practical assessment may be conducted in laboratory environment to implement any preprocessing steps.

UNIT II TEXT CATEGORIZATION AND CLUSTERING 9

Text Categorization – Definition – Document Representation – Feature Selection – Decision Tree Classifiers – Rule-based Classifiers – Probabilistic and Naive Bayes Classifiers – Linear Classifiers Classification of Linked and Web Data – Meta-Algorithms – Clustering – Definition – Vector Space Models – Distance Based Algorithms – Word and Phrase-Based Clustering – Semi-Supervised Clustering – Transfer Learning.

Suggested Activities:

- Role playing to be carried out for groups of students for the understanding of the working principles of clustering and classification.

Suggested Evaluation Methods:

- Assignment on analyzing the performance of different clustering and classification algorithms and showing the best performance of each algorithm for any specific application.

UNIT III TEXT MINING FOR INFORMATION RETRIEVAL AND INFORMATION EXTRACTION 10

Information Retrieval And Text Mining – Keyword Search – Nearest Neighbor Methods – Similarity – Web Based Document Search – Matching – Inverted Lists – Evaluation – Information Extraction – Architecture – Co-Reference – Named Entity and Relation Extraction – Inductive – Unsupervised Algorithms for Information Extraction – Text Summarization Techniques – Topic Representation – Influence of Context – Indicator Representations – Pattern Extraction – Apriori Algorithm – FP Tree Algorithm.

Suggested Activities:

- In class activity – Name entity and relation extraction using role play game.
- In class activity – Show the working principle of searching technique.

Suggested Evaluation Methods:

- Assignment on developing Flash or animated presentation for explaining the working principles of any one algorithm for information retrieval and extraction.

UNIT IV PROBABILISTIC MODELS 9

Probabilistic Models for Text Mining – Mifture Models – Stochastic Processes in Bayesian Nonparametric Models – Graphical Models –Relationship Between Clustering – Dimension Reduction and Topic Modeling – Latent Semantic Indexing – Latent Dirichlet Allocation– Interpretation and Evaluation – Probabilistic Document Clustering and Topic Models – Probabilistic Models for Information Extraction – Hidden Markov Models – Conditional

Random Fields.

Suggested Activities:

- In-class activity – Document clustering and Information Extraction.
- External learning – Markov models and entropy models.

Suggested Evaluation Methods:

- Tutorials – Topic modeling to show its behavior on different data types

UNIT V RECENT TRENDS 9

Visualization Approaches – Architectural Considerations – Visualization Techniques in Link Analysis – Example – Mining Text Streams – Text Mining in Multimedia – Text Analytics in Social Media – Opinion Mining and Sentiment Analysis – Document Sentiment Classification – Aspect – Based Sentiment Analysis – Opinion Spam Detection – Text Mining Applications and Case studies.

Suggested Activities:

- In-class activity – Visualization Approaches.
- External learning – Understanding text mining applications and case studies.

Suggested Evaluation Methods:

- Assignment on extracting the sentiment expressed in the given sentence using opinion word.
- Tutorials – Methodologies available to detect the spam in opinion mining.

PRACTICAL EXERCISES: 30

1. Study Natural Language toolkit (NLTK) and explore the features within that.
2. Study experiment for implement simple text processing operations like character count, word count, stop word removal, etc.,
3. Write a Java program for parsing and tokenizing the given text using NLTK.
4. Write a Java program to implement the named entity recognition and part of speech tagging.
5. Write a Java program to extract the specific pattern for gene – gene and protein – protein interaction information
6. Install RapidMiner and Vega tools and explore the features.
7. Classify any given data set using two classification algorithms using RapidMiner.
8. Clustering the given data set using two clustering algorithms using RapidMiner.
9. Classify any given data set using two classification algorithms using Vega Tool.
10. Clustering the given data set using two clustering algorithms using Vega Tool

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Identify the different features that can be mined from text and web documents.
- Use available open-source classification and clustering tools on some standard text data sets.
- Modify existing classification/clustering algorithms in terms of functionality or features used.

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- Design a system that uses text mining to improve the functions of an existing open-source search engine.
- Implement a text mining system that can be used for an application of your choice.
- Use the opinion mining concepts to extract the sentiment from the large database.

REFERENCES:

1. S. M. Weiss, N. Indurkhya, T. Zhang, F. Damerau, “Text Mining: Predictive Methods for Analyzing Unstructured Information”, Springer, 2005.
2. Ronen Feldman, James Sanger, “The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data”, Cambridge University Press, 2009.
3. Michael Berry, “Survey of Text Mining: Clustering, Classification and Retrieval”, Springer, 2004.
4. Hercules Antonio do Prado, Edilson Ferneda, “Emerging Technologies of Text Mining: Techniques and Applications”, Information Science Reference (IGI), 2008.
5. Charu C. Aggarwal, Cheng Xiang Zhai, “Mining Text Data”, Springer, 2012.

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

IF5015 BLOCKCHAIN TECHNOLOGIES

L	T	P	C
3	0	2	4

OBJECTIVES:

- To decompose a blockchain system’s fundamental components, how they fit together and examine a decentralization using blockchain.
- To explain how Cryptocurrency works, from when a transaction is created to when it is considered part of the blockchain.
- To explain the components of Ethereum and Programming Languages for Ethereum.
- To study the basics Hyperledger and Web3.
- To provide a detail of alternative blockchain and blockchain projects in different perspective.

UNIT I INTRODUCTION TO BLOCKCHAIN 9

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

Suggested Activities:

- External learning - programming to create your own blockchain.
- Flipped classroom on studying blockchain security issues.

Suggested Evaluation Methods:

- Practical assessment to be conducted to evaluate the program for creating blockchain.

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin Limitations – Name Coin – Prime Coin – Zcash – Smart Contracts – Ricardian Contracts

Suggested Activities:

- External learning - creating the Wallets.
- Flipped classroom on showing the tracking process of transaction in Cryptocurrency.

Suggested Evaluation Methods:

- Assignment to be given on Cryptocurrency failures.

UNIT III ETHEREUM 9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

Suggested Activities:

- External learning - For exploring Ethereum tools like Ganache and GO.
- Implement Ethereum development environment.

Suggested Evaluation Methods:

- Practical assessment on developing smart contract on private Blockchain.

UNIT IV WEB3 AND HYPERLEDGER 9

Introduction to Web3 – Contract Deployment – POST Requests – Development frameworks – Hyperledger as a protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

Suggested Activities:

- Creating and deploying a business network on Hyperledger Composer Playground.
- Implementing Business Network in Blockchain using HyperLedger Fabric.

Suggested Evaluation Methods:

- Practical assessment on developing business network on Hyperledger Fabric.

UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple- Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous tools.

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Suggested Activities:

- External learning - blockchain using Multichain.
- Study about blockchain frameworks and business applications

Suggested Evaluation Methods:

- Practical assessment on developing blockchain using Multichain for banking system.

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. Perform bitcoin transactions using Python - bitcoinlib.
4. Develop the environment for Ethereum by using Ganache.
5. Create the nodes on Ethereum blockchain and mine the blockchain.
6. Learn Solidity programming language and develop simple Ethereum based applications.
7. Build the decentralized app and deploy it to provide Ethereum environment.
8. Build a simple application using hyperledger in blockchain environment.
9. Design a smart contract and test it in a Ethereum environment.
10. Develop a block chain-based applications which is suitable for your online shopping services.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Understand the technology components of Blockchain and how it works behind-the scenes.
- Aware of different approaches to developing decentralized applications.
- Understand the Bitcoin and its limitations by comparing with other alternative coins.
- Establish deep understanding of the Ethereum model, its consensus model, code execution.
- Understand the architectural components of a Hyperledger and its development framework.
- Come to 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.

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.

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

IF5017 ADVANCED DATABASE SYSTEMS

L	T	P	C
3	0	2	4

OBJECTIVES:

- To study the working principles of distributed databases.
- To have an introductory knowledge about the query processing in Object-based databases and its usage.
- To understand the basics of Spatial, temporal and Mobile Databases and their applications.
- To learn emerging databases such as XML, Data warehouse and NoSQL.

UNIT I DISTRIBUTED DATABASES **9**

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

Suggested Activities:

- Practical - Design of distributed database with fragmentation using any DBMS.
- Flipped classroom on distributed transaction protocols.
- Practical - Writing distributed queries and optimizing the queries.

Suggested Evaluation Methods:

- Evaluation of practical implementation.
- Quizzes on distributed transaction protocols.
- Tutorial - Distributed queries and optimization.

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 – Advanced MongoDB Features – Cassandra: Data Model – Key Space – Table Operations – CURD Operations – CQL Types – HIVE : Data types – Database Operations – Partitioning – HiveQL – OrientDB Graph database: OrientDB Features

Suggested Activities:

- Practical - Exploring MongoDB using JAVA/Python/Ruby/PHP.
- Practical - Perform database operations using MongoDB/Cassandra/HYPE.
- Practical - Scenario based query development for database applications

Suggested Evaluation Methods:

- Evaluation of the database operations.
- Tutorial - Scenarios to analyze the need for DB in various applications.
- Quizzes on MongoDB basics.

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.

Suggested Activities:

- Individual/group activities for application specific data handling.
- Discussion about advantages and drawbacks of transaction models for different applications involving spatial-temporal data.

Suggested Evaluation Methods:

- Assignment on application specific data handling.
- Quizzes on different transaction models

UNIT IV XML AND DATAWAREHOUSE 9

XML Database: XML – XML Schema – XML DOM and SAX Parsers – XSL – XSLT – XPath and XQuery – Data Warehouse: Introduction –Multidimensional Data Modeling – Star and Snowflake Schema – Architecture – OLAP Operations and Queries

Suggested Activities:

- Flipped classroom on demonstrate the operations on XML data and data warehouse.
- Practical - Use tools to solve data access scenarios

Suggested Evaluation Methods:

- Quizzes on XML data and basics of data warehouse.
- Project demonstration on practical implementation

UNIT V INFORMATION RETRIEVAL AND WEB SEARCH 9

IR concepts –Retrieval models – Queries in IR system – Text Preprocessing – Inverted indexing – evaluation measures – web search and analytics – current trends.

Suggested Activities:

- Flipped classroom on basics of IR concepts.
- Practical - Evaluation measures of IR.

Suggested Evaluation Methods:

- Quizzes on basic IR concepts.
- Demonstration for practical learning.

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 data warehouse and perform OLAP operations in an unstructured data environment.
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 an XML document, traverse the document using DOM and SAX parser.
9. Design a web crawler to extract the information from the websites containing product reviews and classify the reviews as either positive or negative.
10. Create an information retrieval system which processes the corpus of documents and create TF/IDF for the keywords extracted from the documents. Create an inverted index to enable an efficient retrieval process.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Design a distributed database system and execute distributed queries.
- Use NoSQL database systems and manipulate the data associated with it.
- Have knowledge on advanced database system concepts.
- Design a data warehouse system and apply OLAP operations.
- Design XML database systems and validating with XML schema.
- Have knowledge on information retrieval concepts and apply it in web databases

REFERENCES:

1. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sifth 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. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques”, Third Edition, Morgan Kaufmann, 2012.
5. Brad Dayley, “Teach Yourself NoSQL with MongoDB in 24 Hours”, Sams, 2014.
6. Shashank Tiwari, “Professional NoSQL”, O’Reilly Media, 2011.
7. Vijay Kumar, “Mobile Database Systems”, John Wiley, 2006.

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

IF5074 BUILDING INTERNET OF THINGS

L	T	P	C
3	0	2	4

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To build a small low-cost embedded system using Arduino / Raspberry Pi or equivalent boards.
- To learn communication protocols that is frequently used in IoT ecosystems.
- To explore the ways of processing enormous amount of data generated in IoT based systems.
- To understand the role of cloud computing in IoT and to become familiar with various cloud offerings.

UNIT I ENABLING TECHNOLOGIES AND REFERENCE MODELS 9

Sensors and Actuators – Centralized Sensing vs Distributed Sensing – Making Physical Objects as Smart Objects – Enabling Technologies – Wireless Sensor Networks, Cloud Computing and Data Analytics – IoT Vs M2M – Possible IoT Reference Models – Domain Specific IoTs – Levels of IoT Based Systems.

Suggested Activities:

- Flipped classroom on enabling technologies.
- External learning – Exploring proprietary protocols used in IoT and M2M.
- Analyzing the required level of design for different IoT based ecosystems.

Suggested Evaluation Methods:

- Quiz and discussion on enabling technologies (WSN, Cloud and Big Data).
- Assignments on proprietary protocols used in IoT and M2M.
- Deciding the level and designing the IoT framework for case studies.

UNIT II DESIGN OF END DEVICES 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

Suggested Activities:

- Flipped classroom on open-source movement in hardware and SDLC for embedded systems.
- Explore the variants of Arduino Boards, Atmel Microcontrollers, Cypress Pioneer and NXP Freedom.
- Learning to write Arduino Sketches and Python Programs.

Suggested Evaluation Methods:

- Quiz and discussion on open-source movement in hardware and SDLC for embedded systems.
- Assignments on Arduino boards, Atmel Microcontrollers, Cypress Pioneer and NXP Freedom.
- Practical – Developing Arduino Scripts and Python Programs.

UNIT III IoT PROTOCOLS 9

MAC Layer Protocols – IEEE 802.15.4 – G And E Variants of IEEE 802.15.4 – IEEE 802.11ah – IEEE 1901.2a – LoRaWAN – 6LoWPAN – From 6LoWPAN to 6Lo – NBIoT – REST Based Protocols – SCADA, CoAP and MQTT

Suggested Activities:

- External learning – Explore various software tools that support Coap and MQTT.
- Flipped classroom on role of Ipv6 in designing IoT based systems.
- Analyze Cisco Reference Model and IBM Reference Models

Suggested Evaluation Methods:

- Assignments on software tools that support Coap and MQTT.
- Quiz and discussion on role of Ipv6 inIoT based systems.
- Assignments on the IoT policy of Meity (Government of India).

UNIT IV DATA ANALYTICS 9

Structured vs. Unstructured Data – Data in Motion vs. Transit – Machine Learning Overview – Big Data Tools and Technologies –IoT Analytics for Cloud - Azure/ThingWorx - Visualization - Tableau overview - Geospatial Analytics - IoT Analytics platform - ThingSpeak – Providing Multiservice in IoT using FNF Components.

Suggested Activities:

- External learning – Exploring popular machine learning algorithms (both supervised and unsupervised).
- Flipped classroom on MapReduce programming.
- Learning dataflow programming using open-source software library.

Suggested Evaluation Methods:

- Assignments on supervised, unsupervised and reinforcement algorithms.
- Quiz and discussion on MapReduce programming.
- Group discussion on IoT based Tools libraries and software.

UNIT V CLOUD OFFERINGS 9

Cloud Storage Models and Communication API – WAMP AutoBahn – Xively Cloud – Python Web Application Framework – Django–IBM Watson – AWS for IoT – Case Studies – Smart Home, Smart Cities, Smart Agriculture and Weather Monitoring Systems

Suggested Activities:

- Flipped classroom on cloud models and type of clouds.
- External learning – Django framework

Suggested Evaluation Methods:

- Quiz and discussion on cloud models and types of clouds.
- Developing web apps for IoT ecosystems using Django framework

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, 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. Implement a map reduce program that produces a weather data set.
9. Implement an application that stores big data in Hbase/Mongo DB using Hadoop/R.
10. Use Google Collaboration Tools: Create Google Docs, Sheets, and Slides and share it with others.
11. Miniproject.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Understand the enabling technologies and reference models of IoT.
- Design portable IoT devices using Arduino IDE/ Raspberry Pi with Python.
- Apply appropriate protocols in various parts of IoT based systems.
- Understand Big Data tools and technologies and apply them in IoT based systems.
- Design and deploy IoT based systems and connect them to cloud offerings.
- Design IoT systems for various real time applications.

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. Analytics for Internet of Things- Andrew Minteer-Packt Publication Mumbai 2017.

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

IF5078 DISTRIBUTED AND CLOUD COMPUTING L T P C
3 0 2 4

OBJECTIVES:

- To learn distributed Systems and communication.
- To understand distributed resource management.
- To study the basics of cloud computing.
- To study about virtualization and cloud resource management.

UNIT I INTRODUCTION TO DISTRIBUTED SYSTEM AND COMMUNICATION 8

Introduction to Distributed Systems – Characteristics – Issues in Distributed Systems – Distributed Architectural Models – Communication Primitives – Remote Procedure Call – Physical Clock Synchronization – Logical Clocks, Vector Clocks and Causal Ordering – Multicast Ordering

Suggested Activities:

- Practical – Implement clock synchronization in distributed system using Lamport’s algorithm.
- Practical – Create and distribute a Torrent file to share a file in LAN environment.

Suggested Evaluation Methods:

- Demonstration and assessment of the working of the implemented algorithm.

UNIT II DISTRIBUTED RESOURCE MANAGEMENT 10

Distributed Mutual Exclusion Algorithm – Distributed Deadlock Detection Algorithms– Election Algorithm – Distributed File System – Design Issues – Distributed Shared Memory – Global States and Snapshot – Check Point and Recovery – Two Phase Protocol – Non Blocking Commit Protocol.

Suggested Activities:

- Practical – Implement Election Algorithm.
- Practical – Implement any one deadlock detection Algorithm.

Suggested Evaluation Methods:

- Demonstration and assessment of the working of the implemented algorithm.

UNIT III CLOUD COMPUTING, ARCHITECTURE MODELS AND SERVICES 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning – NIST Cloud Computing Reference Architecture– Architectural Design Challenges – Deployment Models: Public, Private and Hybrid Clouds – Service Models: IaaS – PaaS – SaaS – Benefits of Cloud Computing.

Suggested Activities:

- Practical – Use Google Collaboration Tools: Create Google Docs, Sheets, and Slides and share it with others.
- Practical – Explore public cloud services including Amazon, Google, Sales force, and Digital Ocean etc.

Suggested Evaluation Methods:

- Quizzes on different service models and deployment models.
- Report submission – Comparison of various services provided by different Cloud Service Provider (Configuration of VM, Cost, Network Bandwidth etc).

UNIT IV CLOUD ENABLING TECHNOLOGIES 10

Service Oriented Architecture – SOAP – RESTful Web Services – Basics of Virtualization – Types of Virtualizations –Full and Para Virtualization– Implementation Levels of Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization – Server Virtualization –Network and Storage Virtualization – Containers.

Suggested Activities:

- Create a simple web service using Python Flask /Java /any language [Web Service: Client-server model should be implemented using socket/http].
- Install Oracle Virtual Box/Vmware Workstation and Create a blackboard application [Hint: One VM should act as a master and other VMs acts as a listeners, when any content is written by the master VM, the content should be displayed in all the Listener VMs].

Suggested Evaluation Methods:

- Review of the Web Service Implementation: Proper Connection should be established between the client and server to make use of the service offered by the Server.
- Assessment of the workings of installed Virtualization Tools.

- Review the workings of application in virtual environment [Implemented using basic echo and chat concepts].

UNIT V CLOUD MANAGEMENT, SECURITY AND COMPUTING PLATFORMS **8**

Resource Provisioning – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Virtual Machine Security – Application and Data Security Cloud Storage – HDFS – Map Reduce – Google App Engine(GAE) – Programming Environment for GAE – Architecture of GFS – Cloud Software Environments – Openstack, Heroku, Docker, Case Studies: Amazon EC2, AWS, Microsoft Azure, Google Compute Engine.

Suggested Activities:

- Practical – Use security tools like ACUNETIF, ETTERCAP to scan web applications on the cloud, cloud networks for finding vulnerabilities, verifying leakage of information to an unauthorized third party.
- Practical – Install and configure OpenStack all– in– one using Devstack/Packstack and Launch VMs in OpenStack through dashboard:

Suggested Evaluation Methods:

- Report Submission – A detailed report describing vulnerabilities along with the suitable action that can be taken to remedy the loopholes.
- Evaluation of the practical: OpenStack Dashboard should be accessed through web browser and the working of the instances must be verified by logging in to it/pinging the instance.

PRACTICAL EXERCISES: **30**

1. Connect a minimum of 3 nodes and implement a group chat amongst them.
2. Implement any one of the message ordering algorithms on the previously implemented system.
3. Implement an election algorithm to elect a co– ordinator for the system.
4. Perform clock synchronization on the system, with the co– ordinator node's time as reference.Create a VM image which has a C compiler along with an operating system and do the following experiments
5. a.Fibonacci Series. b. File Operations.
6. Install Virtualbox with different flavours of linux or windows OS on top of windows7 or 8.
7. Install Google App Engine/Heroku and run a simple webapp using python/java.
8. Install and run Openstack using Packstack/Devstack
9. Create two VMs in Openstack and exchange data.
10. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim.
11. Install hadoop and manipulate a large dataset and run on Hadoop

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Understand the Distributed Computing concepts and appreciate distributed communication
- Describe and implement various distributed resource management techniques and algorithms.
- Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of the cloud.
- Explain the core issues of cloud computing such as resource management and security.
- Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

REFERENCES:

1. Andrew S. Tanenbaum, Maarten Van Steen, “Distributed Systems – Principles and Paradigms”, Second Edition, Pearson Education, 2006.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann, 2012.
3. Barrie Sosinky, “Cloud Computing bible”, Wiley, 2010.
4. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, John Wiley, 2011.
5. Mukesh Singhal, “Advanced Concepts in Operating Systems”, McGraw-Hill Series in Computer Science, 1994.
6. John W. Rittinghouse, James F. Ransome, “Cloud Computing: Implementation Management, and Security”, CRC Press, 2010.

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CO3	3	3	3	1	3	-
CO4	2	2	1	1	1	-
CO5	3	3	3	3	3	-
CO6	3	3	3	3	3	2

IF5085 VIDEO PROCESSING AND ANALYTICS

L	T	P	C
3	0	2	4

OBJECTIVES:

- To have a better knowledge about video representation and its formats.
- To know the fundamental concepts of data science and analytics.
- To enrich students familiar with video processing tools for analytics.
- To understand the data analytics for processing video content.
- To expose the student to emerging trends in video analytics.

UNIT I VIDEO FUNDAMENTALS 9

Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog to Digital Conversion – Color Representation and Chroma Sub Sampling – Video Sampling Rate and Standards Conversion – Digital Video Formats – Video Features – Colour, Shape and Textural Features.

Suggested Activities:

- In-class activity - Numerical problems on sampling and standard conversions.
- Flipped classroom on description about video features.

Suggested Evaluation Methods:

- Assignments on sampling and standard conversions.
- Quiz on video features.

UNIT II MOTION ESTIMATION AND VIDEO SEGMENTATION 9

Fundamentals of Motion Estimation – Optical flow –2D and 3D Motion Estimation – Block based point correspondences – Gradient Based Intensity Matching – Feature Matching – Frequency Domain Motion Estimation – Video Segmentation.

Suggested Activities:

- In-class activity - Numerical problems on motion estimation.
- External learning - Survey on optical flow techniques.

Suggested Evaluation Methods:

- Online quiz on optical flow techniques.
- Assignments on numerical problems in motion estimation.

UNIT III FUNDAMENTAL DATA ANALYSIS 10

Exploratory Data Analysis – Collection of Data – Graphical Presentation of Data – Classification of Data – Storage and Retrieval of Data – Big Data – Challenges of Conventional Systems – Web Data – Evolution of Analytic Scalability – Analytic Processes and Tools – Analysis versus Reporting.

Suggested Activities:

- In-class activity - Graphical presentation of data for visualization.
- Flipped classroom on description about analytic processes and tools.

Suggested Evaluation Methods:

- Assignments on data visualization.
- Quiz on questionnaires on analytic tools.

UNIT IV MINING DATA STREAMS AND VIDEO ANALYTICS 9

Introduction to Streams Concept– Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Analytic Processes and Tools – Video Shot Boundary Detection – Model Based Annotation and Video Mining – Video Database – Video Categorization – Video Query Categorization.

Suggested Activities:

- Flipped classroom on discussion on streaming data.
- External learning - Survey on video-based content retrieval.

Suggested Evaluation Methods:

- Quiz on questionnaires on data streams.
- Assignments on video-based content retrieval.

UNIT V EMERGING TRENDS 9

Affective Video Content Analysis – Parsing a Video into Semantic Segments – Video Indexing and Abstraction for Retrieval – Automatic Video Trailer Generation– Video Inpainting – Forensic Video Analysis.

Suggested Activities:

- External learning - Survey on Affective Video Content Analysis.
- Flipped classroom on discussion on forensic video analysis

Suggested Evaluation Methods:

- Assignments on affective video content analysis.
- Quiz on questionnaires on forensic video analysis.

PRACTICAL EXERCISES: 30

1. Choose appropriate features for video segmentation for given sample video.
2. Compute two-dimension motion estimation using block-based match technique.
3. Calculate the motion estimation based on Frequency domain.
4. Compare the video features extracted from a given video dataset using graphical representation.
5. Compute the number of distinct elements found in the given sample data stream.
6. Detect shot boundary for given sample video.
7. Parse the given sample video for indexing and faster retrieval.
8. Generate an automatic video trailer for given sample video.
9. Design simple application using video inpainting technique.
10. Mini project for video categorization based on content analysis.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Apply mathematics and basic science knowledge to compute basic video processing functions.
- Compute optical flow and motion estimation
- Implement algorithms and techniques to segment video based on its features.
- Analyze video data to visualize graphically for presentation.
- Solve engineering problems to index and retrieve videos for faster access.
- Develop and design applications for video analytics using current trend.

REFERENCES:

1. Roy, R. Difit, R. Naskar, R. S. Chakraborty, “Digital Image Forensics: Theory and Implementation”, Springer, 2018.
2. Paul Kinley, “Data Analytics for Beginners: Basic Guide to Master Data Analytics”, CreateSpace Independent Publishing, 2016.
3. Murat Tekalp, “Digital Video Processing”, Second Edition, Prentice Hall, 2015.
4. Henrique C. M. Andrade, Bugra Gedik, Deepak S. Turaga, “Fundamentals of Stream Processing: Application Design, Systems, and Analytics”, Cambridge University Press, 2014.
5. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications “, Wiley, 2014.
6. Oges Marques, “Practical Image and Video Processing Using MATLAB”, Wiley-IEEE Press.

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

IF5087 VISUALIZATION TECHNIQUES

L	T	P	C
3	0	2	4

OBJECTIVES:

- To understand the fundamentals of data visualization.
- To know the working principles of various information visualization tools.
- To acquire knowledge about the issues in data representation.
- To visualize the complex engineering design.
- To gain skill in designing real time interactive information visualization system.

UNIT I INTRODUCTION **9**

Introduction – Visualization Stages – Computational Support – Issues – Different Types of Tasks – Data representation – Limitation: Display Space, Rendering Time, Navigation Link.

Suggested Activities:

- Blended Learning - Displaying Different types / visualization images.
- Flipped classroom on task of representing information.
- External learning - Problems related to acquiring data

Suggested Evaluation Methods:

- Tutorial - Different data visualizing images.
- Assignment on different data acquiring methods.
- Quizzes on issues and solutions in different visualization applications.

Attested

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UNIT II DATA REPRESENTATION 9

Human Factors – Foundation for a Science of Data Visualization – Environment- Optics – Optimal Display – Overview about Lightness, Brightness, Contrast, Constancy, Color –Visual attention that Pops Out – Types of Data – Data Complexity – The Encoding of Values – Encoding of Relation – Relation and Connection – Alternative Canvass.

Suggested Activities:

- Blended learning - Human visual and auditory system.
- Flipped classroom on color formats.
- External learning - Survey on different human computer interaction and types of user interface.

Suggested Evaluation Methods:

- Assignment on human visual and auditory system.
- Quizzes on various color format.
- Assignment on human computer interaction user interface.

UNIT III DATA PRESENTATION 9

Human Vision – Space Limitation – Time Limitations – Design – Exploration of Complex Information Space – Figure Caption in Visual Interface – Visual Objects and Data Objects – Space Perception and Data in Space – Images, Narrative and Gestures for Explanation.

Suggested Activities:

- Blended learning - Drawing charts for display.
- Flipped classroom on various presentation techniques.
- External learning-Different font and font styles, symbols and Gesture representation.

Suggested Evaluation Methods:

- Assignment on chart preparation.
- Quizzes on Various presentation techniques.
- Assignment on gesture presentation.

UNIT IV INTERACTION AND DESIGN 9

Norman's Action Cycle – Interacting with Visualization – Interaction for Information Visualization – Interaction for Navigation – Interaction with Models – Interacting with Visualization – Interactive 3D Illustrations with Images and Text – Personal View – Attitude – user perspective – Convergence – Sketching – Evaluation.

Suggested Activities:

- Flipped classroom on various interacting techniques.
- External learning - Interaction facilities and high-level support for animation design.

Suggested Evaluation Methods:

- Tutorial - Interaction models.
- Assignment on animation design.

UNIT V CURRENT TRENDS **9**

Design – Virtual Reality: Interactive Medical Application – Tactile Maps for Visually Challenged People – Animation Design for Simulation – Integrating Spatial and Nonspatial Data – Innovating the Interaction- Small Interactive Calendars – Selecting One from Many – Web Browsing Through a Key Hole – Communication Analysis – Archival Galaxies.

Suggested Activities:

- External learning - Mini project for designing and implementing a innovative interfaces.
- Flipped classroom on implementation of virtual reality environment.

Suggested Evaluation Methods:

- Demonstration of the mini project.
- Tutorial - Virtual reality application.

PRACTICAL EXERCISES: **30**

1. Creating Interoperable Web Visualization Components using Candela tool.
2. Implementing Line and Stacked charts with Labels and Notes using Datawrapper tool.
3. Creating Interactive Charts using Google Chart tool.
4. Use Myheatmap tool to View Geographic Data Interactively.
5. Visualizing TSV, CSV, DSV data using Rawgraph.
6. Working with animation using Chartist.js tool.
7. Visualizing Image data using Matlab.
8. Visualizing Complex Historical Data using Palladio tool.
9. Creating Mobile Friendly Interactive Maps using Leaflet tool.
10. Implementing a Real Time Application using VTK tool as a mini project.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course, the students will be able to

- Apply mathematics and basic science knowledge for Computational Support designing.
- Collect data ethically and solve engineering problems in information visualization and representation.
- Conduct experiments by applying various modern visualization tools and solve the space layout problem for presentation.
- Implement algorithms and techniques for interactive information visualization.
- Analyze and design systems to and visualize multidisciplinary multivariate Data individually or in teams.
- Develop a cost effective and a scalable information visualization system.

REFERENCES:

1. Robert Spence, “Information Visualization an Introduction”, Third Edition, Pearson Education, 2014.
2. Colin Ware, “Information Visualization Perception for Design”, Fourth edition, Morgan Kaufmann Publishers, 2019.
3. Benjamin B. Bederson and Ben shneiderman, “The Craft of Information Visualization”, Morgan Kaufmann Publishers, 2003.

4. Thomas strothotte, “Computational Visualization: Graphics, Abstraction and Interactivity”, Springer, 1998.
5. Matthew O. Ward, George Grinstein, Daniel Keim, “Interactive Data Visualization: Foundation, Techniques and Applications”, Second Edition, A. K. Peters/CRC Press, 2015.
6. Joerg Osarek, “Virtual Reality Analytics”, Gordon’s Arcade, 2016.

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

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS **9**

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support — Skills Required for a Business Analyst — Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real-time decision-making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS **9**

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics:

Frequency,Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and ColumnChart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for datavisualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real-time decision-making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web-based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query

Attested

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Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – HBase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real-world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real-world decision-making problem to hypothesis and apply suitable statistical testing.
- Write and demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open-source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

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

CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

OE5092 **INDUSTRIAL SAFETY** **L T P C**
3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment, and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relationship with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle, and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal, and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning, and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and

advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program, and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Ability to summarize basics of industrial safety
2. Ability to describe fundamentals of maintenance engineering
3. Ability to explain wear and corrosion
4. Ability to illustrate fault tracing
5. Ability to identify preventive and periodic maintenance

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgraw Hill Publication, 1978.
2. Garg H P, Maintenance Engineering, S.Chand and Company,1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition,2008

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

OE5093 **OPERATIONS RESEARCH** **L T P C**
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING **9**

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method - CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. To formulate linear programming problem and solve using graphical method.
2. To solve LPP using simplex method
3. To formulate and solve transportation, assignment problems
4. To solve project management problems
5. To solve scheduling problems

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	✓					
CO2	✓					
CO3	✓	✓	✓			
CO4	✓	✓	✓			
CO5	✓	✓	✓			

Attested

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OE5094	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Understand the costing concepts and their role in decision making
2. Understand the project management concepts and their various aspects in selection
3. Interpret costing concepts with project execution
4. Gain knowledge of costing techniques in service sector and various budgetary control techniques
5. Become familiar with quantitative techniques in cost management

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
2. Identify the various reinforcements used in composite materials.
3. Compare the manufacturing process of metal matrix composites.
4. Understand the manufacturing processes of polymer matrix composites.
5. Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method –Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Know the characteristics of composite materials and effect of reinforcement in composite materials.
2. Know the various reinforcements used in composite materials.
3. Understand the manufacturing processes of metal matrix composites.
4. Understand the manufacturing processes of polymer matrix composites.
5. Analyze the strength of composite materials.

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, WestGermany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. Interpret the various types of wastes from which energy can be generated
2. Develop knowledge on biomass pyrolysis process and its applications
3. Develop knowledge on various types of biomass gasifiers and their operations
4. Invent knowledge on biomass combustors and its applications on generating energy
5. Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY **9**

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Understand the various types of wastes from which energy can be generated
2. Gain knowledge on biomass pyrolysis process and its applications
3. Develop knowledge on various types of biomass gasifiers and their operations
4. Gain knowledge on biomass combustors and its applications on generating energy
5. Understand the principles of bio-energy systems and their features

REFERENCES:

1. Biogas Technology - A Practical Handbook - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

AUDIT COURSES (AC)

		L	T	P	C
AX5091	**ENGLISH FOR RESEARCH PAPER WRITING**	**2**	**0**	**0**	**0**

OBJECTIVES

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

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING **6**

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS **6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

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

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

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

TOTAL: 30 PERIODS

OUTCOMES

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Understand the skills needed when writing the Conclusion
5. Ensure the good quality of paper at very first-time submission

REFERENCES

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

AX5092 DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

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- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL: 30 PERIODS

OUTCOMES

1. Ability to summarize basics of disaster
2. Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3. Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4. Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES

1. Goel S. L., Disaster Administration and Management Text And Case Studies",Deep& Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", NewRoyal book Company,2007.

3. Sahni, Pardeepet. al.," Disaster Mitigation Experiences and Reflections", Prentice Hall ofIndia, New Delhi,2001.

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

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE

L	T	P	C
2	0	0	0

OBJECTIVES

1. Illustrate the basic sanskrit language.
2. Recognize sanskrit, the scientific language in the world.
3. Appraise learning of sanskrit to improve brain functioning.
4. Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
5. Extract huge knowledge from ancient literature.

UNIT I ALPHABETS **6**

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES **6**

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS **6**

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE **6**

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING **6**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

1. Understanding basic Sanskrit language.
2. Write sentences.
3. Know the order and roots of Sanskrit.
4. Know about technical information about Sanskrit literature.
5. Understand the technical concepts of Engineering.

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

AX5094 **VALUE EDUCATION**

L	T	P	C
2	0	0	0

OBJECTIVES

1. Understand value of education and self-development
2. Imbibe good values in students
3. Let they should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

1. Knowledge of self-development.
2. Learn the importance of Human values.
3. Developing the overall personality.

Suggested reading

1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX5095	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
3. Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
4. To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election

Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

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

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096	**PEDAGOGY STUDIES**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES

1. Review existing evidence on their view topic to inform programme design and policy
2. Making undertaken by the DFLD, other agencies and researchers.
3. Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework, and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

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UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

1. What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, ‘learning to read’ campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

1. To achieve overall health of body and mind
2. To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do`s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

		L	T	P	C
AX5098	**PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENT SKILLS**	**2**	**0**	**0**	**0**

OBJECTIVES

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality, and determination
3. To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimadbhagwadgeeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality

and achieve the highest goal in life

2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi, 2010.
2. Swami Swarupananda ,Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

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