1st Semester

Course Title: Mathematical Foundations of Computer Science							
Course Code: MCSECMF124					Examination Scheme		
Total Number of Lecture Hours: 50					External		72
					Internal		28
Lecture (L)	4	Practical (P)	0	Tutorial (T)	0	Total Credits	4

Course Objectives

- *To understand the mathematical fundamentals that support a variety of computer science courses, including data mining, network protocols, machine learning, and bioinformatics, and to develop a logical foundation for modern IT techniques like programming language design and concurrency.*
- *To provide a solid foundation in probability theory, statistical distributions, and limit theorems for uncertainty modelling in computational problems.*
- *To explore combinatorics, graph theory, and algebraic structures and their applications in networks, cryptography, and algorithm design.*

Course Content	No. of Teaching Hours
UNIT 1	**12 Hrs**

Probability mass functions (PMF), probability density functions (PDF), cumulative distribution functions (CDF). Parametric families of distributions: Binomial, Poisson, Normal, Exponential distributions. Expected value, variance, higher-order moments, conditional expectation. Law of Large Numbers, Central Limit Theorem, Markov's inequality, Chebyshev's inequality

UNIT 2	**12 Hrs**

Random samples and sampling distributions. Methods of Moments and Maximum Likelihood Estimation (MLE). Hypothesis testing: Null and alternative hypotheses, Type I and Type II errors, p-values. Linear regression models: Simple and multiple regression. Classification problems: Binary and multiclass classification basics. Principal Component Analysis (PCA) for dimensionality reduction.

UNIT 3	**12 Hrs**

Permutations and combinations: With and without repetition. Pigeonhole principle, inclusion-exclusion principle. Graph theory fundamentals: Graph isomorphism, planar graphs, Kuratowski's theorem. Graph colouring, Hamiltonian circuits, Eulerian cycles. Trees and spanning trees, minimal spanning trees (Prim's and Kruskal's algorithms). Introduction to Groups, Rings, and Fields, Rings and Fields in cryptographic applications.

UNIT 4	**14 Hrs**

Introduction to Markov chains: Transition matrices, classification of states, steady-state behaviour. Model assessment techniques: Cross-validation, metrics for model evaluation. Overfitting and regularization. Introduction to recent trends: Probabilistic modelling in bioinformatics, Stochastic models in distributed systems and network security, Soft computing using probabilistic and algebraic methods, Graph-based anomaly detection in cybersecurity

Books:

1. Probability and Statistics with Reliability, Queuing, and Computer Science Applications by Kishor S. Trivedi, PHI Learning.
2. M. Mitzenmacher and E. Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press.
3. Fundamentals of Probability and Statistics for Engineers by T.T. Soong, Wiley India,
4. John Vince, Foundation Mathematics for Computer Science, Springer.
5. Alan Tucker, Applied Combinatorics, Wiley.

Course Outcomes

CO1: Apply probability and distribution concepts to real-world problems.
CO2: Perform statistical analysis, including estimation, hypothesis testing, and regression.
CO3: Use combinatorics, graph theory, and algebraic structures in algorithms and security.
CO4: Analyse Markov chains, evaluate models, and explore applications in emerging fields.

Level of CO-PO Mapping

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	2	3	2	-	-	-	-	1	-	-
2	3	3	3	3	2	-	-	-	-	1	-	-
3	2	2	3	2	2	2	1	2	2	2	2	-
4	3	3	2	3	2	-	-	-	-	1	-	2

Course Title: Advanced Data Structures			
Course Code: MCSECDS124		**Examination Scheme**	
Total Number of Lecture Hours: 40		**External**	**72**
		Internal	**28**

Lecture (L)	4	**Practical (P)**	**0**	**Tutorial (T)**	**0**	**Total Credits**	**4**

Course Objectives: *The aim of this course is to provide a comprehensive understanding of basic data structures including their representations, operations, and applications. Implement and apply advanced data structures like skip lists, AVL trees, B- trees etc. To familiarize students with hashing, graph traversals, and dynamic programming techniques. Apply various data structures and algorithms to real-world problems such as text processing, pattern matching, and compression algorithms.*

Course Content	**No. of Teaching Hours**
UNIT 1	**10 Hrs**
Basic concepts overview: Stack, Representation of stack in memory, Operations on Stacks, Implementation of Stack using arrays and linked list, Applications of stacks. Queues, Representation of Queue in Memory, Operations on Queue, Implementation of Queue using arrays and linked list, Queues, Implementation using Arrays and Linked list. Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.	
UNIT 2	**10 Hrs**
Trees : Definitions, terminologies and properties, Binary tree representation, traversals and applications, Threaded binary trees, Binary Search Trees, AVL Trees, M-way Search Trees, B-trees, B*-trees. Graphs: Terminology, Graph representations, Traversal Techniques, Operations on Graphs, Applications of Graphs Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.	
UNIT 3	**10 Hrs**
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.	
UNIT 4	**10 Hrs**
Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.	

Recommended Books:

1. *Mark Allen Weiss, Data Structures &Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.*
2. *M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.*
3. *A. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C and C++, Prentice Hall, 2/e, 1995*

Course Outcomes:

1. *Understand and implement linear data structures such as stacks, queues, and skip lists, and analyze their operations and memory representations.*
2. *Apply various tree and graph structures (binary trees, AVL trees, B-trees, Red-Black trees) and perform efficient traversals, insertions, deletions, and searches.*
3. *Analyse and Optimize Hashing Techniques: Students will be able to apply different hashing techniques (e.g., separate chaining, linear probing, double hashing) to resolve collisions and optimize dictionary operations, while understanding their time and space complexities.*
4. *Apply Advanced Algorithms: Students will be able to apply advanced algorithms such as the Boyer-Moore and Knuth-Morris-Pratt pattern matching algorithms, Huffman coding, and the Longest Common Subsequence (LCS) problem, along with understanding their efficiency.*

Level of CO-PO Mapping

COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	2	2	1	1	-	1	1	2	1	2
2	3	3	2	2	2	-	-	1	1	2	1	1
3	3	3	2	2	2	1	-	1	2	2	-	1
4	3	3	2	2	2	1	1	1	1	2	2	2

Course Title: Research Methodology and IPR			
Course Code: MCSECRM124		**Examination Scheme**	
Total Number of Lecture Hours: 48		**External**	**36**
		Internal	**14**

Lecture (L)	**2**	**Practical (P)**	**0**	**Tutorial (T)**	**0**	**Total Credits**	**2**

Course Objectives

1. *To understand the basic concepts and processes of research.*
2. *To identify appropriate research problems and parameters.*
3. *To develop skills for scientific report writing and technical communication.*
4. *To understand the importance of Intellectual Property Rights (IPR) and patent procedures.*

Course Content	**No. of Teaching Hours**
UNIT 1	**10 Hrs**

Introduction to Research Methodology

Meaning of research, objectives and motivation of research: Types of research: fundamental, applied, descriptive, analytical: Research process and formulation of research problem: Criteria for good research

UNIT 2	**12 Hrs**

Literature Review and Technical Writing

Searching for literature: digital libraries, journals, databases: Literature survey and review techniques: Technical writing: structure of a research paper, proposal, thesis, and report writing. Journal metrics, indexing, and their significance in defining the quality of a journal.

UNIT 3	**12 Hrs**

Plagiarism and Research Ethics: Objectivity and subjectivity in research, integrity in research, and respect for intellectual property. Definition of plagiarism and plagiarism detection tools. Role of referencing/bibliography in handling plagiarism. Ethical publishing practices and transparency in authorship. University Grants Commission's (UGC) policy for curbing plagiarism.

UNIT 4	**14 Hrs**

Intellectual Property Rights and Patents

Introduction to IPR: Patents, designs, trade secrets, and copyrights. Process of patenting, innovation, and technological research. International patenting under PCT and global cooperation in intellectual property. Patent rights and scope, licensing, and technology transfer

Books:

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International.
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners*, Sage Publications.
3. Levine, Stephan, Krehbiel, Berenson, *Statistics for Managers*, Pearson Education.
4. Prabuddha Ganguli, *Intellectual Property Rights: Unleashing the Knowledge Economy*, Tata McGraw-Hill.

Course Outcomes

After completing this course, the students will be able to:

1. *Understand the foundational concepts of research methodology*
2. *Identify research problems, formulate hypotheses, and design experiments.*
3. *Conduct a comprehensive literature review and write research reports.*
4. *Understand the role and importance of IPR in research and innovation.*

Level of CO-PO Mapping

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	2	2	1	2	-	2	-	2	2	3
2	3	3	2	2	1	2	-	2	1	2	2	3
3	2	3	3	2	2	2	-	3	2	3	2	3
4	1	2	2	1	2	3	3	3	-	2	2	3

PROGRAM ELECTIVE-I & II

Course Title: Data Science							
Course Code: MCSEDAA124						Examination Scheme	
Total Number of Lecture Hours: 48						External	54
						Internal	21
Lecture (L)	3	Practical (P)	0	Tutorial (T)	0	Total Credits	3

Course Objectives

- *To introduce the fundamental concepts of data science and its applications.*
- *To impart knowledge of statistical analysis, data preprocessing, and visualization.*
- *To develop skills for applying machine learning models on real-world data.*
- *To familiarize students with data science tools, techniques, and ethical aspects.*

Course Content	No. of Teaching Hours
UNIT 1	**11 Hrs**
Introduction to Data Science What is Data Science? Need and importance, Data Science Life Cycle, Roles of a Data Scientist, Types of Data and Sources, Structured vs Unstructured Data, Introduction to Big Data and Hadoop Ecosystem	
UNIT 2	**13 Hrs**
Data Preprocessing and Visualization Data Cleaning: Handling missing data, outliers, Data Transformation: Normalization, encoding, Data Reduction Techniques, Exploratory Data Analysis (EDA), Visualization tools: Matplotlib, Seaborn, Tableau basics	
UNIT 3	**12 Hrs**
Statistical Methods for Data Science Descriptive and Inferential Statistics, Probability Distributions (Normal, Binomial, Poisson), Hypothesis Testing, Correlation and Regression Analysis, Sampling Methods and Estimation	
UNIT 4	**12 Hrs**
Machine Learning Basics for Data Science Introduction to Machine Learning, Supervised vs Unsupervised Learning, Regression, Classification, Clustering, Overfitting and Underfitting, Model Evaluation Metrics (Accuracy, Precision, Recall, F1 Score)	

Recommended Books:

- *Joel Grus, "Data Science from Scratch", O'Reilly Media.*
- *Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media.*
- *Chanchal Chatterjee, "Data Science and Analytics", McGraw Hill.*
- *Tirthajyoti Sarkar, "Data Science and Machine Learning Projects", Packt Publishing.*

Course Outcomes:

1. *Understand the foundational concepts and processes of data science.*
2. *Perform data cleaning, transformation, and visualization tasks.*
3. *Apply statistical methods to analyze and interpret data.*
4. *Implement machine learning algorithms on datasets and evaluate models.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	2	1	1	1	2	1	1	1	1	1
2	3	3	2	2	3	1	1	1	2	2	2	2
3	3	3	3	2	2	1	2	1	2	2	2	2
4	3	3	3	2	3	2	2	2	2	2	2	2

Course Title: Distributed Systems								
Course Code: MCSEDAB124						Examination Scheme		
Total Number of Lecture Hours: 48						External	54	
						Internal	21	
Lecture (L)	3	Practical (P)	0	Tutorial (T)	0	Total Credits		3

Course Objectives

- *To study foundations of distributed systems.*
- *To understand in detail network virtualization and remote invocations required for a distributed system.*
- *To introduce the idea of peer-to-peer services and file system.*
- *To understand clock synchronization techniques, transactions and concurrency control mechanisms.*

Course Content	No. of Teaching Hours
UNIT 1	**11 Hrs**

Introduction – Taxonomy of Distributed Systems - Scalable performance - load balancing and availability. Models of computation - shared memory and message passing system - synchronous and asynchronous systems. Various Paradigms in Distributed Applications.

UNIT 2	**13 Hrs**

Communication in Distributed Systems- Remote Procedure Call – Remote Object invocation-Message-Oriented Communication – Unicasting, Multicasting and Broadcasting – Group Communication. System Model – Inter process Communication - the API for internet protocols – External data representation and Multicast communication.

UNIT 3	**12 Hrs**

Peer-to-peer Systems – Introduction - Napster and its legacy - Peer-to-peer – Middleware - Routing overlays. Distributed File Systems –Introduction - File service architecture – Andrew File system. Features-File model -File accessing models - File sharing semantics, Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

UNIT 4	**12 Hrs**

Clocks, events and process states - Synchronizing physical clocks- Logical time and logical clocks - Global states – Coordination and Agreement – Introduction - Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control - Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study (Coda)

Recommended Books:

- *Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education.*
- *George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education.*
- *Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India.*
- *Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.*

Course Outcomes:

1. *Understand the design principles and architecture of distributed systems.*
2. *Analyze the functioning of communication mechanisms such as RPC, multicasting, etc.*
3. *Analyze the design and functioning of existing distributed file systems.*
4. *Apply various distributed algorithms related to clock synchronization, concurrency control, deadlock detection, load balancing, etc.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	1	0	0	0	0	0	0	0	0	0	0
2	3	3	2	1	2	0	0	0	0	0	0	0
3	3	2	2	1	1	0	0	0	0	0	0	0
4	3	3	2	2	2	0	0	0	0	0	0	0

Course Title: Data Preparation and Analysis								
Course Code: MCSEDAC124						**Examination Scheme**		
Total Number of Lecture Hours: 50						**External**	**54**	
						Internal	**21**	
Lecture (L)	**3**	**Practical (P)**	**0**	**Tutorial (T)**		**0**	**Total Credits**	**3**

Course Objectives

1. *To understand various types of data and their sources.*
2. *To learn techniques for data cleaning, transformation, integration, and reduction.*
3. *To prepare data for advanced analytics using feature engineering and selection.*
4. *To apply techniques for handling missing data, outliers, and noise in datasets.*

Course Content	No. of Teaching Hours
UNIT 1	**10 Hrs**

Introduction to Data and Data Sources

Types of data: structured, semi-structured, unstructured: Sources of data: databases, web, sensors, APIs: Understanding data formats: CSV, JSON, XML: Overview of data science workflow and the role of data preparation

UNIT 2	**12 Hrs**

Data Cleaning and Preprocessing

Handling missing data: deletion, imputation techniques: Identifying and treating outliers and noisy data: Data normalization and standardization: Data inconsistency detection and resolution

UNIT 3	**12 Hrs**

Data Integration, Transformation, and Reduction

Data integration from multiple sources: Schema integration and conflict resolution: Data transformation: aggregation, generalization, discretization, encoding: Data reduction: PCA, sampling, attribute subset selection

UNIT 4	**14 Hrs**

Feature Engineering and Data Preparation Tools

Feature extraction and construction: Feature selection: filter, wrapper, and embedded methods: Introduction to automated data preparation tools: Data preparation using Python: Pandas, NumPy, Scikit-learn

Books:

1. "Data Preparation for Data Mining" by Dorian Pyle
2. "Python for Data Analysis" by Wes McKinney
3. "Data Wrangling with Pandas" by Jacqueline Kazil & Katharine Jarmul
4. "Feature Engineering for Machine Learning" by Alice Zheng and Amanda Casari

Course Outcomes

1. *Understand the types of data and their implications for data preparation.*
2. *Apply techniques for data cleaning, integration, transformation, and reduction.*
3. *Perform data preparation tasks using tools like Python and libraries like Pandas, NumPy, and Scikit-learn.*
4. *Evaluate and handle missing data, outliers, noise, and data inconsistencies.*

Level of CO-PO Mapping

COs	POs										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	1	1	1	-	-	-	-	1	-	-
2	3	3	2	2	2	-	-	-	-	2	-	-
3	3	3	3	2	3	2	-	-	1	2	1	2
4	2	3	3	2	2	1	-	-	-	2	-	1

Course Title: Recommender System								
Course Code: MCSEDAD124						Examination Scheme		
Total Number of Lecture Hours: 50						External	54	
						Internal	21	
Lecture (L)	3	Practical (P)	0	Tutorial (T)	0	Total Credits		3

Course Objectives

- *Students will be able to explain key concepts in information retrieval, including retrieval models, search techniques, and the role of relevance feedback and user profiles in enhancing search effectiveness.*
- *Students will develop skills in designing and implementing content-based filtering systems, including feature extraction, item profiling, and user profile learning methods.*
- *Students will evaluate different collaborative filtering approaches, including user-based and item-based methods, as well as hybrid models, while understanding the challenges and potential vulnerabilities of these systems.*
- *Students will learn to assess the performance of various recommender systems using established evaluation metrics, and classify systems into categories such as personalized web search, knowledge-based, and social tagging recommender systems*

Course Content	No. of Teaching Hours
UNIT 1	10 Hrs

Introduction to Recommender Systems (RS): Goals of RS, Basic models of RS, Challenges in RS. **Collaborative filtering:** Key properties of rating matrices, user and item based nearest recommendation, predicting ratings, neighbourhood-based methods (clustering, dimensionality reduction, regression modelling and graph models), Model based collaborative filtering, Content-based, knowledge based, ensemble based and hybrid recommender system.

UNIT 2	10 Hrs

Evaluating Recommender Systems: Explanations in recommender systems, General properties of evaluation research, popular evaluation designs, goals of evaluation design design issues in offline recommender evaluation, accuracy metrics in offline evaluation.

Context, time and location sensitive RS: Multidimensional approach, context pre filtering, post filtering, contextual modelling, temporal collaborative filtering, discrete temporal models, and location aware recommender systems.

UNIT 3	10 Hrs

Structural recommendations in networks Ranking algorithms, recommendations by collective classification, recommending friends: link prediction, social influence analysis and viral marketing.

Social and trust centric RS: Multidimensional models for social context, network centric and trust centric methods, user interaction in social recommenders.

UNIT 4	10 Hrs

Attack-resistant RS: Trade-offs Attack models, Types of attacks, detecting attacks on RS, strategies for robust RS, Online consumer decision making Learning to rank, multi-armed bandit algorithms, group RS, multi criteria RS, Active learning in RS, privacy in RS, Recommender systems and the next generation web.

Recommended Books:

1. *Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.*
2. *Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011).*
3. *Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.*

Course Outcomes:

1. *Students will be able to describe the objectives of RS, differentiate among basic types (collaborative, content-based, knowledge-based), and identify common challenges like data sparsity, scalability, and cold start problems.*
2. *Students will gain the ability to implement user-based and item-based nearest neighbour methods, clustering, dimensionality reduction, regression models, and hybrid approaches combining multiple recommendation techniques.*
3. *Students will learn to design offline evaluation experiments, utilize metrics such as precision, recall, MAE, and build context-aware, time-aware, and location-aware recommender systems.*
4. *Students will be able to model social influence, predict links, design robust RS against adversarial attacks, and explore current trends like group RS, multi-armed bandits, and recommender systems in next-gen web environments.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	2	2	1	1	0	1	1	1	-	2
2	3	3	3	2	3	1	0	1	2	2	1	2
3	3	3	3	3	3	2	1	2	2	2	2	3
4	3	3	3	3	3	2	1	2	2	2	2	3

COURSE TITLE: Machine Learning							
Course Code:			MCSEDAE124		Examination Scheme		
					External	72	
Total number of Lecture Hours: 56					Internal	28	
					Total Credits		4
Lecture (L):	4	Practicals(P):	-	Tutorial (T):	-		

Course Objectives

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Content	TEACHING HOURS
UNIT 1: Supervised Learning (Regression/Classification)	14-Hrs
• K Nearest-Neighbor Classifier • Decision Trees (ID3, SAFARI). • Linear Regression, Logistic Regression • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class Outputs.	
UNIT 2: Unsupervised Learning	14-Hrs
• Distance-based methods • Clustering: K-means • Dimensionality Reduction: PCA • Generative Models	
UNIT 3:	14-Hrs
• Ensemble Methods • Boosting • Bagging • Random Forests	
UNIT 4:	14-Hrs
• Semi-supervised Learning, • Active Learning, • Reinforcement Learning, • Introduction to Bayesian Learning	
Textbooks	

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Reference Books

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007

COURSE OUTCOMES (CO):

After completion of course, students would be able to:

CO1: Extract features that can be used for a particular machine learning approach in various applications.

CO2: To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.

CO3: To mathematically analyze various machine learning approaches and paradigms.

CO4: To discover Deep learning method and different feature extraction approaches.

LEVEL OF CO-PO MAPPING TABLE

	Pos											
Cos	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	3	3	2	1	1	-	1	2	1	2
2	2	-	3	-	2	2	1	-	1	2	2	3
3	3	3	2	3	2	1	1	-	1	3	2	3
4	2	2	3	3	2	1	1	3	3	2	1	2

Course Title: Data Storage Technologies & Networks							
Course Code: MCSEDAF124					Examination Scheme		
Total Number of Lecture Hours: 50					External	54	
					Internal	21	
Lecture (L)	3	Practical (P)	0	Tutorial (T)	0	Total Credits	3

Course Objectives

1. *To provide in-depth knowledge of various data storage architectures, systems, and technologies.*
2. *To understand the structure and operation of modern storage area networks (SAN, NAS, DAS).*
3. *To analyze performance, scalability, and security in enterprise storage environments.*
4. *To examine the role of storage networking protocols, virtualization, and cloud storage technologies.*

Course Content	No. of Teaching Hours
UNIT 1	**10 Hrs**
Introduction to Data Storage Data explosion and storage challenges, Storage system environment: components and technologies, Data center infrastructure: physical and logical components, RAID: levels, techniques, and performance analysis	
UNIT 2	**12 Hrs**
Storage Architectures and Interfaces Direct-Attached Storage (DAS), Network-Attached Storage (NAS) – architecture, protocols (NFS, CIFS), Storage Area Networks (SAN) – Fibre Channel, iSCSI, Content-Addressed Storage (CAS), Object Storage basics	
UNIT 3	**12 Hrs**
Storage Networking and Management Storage virtualization – block and file level, Storage tiering, thin provisioning, deduplication, Backup and recovery techniques, Business continuity and disaster recovery strategies	
UNIT 4	**14 Hrs**
Cloud and Modern Storage Systems Cloud storage architectures: public, private, hybrid, Storage as a service (STaaS), APIs for cloud storage (e.g., S3), Storage security: threats, encryption, access control, Case studies: enterprise storage solutions and trends	

Recommended Books:

1. ***EMC Education Services***, Information Storage and Management, *Wiley, 2nd Edition*
2. ***Robert Spalding***, Storage Networks: The Complete Reference, *Tata McGraw Hill*
3. ***Marc Farley***, Building Storage Networks, *Tata McGraw-Hill*
4. ***Ulf Troppens et al.***, Storage Networks Explained, *Wiley*
5. ***Tom Clark***, Designing Storage Area Networks, *Pearson Education*

Course Outcomes: *Upon successful completion of the course, the students will be able to:*

1. *Understand the fundamental concepts of storage technologies and architectures.*
2. *Analyze the design and implementation of various storage systems such as SAN, NAS, and DAS.*
3. *Evaluate performance, reliability, and security issues in storage networking systems.*
4. *Apply storage virtualization and cloud-based storage models to solve enterprise data management problems.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	0	0	1	0	0	0	0	0	0	0
2	3	3	2	1	2	0	0	0	0	0	0	0
3	2	3	3	2	2	0	0	1	0	0	0	0
4	2	2	3	2	3	1	1	1	1	1	0	2

Course Title: Digital Image Processing								
Course Code: MCSEDAG124						**Examination Scheme**		
Total Number of Lecture Hours: 40						**External**	**54**	
						Internal	**21**	
Lecture (L)	**3**	**Practical (P)**	**0**	**Tutorial (T)**	**0**	**Total Credits**		**3**

Course Objectives: *To introduce the concepts of image processing and basic analytical methods to be used in image processing. To familiarize students with image enhancement and restoration techniques, To explain different image compression techniques. To introduce segmentation and morphological processing techniques.*

Course Content	No. of Teaching Hours
UNIT 1	**10 Hrs**

Digital Image Fundamentals: Fundamental steps in Digital Image Processing, Components of an Image processing system, Digital Image Representation, Basic relationship between pixels, Color Modules, RGB and HSI color models.
Image Enhancement: Image negatives, Histogram Equalization, Local Enhancement, Image Subtraction, Image Averaging, Smoothing and Sharpening Spatial Filters, Combining Spatial Enhancement methods.

UNIT 2	**10 Hrs**

Image Transform: Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, Homomorphic filtering, Convolution and Correlation Theorems, Wavelet Transforms, The Fast Wavelet Transforms.
Image Restoration: Noise Models, Restoration in the presence of Noise-Only Spatial filtering , Mean filters, Adaptive filters Periodic Noise Reduction by Frequency Domain filtering , Inverse Filtering , Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter.

UNIT 3	**10 Hrs**

Image Segmentation: Detection of Discontinuities, Point Detection, Line detection, Edge Detection, Thresholding, Optimal Global and Adaptive thresholding, Region-based Segmentation.
Representation and Description: Chain codes, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, Regional Descriptors, Relational Descriptors.

UNIT 4	**10 Hrs**

Image Compression: Fundamentals, Redundancy, Image Compression Models, Fidelity Criteria, Compression ratio, Coding Theorems, Error free Compression techniques like Variable- length Coding and Lossless Predictive Coding, Lossy Compression techniques like Lossy Predictive Coding and Wavelet Coding, Image Compression standards.

Recommended Books:

1. *Digital Image Processing By Rafael C. Gonzalez, Richard Eugene Woods.*
2. *Fundamentals of Image Processing by Anil K. Jain Prentice Hall.*
3. *Kenneth R. Castleman, Digital Image Processing ', Pearson, 2006.*
4. *William K. Pratt, Digital Image Processing ', John* Wiley, New York, 2002

Course Outcomes:

1. *Understand the fundamentals of digital images, pixel relationships, color models (RGB, HSI), and apply various spatial domain enhancement techniques.*
2. *Apply Fourier and Wavelet transforms, understand frequency domain filtering techniques, and implement image restoration algorithms to recover degraded images.*
3. *Analyze and implement image segmentation and feature extraction, detect edges, lines, and regions using segmentation techniques, and extract meaningful features using boundary and regional descriptors for image analysis.*
4. *Apply Image Compression Techniques and evaluate them using compression ratios and fidelity criteria.*

Level of CO-PO Mapping

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	2	1	2	-	-	1	1	2	-	2
2	3	2	2	3	2	-	-	1	1	2	-	2
3	3	3	3	3	2	1	-	1	1	2	1	2
4	3	2	3	2	3	-	-	1	1	2	1	2

Course Title: Audit Course						Examination Scheme		
Course Code: MCSEAXX124						External		
Total Number of Lecture Hours: 50						Internal	50	
Lecture (L)	4	Practical (P)	0	Tutorial (T)	0	Total Credits		0

Course Objectives

These courses shall be taken from the model curriculum proposed by AICTE

Course Content	No. of Teaching Hours
UNIT 1	10 Hrs
.	
UNIT 2	12 Hrs
UNIT 3	12 Hrs
UNIT 4	14 Hrs

Books:

Course Outcomes

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												
4												

Course Title: Advanced Data Structures Lab							
Course Code: MCSELDS124					**Examination Scheme**		
Total Number of Lecture Hours: 30					**External**	**36**	
					Internal	**14**	
Lecture (L)	**0**	**Practical (P)**	**4**	**Tutorial (T)**	**0**	**Total Credits**	**2**

Course Objectives

To introduce and implement the basic and advanced data structures. Application of various data structures and algorithms in real-world problems such as text processing, pattern matching, and compression algorithms.

List of Experiments

1. Stack Implementation
2. Queue Implementation
3. Skip List Operations
4. Dictionary Implementation
5. Hashing Techniques
6. Binary Tree Operations
7. Binary Search Tree (BST) Operations
8. AVL Tree Operations
9. Graph Representation and Traversal
10. B-trees and B Trees*
11. Pattern Matching Algorithms
12. Tries and Compressed Tries
13. Huffman Coding Algorithm
14. Longest Common Subsequence (LCS)
15. Graph Algorithms (Advanced)
16. Dynamic Programming (Advanced Algorithms)

This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Recommended Books:

Course Outcomes:

1. *To implement and manipulate fundamental data structures such as stacks, queues, trees, and graphs using arrays and linked lists, and perform standard operations like insertion, deletion, and traversal.*
2. *Students will demonstrate the ability to implement and apply advanced data structures such as AVL trees, B-trees, and skip lists, and solve complex traversal and path finding problems in graphs.*
3. *Implement various hashing techniques (e.g., linear probing, separate chaining) and implement dictionaries for efficient data access & storage, analyzing their performance in terms of time & space.*
4. *Develop Solutions Using Text Algorithms and Dynamic Programming Students will be able to apply pattern matching algorithms (e.g., KMP, Boyer-Moore), Huffman coding, and dynamic programming-based solutions (like LCS), understanding their real-world applications and efficiency.*

Level of CO-PO Mapping

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	2	2	2	-	-	-	1	1	-	2
2	3	3	3	2	3	1	-	-	1	1	1	2
3	3	3	2	2	2	1	-	1	1	1	1	2
4	3	2	3	2	2	-	-	1	1	1	-	3

Course Title: Data Science Lab							
Course Code: MCSELAA124					**Examination Scheme**		
Total Number of Lecture Hours:30					**External**		36
					Internal		14
Lecture (L)	**0**	**Practical (P)**	**4**	**Tutorial (T)**	**0**	**Total Credits**	**2**

Course Objectives

1. *To implement core concepts in Data Science through Python programming.*
2. *To apply data analytics, visualization, and machine learning tools for solving real-world problems.*
3. *To perform statistical, NLP, and unsupervised learning tasks using Python libraries such as NumPy, Pandas, Matplotlib, SciPy, Scikit-learn, and Seaborn.*
4. *To practice hands-on experiments that reflect topics from theoretical units, enhancing understanding through projects and exercises.*

List of Experiments

1. Introduction to SciPy and Linear Algebra with SciPy
2. Integration, Optimization, CDF & PDF using SciPy
3. Visualization with Matplotlib
4. Pair Plot with Seaborn
5. Data Mugging and Wrangling with Pandas
6. Linear & Logistic Regression using Scikit-learn
7. Decision Trees and Random Forests, Support Vector Machines and K-Nearest Neighbors
8. K-Means Clustering and PCA
9. Statistical Analysis using Python
10. NLP – Text Preprocessing and Sentiment Analysis

Note: *This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Course Outcomes:

CO1: Implement data manipulation techniques using Python libraries such as NumPy and Pandas.
CO2: Apply scientific computing methods using SciPy for solving mathematical/statistical problems.
CO3: Visualize data effectively using Matplotlib and Seaborn to interpret and communicate insights.
CO4: Perform exploratory data analysis (EDA) and preprocessing tasks to prepare data for modeling.
CO5: Build and evaluate supervised and unsupervised machine learning models using Scikit-learn.
CO6: Apply Natural Language Processing techniques for sentiment analysis & text classification tasks.

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	2	2	3	-	-	1	-	-	-	1
2	3	3	2	3	3	-	-	-	-	-	-	1
3	3	2	2	2	3	-	-	-	-	-	-	1
4	3	3	3	3	3	-	-	1	1	1	-	2
5	3	3	3	3	3	-	-	-	-	-	1	2
6	3	3	3	3	3	-	-	-	-	-	1	2

Course Title: Distributed Systems Lab							
Course Code: MCSELAB124						**Examination Scheme**	
Total Number of Lecture Hours: 50						**External**	**36**
						Internal	**14**
Lecture (L)	**0**	**Practical (P)**	**4**	**Tutorial (T)**	**0**	**Total Credits**	**2**

Course Objectives

1. *To provide hands-on experience in simulating distributed database design and operations across multiple environments.*
2. *To develop skills in query processing, optimization, and transaction management in distributed systems.*
3. *To understand and implement distributed concurrency control, failure handling, and recovery protocols.*
4. *To analyze the performance implications of distributed query processing, load balancing, and system integration techniques.*

List of Experiments

1. Set up a simulated distributed database environment using multiple database instances or virtual machines.
2. Perform horizontal, vertical, and hybrid fragmentation on a relational schema and distribute fragments.
3. Simulate data allocation strategies across multiple sites and validate distributed design.
4. Create distributed views and implement user-level access control with SQL privileges.
5. Simulate query decomposition and localization in a distributed system using sample queries.
6. Analyze and simulate execution plans to compare centralized vs. distributed query processing.
7. Implement and simulate the two-phase commit protocol using SQL scripts or procedural code.
8. Simulate concurrency control scenarios with locking, isolation levels, and deadlock handling.
9. Simulate various system failures (site, link, transaction) and apply recovery protocols.
10. Demonstrate parallel query processing, load balancing, and simulate integration of mobile or heterogeneous databases.

Note: *This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Course Outcomes:

CO1: Design and simulate distributed database architectures with data fragmentation, allocation, and replication.

CO2: Implement query decomposition, localization, and analyze performance trade-offs in distributed query processing.

CO3: Apply and simulate distributed transaction management techniques such as two-phase commit and concurrency control.

CO4: Demonstrate fault tolerance mechanisms including recovery protocols and simulate integration with mobile or heterogeneous systems.

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	3	3	2	2	2	1	1	1	1	2
2	3	3	3	3	3	2	1	1	2	1	2	2
3	3	3	3	3	3	2	2	1	2	2	2	3
4	3	3	3	2	3	3	2	2	2	2	2	3

Course Title: Data Preparation and Analysis Lab						Examination Scheme		
Course Code: MCSELAC124						External	36	
Total Number of Lecture Hours: 30						Internal	14	
Lecture (L)	0	Practical (P)	4	Tutorial (T)	0	Total Credits		2

Course Objectives

1. *To gain hands-on experience in data wrangling and preprocessing.*
2. *To work with real-world datasets for cleaning, transformation, and reduction.*
3. *To implement feature engineering and automation in data preparation pipelines.*

List of Experiments

1. Exploring data using Pandas (loading, summarizing, visualization)
2. Handling missing data using imputation techniques
3. Detecting and treating outliers using statistical methods and visualizations
4. Normalization and Standardization of data
5. Encoding categorical variables (Label encoding, One-hot encoding)
6. Data integration from multiple files/sources
7. Data reduction using PCA and Feature Selection methods
8. Feature engineering: creation of new features from existing data
9. Using Scikit-learn pipelines for data preprocessing

Note: *This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Course Outcomes:

After completing this course, the students will be able to:

1. *Understand and apply data preprocessing techniques such as handling missing values, outliers, and normalization.*
2. *Perform feature engineering and selection methods using Python libraries like Pandas and Scikit-learn.*
3. *Implement end-to-end data preparation pipelines for real-world datasets using Python and relevant tools.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	2	1	2	-	-	-	-	1	-	1
2	2	3	3	2	3	-	-	-	1	2	1	2
3	3	3	3	3	3	2	-	-	1	2	2	3

Course Title: Recommender System Lab							
Course Code: MCSELAD124					Examination Scheme		
Total Number of Lecture Hours: 50					External	36	
					Internal	14	
Lecture (L)	0	Practical (P)	4	Tutorial (T)	0	Total Credits	2

Course Objectives

- *To enable students to gain practical insights into Information Retrieval and Recommender Systems. Students will explore the creation of user profiles and the core functions of recommender systems, including content-based filtering and similarity-based retrieval.*
- *Students will explore collaborative filtering approaches (both user-based and item-based), matrix factorization techniques, and hybrid recommendation models.*
- *Students will develop the skills needed to design, implement, and assess various types of recommender systems effectively.*

List of Experiments

1. Introduction to Information Retrieval
2. Retrieval Models
3. Search Techniques and Relevance Feedback
4. User Profiles and Recommender System Functions
5. Content-Based Filtering Techniques
6. Similarity-Based Retrieval
7. Collaborative Filtering: User-Based and Item-Based
8. Matrix Factorization Techniques
9. Hybrid Recommender Systems
10. Evaluating Recommender Systems
11. Advanced Evaluation Techniques
12. Types of Recommender Systems

Note: *This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Course Outcomes:

1. *Understand and implement foundational retrieval models and search techniques. Students will gain hands-on experience with various retrieval models, relevance feedback, and search algorithms, enabling them to build and evaluate basic information retrieval systems.*
2. *Design and analyze content-based and similarity-based filtering techniques. Students will be able to apply user profiling, content analysis, and similarity metrics to develop personalized recommendation solutions.*
3. *Develop and compare collaborative filtering and matrix factorization methods. Through practical implementation, students will learn the differences between user-based, item-based, and latent factor-based techniques, and understand their strengths and limitations.*
4. *Evaluate and optimize recommender systems using standard and advanced metrics. Students will be able to apply evaluation metrics and performance analysis tools to assess recommender systems and suggest improvements using hybrid approaches.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	2	3	1	-	-	1	1	-	2
2	3	3	3	2	3	1	-	1	2	1	1	2
3	3	3	3	2	3	1	-	1	2	2	1	2
4	3	3	2	3	3	1	-	1	2	2	1	2

Course Title: Machine Learning Lab						Examination Scheme		
Course Code: MCSELAE124						External	36	
Total Number of Lecture Hours: 50						Internal	14	
Lecture (L)	0	Practical (P)	4	Tutorial (T)	0	Total Credits		2

Course Objectives

To enable students to design and implement machine learning solutions to classification, regression and clustering problems and be able to evaluate and interpret the results of the algorithms using python and other development environments.

List of Experiments

1. Implementation of Distance-Based Methods (e.g., K-Nearest Neighbors).
2. Building Decision Trees for Classification and Regression (ID3).
3. Linear Regression and Logistic Regression using Python/Scikit-learn.
4. Training Support Vector Machines with Linear and Nonlinear Kernels.
5. Implementing Multi-class Classification Techniques.
6. K-means Clustering on real-world datasets (e.g., customer segmentation).
7. Dimensionality Reduction using PCA and visualizing results in 2D/3D.
8. Implementing Generative Models for unsupervised learning.
9. Implementing Bagging and Random Forests for robust classification.
10. Experimenting with Boosting Techniques (e.g., AdaBoost, Gradient Boosting).
11. Hyperparameter tuning and model evaluation using Cross-Validation.

This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Recommended Books:

Course Outcomes:

1. *Apply distance-based and tree-based classification algorithms such as K-Nearest Neighbors and ID3 to solve real-world classification and regression problems.*
2. *Implement and analyze linear models including Linear and Logistic Regression, and advanced classifiers like Support Vector Machines, for both binary and multi-class problems using Python libraries.*
3. *Develop unsupervised learning solutions through clustering (K-Means), dimensionality reduction (PCA), and generative models, and visualize results effectively in 2D/3D.*
4. *Evaluate and enhance model performance using ensemble techniques (Bagging, Random Forests, Boosting), along with hyperparameter tuning and cross-validation strategies.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	2	2	-	-	-	1	1	0	1
2	3	3	3	2	3	-	-	-	1	1	1	2
3	3	3	3	3	3	1	-	1	1	2	1	2
4	3	3	3	3	3	1	-	1	2	2	2	2

Course Title: Data Storage Technologies and Networks Lab

Course Code: MCSELAF124						**Examination Scheme**	
Total Number of Lecture Hours: 50						**External**	36
						Internal	14
Lecture (L)	0	**Practical (P)**	4	**Tutorial (T)**	0	**Total Credits**	2

Course Objectives

1. *To provide hands-on experience with various types of storage systems and protocols.*
2. *To configure and manage DAS, NAS, and SAN environments.*
3. *To implement and test storage virtualization and backup mechanisms.*
4. *To explore cloud storage platforms and simulate data access/security models.*

List of Experiments

1. **RAID Configuration:** Create and analyze RAID 0, 1, and 5 using Linux or simulation tools.
2. **DAS Setup:** Configure and benchmark performance of DAS on a local system.
3. **NAS Configuration:** Setup NAS using FreeNAS/TrueNAS and access via NFS/CIFS.
4. **SAN Configuration:** Setup a basic SAN environment using open-source SAN tools (Openfiler/iSCSI targets).
5. **Backup & Recovery:** Simulate backup and restoration using tools like Bacula, Amanda, or rsync.
6. **Storage Virtualization:** Implement block/file level virtualization using LVM or ZFS.
7. **Cloud Storage Access:** Access AWS S3/Azure Blob/Google Cloud Storage via SDK or API.
8. **Disaster Recovery Simulation:** Implement a simple DR mechanism using replication or snapshots.
9. **Storage Security:** Demonstrate encryption of data at rest and in transit using SSL/TLS.
10. **Performance Analysis:** Use benchmarking tools (FIO, IOzone) to measure storage throughput and latency.

This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Recommended Books:

Course Outcomes: By the end of this lab, students will be able to:

1. *Configure and compare different RAID levels for performance and fault tolerance.*
2. *Set up and manage DAS, NAS, and SAN environments for enterprise storage.*
3. *Implement storage virtualization and backup/recovery solutions.*
4. *Apply cloud storage services and enforce basic security and DR mechanisms*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	2	2	2	2	3	0	0	0	0	0	0	0
2	3	2	3	2	3	1	0	0	1	0	0	1
3	2	3	3	2	3	0	0	1	1	1	0	1
4	2	2	2	2	2	1	1	1	1	1	0	2

Course Title: Digital Image Processing Lab							
Course Code: MCSELAG124						Examination Scheme	
Total Number of Lecture Hours: 50						External	36
						Internal	14
Lecture (L)	0	Practical (P)	4	Tutorial (T)	0	Total Credits	2

Course Objectives: *The aim of the course is to provide hands-on experience in implementing fundamental and advanced image processing techniques, including image enhancement, filtering, transformation, restoration, segmentation, feature extraction, and compression.*

List of Experiments

1. Implement the basic image operations reading, displaying, resizing, converting color spaces.
2. Apply image negative, gamma law and log transform to grayscale images.
3. Implement histogram equalization and histogram matching.
4. Demonstrate and implement image filtering in spatial domain.
5. Implement Fourier and Wavelet Transforms and visualize magnitude and phase.
6. Demonstrate and implement image filtering in frequency domain.
7. Add noise (Gaussian, salt & pepper) and restore using Mean, Median, Wiener, and Adaptive filters.
8. Apply Sobel, Prewitt, Canny, and Laplacian edge detectors.
12. Implement thresholding and region-based segmentation.
13. Extract textural features using Gray-Level Co-occurrence Matrix (GLCM).
14. Implement Image compression techniques e.g Huffman coding or Run-Length Encoding (RLE) etc.

This is only a suggested list of experiments/simulations. The instructor is encouraged to familiarize students with additional relevant exercises.

Recommended Books:

Course Outcomes:

1. *Apply some basic and advanced intensity transformation techniques to enhance image such as negative transformation, logarithmic and gamma correction, histogram equalization, and histogram matching.*
2. *Analyze and apply spatial and frequency domain filtering methods (e.g., smoothing, sharpening, Fourier and Wavelet transforms) and visualize the corresponding effects on image data.*
3. *Apply noise models and restoration filters and implement segmentation techniques such as thresholding, edge detection, and region-based methods for accurate object detection.*
4. *Extract features using GLCM and implement basic image compression techniques such as Huffman Coding and Run-Length Encoding (RLE), evaluating efficiency based on fidelity and compression ratio.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	2	1	2	-	-	1	1	1	1	2
2	3	3	2	2	3	-	-	1	1	1	-	2
3	3	3	2	3	3	-	-	1	1	1	-	2
4	3	2	2	2	2	1	-	1	1	1	1	2

2^{nd} Semester

Course Title: Advanced Algorithms								
Course Code: MCSECAL224						**Examination Scheme**		
Total Number of Lecture Hours: 40						**External**	**72**	
						Internal	**28**	
Lecture (L)	**4**	**Practical (P)**	**0**	**Tutorial (T)**	**0**	**Total Credits**	**4**	

Course Objectives

To develop the ability to design, analyze, and implement advanced algorithms for complex problems. Students will learn efficient techniques such as greedy methods, dynamic programming, graph algorithms, and linear programming, along with understanding NP-completeness and advanced computational models.

Course Content	No. of Teaching Hours
UNIT 1	**10 Hrs**

Sorting: Review of various sorting algorithms, topological sorting.
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT 2	**10 Hrs**

Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path. Flow Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

UNIT 3	**10 Hrs**

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo representation. Schonhage-Strassen Integer Multiplication algorithm.

UNIT 4	**10 Hrs**

Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.

Recommended Books:

1. *Introduction to Algorithms by Cormen, Leiserson, Rivest, Stein.*
2. *The Design and Analysis of Computer Algorithms by Aho, Hopcroft, Ullman.*
3. *Algorithm Design by Kleinberg and Tardos.*
4. *H. S. Wilf, Algorithms and complexity, Prentice hall.*

Course Outcomes:

1. *Analyze and apply advanced sorting and graph algorithms with correctness proofs and time/space complexity analysis.*
2. *Apply greedy algorithms and graph matching techniques to solve optimization problems.*
3. *Solve complex problems using dynamic programming, including shortest paths and integer multiplication.*
4. *Apply Linear Programming techniques and understand their geometric interpretations and algorithmic implementations*

Level of CO-PO Mapping

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	3	3	2	3	2	2	1	2	1	1	2
2	3	3	3	2	3	2	2	1	2	1	1	2
3	3	3	3	2	3	2	2	1	2	1	1	2
4	3	3	3	2	3	2	2	1	2	1	1	2

Course Title: Soft Computing							
Course Code: MCSECSC224					Examination Scheme		
Total Number of Lecture Hours: 56					External	72	
					Internal	28	
Lecture (L)	4	Practical (P)	0	Tutorial (T)	0	Total Credits	4

Course Objectives:

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide students a hand-on experience on MATLAB/Python to implement various strategies.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 **SOFT COMPUTING and FUZZY LOGIC:** Soft Computing Constituents, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	14
Unit 2 **NEURAL NETWORKS:** Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks, Unsupervised Learning Neural Networks,	14
Unit 3 **DEEP LEARNING and GENETIC ALGORITHMS:** Recent Trends in deep learning, various classifiers. Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning. Implementation of recently proposed soft computing techniques.	14
Unit 4 **Matlab/Python Lib:** Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of machine learning/soft computing toolbox/libraries, Simple implementation of machine learning/soft computing techniques.	14

COURSE OUTCOMES

After completion of course, students would be able to:

- Identify and describe soft computing techniques and their roles in building intelligent machines
- Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
- Apply genetic algorithms to combinatorial optimization problems.
- Evaluate and compare solutions by various soft computing approaches for a given problem

References

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

Level of CO-PO Mapping												
COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	1	1	1	1	-	1	-	1	-	2
2	3	3	2	2	2	1	-	1	1	1	-	2
3	3	2	3	2	3	1	-	1	2	2	2	2
4	3	2	2	2	3	1	-	1	1	2	1	3

PROGRAM ELECTIVE-III & IV

Course Title: Mini Project with Seminar							
Course Code: MCSECPS224					**Examination Scheme**		
Total Number of Lecture Hours: 30					**External**	**36**	
					Internal	**14**	
Lecture (L)	**0**	**Practical (P)**	**4**	**Tutorial (T)**	**0**	**Total Credits**	**2**

Course Objectives

1. *To develop technical presentation and research communication skills.*
2. *To enhance the ability to review literature and identify relevant research areas.*
3. *To design and implement a mini project addressing a real-world or research-based problem.*
4. *To encourage innovation and application of theoretical knowledge to practical problems.*

Description	No. of Teaching Hours
Literature Survey & Problem Identification Identifying a domain of interest Surveying recent research papers, patents, and open problems Defining scope and significance of the problem Framing project objectives and deliverables **Design and Implementation** System architecture/design models Choice of tools, algorithms, datasets, or simulations Implementation phases: coding, testing, modeling Iterative development and testing strategies **Documentation & Report Writing** Technical writing standards and structure Preparation of interim and final reports Citing references (IEEE/APA style) Plagiarism checking and ethics in research **Seminar & Presentation** Preparing slides and poster presentations Verbal and visual communication skills Feedback-based refinement Final seminar and viva-voce	

Course Outcomes: By the end of this course, students will be able to:

1. *Identify and articulate a research problem through comprehensive literature review.*
2. *Demonstrate the ability to design, model, or simulate a technical solution.*
3. *Present technical content effectively in oral and written form.*
4. *Collaborate in a team environment to complete a research-oriented mini project.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	2	2	1	1	1	1	2	2	2	3
2	3	2	3	2	3	0	1	1	2	2	2	2
3	2	1	1	1	1	0	0	0	1	3	3	2
4	2	2	2	2	2	1	1	1	3	3	-	-

Course Title: Data Visualisation

Course Code: MCSEDAA224		**Examination Scheme**	
Total Number of Lecture Hours: 40		**External**	**54**
		Internal	**21**

Lecture (L)	**3**	**Practical (P)**	**0**	**Tutorial (T)**	**0**	**Total Credits**	**3**

Course Objectives

- *To introduce fundamental principles of visual perception, Gestalt laws, and their role in visualization design and interpretation.*
- *To develop skills in designing, implementing, and evaluating effective data visualizations, with emphasis on visual mapping, interaction, and minimizing information overload.*
- *To provide techniques for visualizing complex data types, including volumetric, vector, and geographic information.*
- *To familiarize students with emerging trends, technologies, and innovations in data visualization.*

Course Content	**No. of Teaching Hours**
UNIT 1	**10 Hrs**

Introduction to Visual Perception and Data Representation

Visual perception fundamentals, Gestalt principles, challenges of information overload, methods of visual data representation, visualization reference models, visual mappings, visual analytics, and design of visualization applications.

UNIT 2	**12 Hrs**

Visualization Systems, Interaction Techniques, and Data Types

Classification of visualization systems, interaction techniques (filtering, zooming, linking, brushing), visualization of one-, two-, and multi-dimensional data, text and document visualization, visualization of groups, trees, graphs, clusters, networks, and metaphorical visualization approaches

UNIT 3	**12 Hrs**

Advanced Visualization Techniques

Visualization of volumetric data, vector fields, dynamic processes, and simulations, map and geographic information visualization, GIS systems, collaborative visualization techniques, and evaluation methods for visualizations

UNIT 4	**14 Hrs**

Emerging Trends and Data Structures in Visualization

Recent trends in perception and visualization techniques, data structures for visualization, immersive visualization (AR/VR), real-time visualization technologies, and future directions in data visualization.

Recommended Books:

- *Edward R. Tufte, "The Visual Display of Quantitative Information", Graphics Press, 2001.*
- *Colin Ware, "Information Visualization: Perception for Design", Morgan Kaufmann, 2013.Tamara Munzner, "Visualization Analysis and Design", CRC Press, 2014.*
- *Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", CRC Press, 2015.*
- *Kieran Healy, "Data Visualization: A Practical Introduction", Princeton University Press, 2018.*

Course Outcomes

CO1: Apply principles of visual perception and Gestalt theory to create meaningful and intuitive visualizations.

CO2: Design and develop interactive and efficient data visualizations for one-dimensional, multi-dimensional, and complex datasets.

CO3: Visualize specialized data such as volumetric fields, dynamic processes, and geographic information using appropriate techniques.

CO4: Analyse and adapt to emerging tools, methods, and trends in the field of data visualization.

Level of CO-PO Mapping

COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	2	-	2	-	-	-	-	2	-	2
2	3	3	3	2	3	0	0	0	2	2	2	2
3	3	2	3	2	3	-	-	-	1	1	1	2
4	2	2	2	2	3	0	0	0	0	1	0	3

Course Title: Big Data Analytics							
Course Code: MCSEDAB224					Examination Scheme		
Total Number of Lecture Hours: 50					External	54	
					Internal	21	
Lecture (L)	3	Practical (P)	0	Tutorial (T)	0	Total Credits	3

Course Objectives

1. *To introduce the fundamentals of big data and the challenges in data management.*
2. *To enable students to use the Hadoop ecosystem for distributed data storage and processing.*
3. *To understand big data frameworks such as Apache Spark for real-time processing.*
4. *To analyze structured and unstructured data using big data tools and algorithms.*

Course Content	No. of Teaching Hours
UNIT 1	12 Hrs

Introduction to Big Data

- Introduction to Big Data – Types, Characteristics, and Challenges
- Traditional vs Big Data Approaches; Big Data Applications in Real-world Scenarios
- Introduction to Hadoop Ecosystem – HDFS Architecture, YARN, MapReduce Framework

UNIT 2	12 Hrs

Hadoop and Data Storage

- HDFS Operations, Blocks, Replication; Data Loading using Sqoop and Flume
- Data Querying using Hive and Pig; Hands-on MapReduce Programming – Word Count, Sorting, Filtering

UNIT 3	12 Hrs

Apache Spark and Real-time Processing

- Spark Architecture – RDDs, DAGs, Lazy Evaluation; Spark Core and SQL
- Spark Streaming and Kafka Integration; Performance Tuning and Monitoring in Spark

UNIT 4	14 Hrs

Advanced Big Data Analytics

- Graph Processing with GraphX; Machine Learning with Spark MLlib
- Text and Sentiment Analysis; Case Studies: Recommendation Systems, Social Media Mining

Books:

1. Tom White, *Hadoop: The Definitive Guide*, O'Reilly Media
2. Vignesh Prajapati, *Big Data Analytics with R and Hadoop*, Packt
3. Matei Zaharia, *Learning Spark: Lightning-Fast Big Data Analysis*, O'Reilly
4. Jure Leskovec, Anand Rajaraman, *Mining of Massive Datasets*, Cambridge University Press
5. Boris Lublinsky et al., *Professional Hadoop Solutions*, Wiley

Course Outcomes

After completing this course, the students will be able to:

1. *Explain the fundamental concepts of big data and challenges in handling it.*
2. *Implement Hadoop-based storage and MapReduce-based processing.*
3. *Analyze large-scale data using Spark for real-time and batch processing.*
4. *Apply big data techniques for analytics on structured and unstructured data.*
5. *Evaluate performance of big data solutions in terms of scalability and efficiency.*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	2	1	1	1	1	-	-	-	-	1
2	3	3	2	2	3	1	1	-	-	-	-	2
3	3	3	3	2	3	1	1	-	-	1	-	3
4	3	3	3	3	3	1	1	-	-	2	1	3
5	2	3	3	2	3	1	-	-	-	2	1	3

Course Title: Data Warehouse and Data Mining							
Course Code: MCSEDAC224						Examination Scheme	
Total Number of Lecture Hours: 50						External	54
						Internal	21
Lecture (L)	3	Practical (P)	0	Tutorial (T)	0	Total Credits	3

Course Objectives

1. *To understand the concepts, architecture, and applications of Data Warehousing.*
2. *To explore the techniques and tools of Data Mining for knowledge discovery.*
3. *To learn methods for data preprocessing, transformation, and visualization.*
4. *To analyze and implement classification, clustering, and association rule mining algorithms.*
5. *To evaluate mining results using different metrics and visualization techniques.*

Course Content	No. of Teaching Hours
UNIT 1	**10 Hrs**

- Introduction to Data Warehousing
- Architecture and Components. Data Modeling and Star, Snowflake Schemas
- ETL Processes, OLAP: Concepts, Types and Operations

UNIT 2	**12 Hrs**

- Data Cleaning, Integration, Transformation, and Reduction
- Discretization and Concept Hierarchy Generation
- Association Rule Mining: Apriori, FP-Growth Algorithms
- Evaluation of Association Patterns

UNIT 3	**12 Hrs**

- Classification: Decision Tree, Naive Bayes, k-NN, SVM
- Prediction Techniques: Linear & Logistic Regression
- Model Evaluation Techniques: Confusion Matrix, Precision, Recall, F1-Score

UNIT 4	**14 Hrs**

- Clustering: k-Means, Hierarchical Clustering, DBSCAN
- Outlier Detection and Anomaly Mining
- Web Mining, Text Mining. Applications of Data Mining in Business and Scientific Domains

Books:

1. **"Data Mining: Concepts and Techniques",** Jiawei Han, Micheline Kamber, Jian Pei 3rd Edition, Morgan Kaufmann
2. **"Data Warehousing Fundamentals"**, Paulraj Ponniah, Wiley
3. **"Mastering Data Mining"**, Michael J. Berry, Gordon S. Linoff, Wiley
4. **"Building the Data Warehouse"**, W.H. Inmon, Wiley
5. **"Introduction to Data Mining"**, Pang-Ning Tan, M. Steinbach, V. Kumar, Pearson Education

Course Outcomes:

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

1. *Understand the architecture and components of data warehouses*
2. *Apply data preprocessing and transformation techniques for data mining*
3. *Analyze and implement classification, clustering, and association algorithms*
4. *Evaluate the results of data mining using appropriate metrics*
5. *Apply mining techniques to real-world datasets using appropriate tools*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	-	-	-	-	-	-	-	-	-	-
2	3	3	2	-	-	-	-	-	-	-	-	-
3	3	3	3	2	-	-	-	-	-	-	-	-
4	2	3	3	-	-	-	-	-	-	-	-	-
5	3	3	3	3	2	-	-	-	2	2		2

Course Title: Data Security & Access Control							
Course Code: MCSEDAD224					**Examination Scheme**		
Total Number of Lecture Hours: 50					**External**	**54**	
					Internal	**21**	
Lecture (L)	**3**	**Practical (P)**	**0**	**Tutorial (T)**	**0**	**Total Credits**	**3**

Course Objectives

- *The objective of the course is to provide fundamentals of access control techniques along with application areas of access control techniques.*
- *Analyse the structure and application of RBAC models and compare them with DAC and MAC access control policies.*
- *Examine integrity and security models while integrating RBAC into enterprise IT infrastructures. Explore smart card technology, its security mechanisms, and emerging trends in data security management.*

Course Content	No. of Teaching Hours
UNIT 1	**10 Hrs**

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Recent trends in access control mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.

UNIT 2	**12 Hrs**

Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy. Case study of Role-Based Access Control (RBAC) systems.

UNIT 3	**12 Hrs**

Biba's integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi-line Insurance Company.

UNIT 4	**14 Hrs**

Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.

Recent Trends related to data security management, vulnerabilities in different DBMS.

Recommended Books:

1. *Computer Security: Principles and Practice" (4th Edition) by William Stallings and Lawrie Brown*
2. *Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli. Second Edition*

Course Outcomes

CO1: In this course, the students will be enabled to understand and implement classical models and algorithms

CO2: They will learn how to analyse the data, identify the problems, and choose the relevant models and algorithms to apply.

CO3: They will learn how to analyse the data, identify the problems, and choose the relevant models and algorithms to apply.

Level of CO-PO Mapping

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	2	1	2	1	1	0	0	1	0	1
2	2	3	3	2	2	1	1	0	0	1	0	1
3	2	3	3	2	2	1	1	0	0	1	0	1

Course Title: Web Analytics & Development							
Course Code: MCSEDAE224						**Examination Scheme**	
Total Number of Lecture Hours: 50						**External**	**54**
						Internal	**21**
Lecture (L)	**3**	**Practical (P)**	**0**	**Tutorial (T)**	**0**	**Total Credits**	**3**

Course Objectives

1. *To provide an in-depth understanding of web analytics tools, methodologies, and metrics.*
2. *To enable students to design and develop interactive, dynamic, and analytics-enabled web applications.*
3. *To integrate analytical insights into web development for optimizing user experience and digital marketing.*
4. *To develop the capability to extract actionable insights from web data to support decision-making.*

Course Content	No. of Teaching Hours
UNIT 1	**10 Hrs**

Web Fundamentals and Development Basics

HTML5, CSS3, JavaScript, Responsive Design, Client-server architecture, HTTP, HTTPS, and protocols, Introduction to Content Management Systems (CMS),

UNIT 2	**UNIT 2**

Server-side Development & Databases

Introduction to backend frameworks (e.g., Node.js/PHP/Python), Connecting to Databases (MySQL, MongoDB), RESTful APIs and Web Services

UNIT 3	**UNIT 3**

Web Analytics Concepts

Introduction to Web Analytics: Definitions, Benefits, Tools, Key Metrics: Page views, sessions, bounce rate, conversions, Google Analytics: Account setup, goals, dashboards, Traffic sources, audience demographics, behaviour analysis.

UNIT 4	**UNIT 4**

Advanced Web Analytics & Optimization

Campaign Tracking: UTM parameters, Email/Ad campaign analysis, A/B Testing and Multivariate Testing, SEO basics, Keyword Analysis, Google Search Console, Heatmaps and Clickstream Analysis

Recommended Books:

1. *Justin Cutroni,* Google Analytics, *O'Reilly Media.*
2. *Avinash Kaushik,* Web Analytics 2.0, *Sybex.*
3. *Jon Duckett,* HTML and CSS: Design and Build Websites, *Wiley.*
4. *Robin Nixon,* Learning PHP, MySQL & JavaScript, *O'Reilly.*

Course Outcomes

1. *Understand fundamental concepts, key tools, and metrics of web analytics.*
2. *Apply web development techniques and integrate analytics solutions into websites.*
3. *Analyze web traffic data and generate actionable insights for business improvement.*
4. *Develop analytics-driven web applications and conduct user behavior analysis.*

Level of CO-PO Mapping

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	2	1	2	1	0	0	0	1	0	1
2	2	3	3	2	2	1	0	0	0	2	0	1
3	2	3	3	2	2	1	0	0	0	1	0	2
4	2	2	3	2	3	1	0	0	0	1	0	2

Course Title: Knowledge Discovery							
Course Code: MCSEDAF224						Examination Scheme	
Total Number of Lecture Hours: 50						External	54
						Internal	21
Lecture (L)	3	Practical (P)	0	Tutorial (T)	0	Total Credits	3

Course Objectives

1. *To introduce the concepts and techniques of data mining and knowledge discovery.*
2. *To impart knowledge about preprocessing, cleaning, and transformation of data for mining tasks.*
3. *To develop skills in various data mining techniques such as classification, clustering, and association rule mining.*
4. *To enable students to analyze real-world data using advanced tools and interpret the discovered knowledge.*

Course Content	No. of Teaching Hours
UNIT 1	10 Hrs

Introduction and Preprocessing

Introduction to KDD process, Difference between data mining and knowledge discovery, Types of data and patterns, Data preprocessing: data cleaning, integration, reduction, transformation, Data warehousing: OLAP, data cube technology

UNIT 2	12 Hrs

Classification and Prediction

Basic concepts, decision tree induction, Bayesian classification, Rule-based classification, model evaluation and performance metrics, Techniques: k-nearest neighbor, SVM, ensemble methods (bagging, boosting), Predictive modeling and regression techniques

UNIT 3	12 Hrs

Clustering and Association Analysis

Cluster analysis: Partitioning methods, hierarchical methods, density-based methods, Evaluation of clustering techniques, Association rule mining: Apriori algorithm, FP-Growth algorithm, Interestingness measures and constraint-based mining

UNIT 4	14 Hrs

Advanced Topics and Applications

Web mining, spatial mining, text and multimedia mining, Mining social network data, Privacy preserving data mining, Case studies in retail, health, finance, and bioinformatics

Recommended Books:

1. *Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques," Morgan Kaufmann.*
2. *Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, "Introduction to Data Mining," Pearson.*
3. *Arun K. Pujari, "Data Mining Techniques," Universities Press.*
4. *Ian H. Witten, Eibe Frank, and Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques," Morgan Kaufmann.*

Course Outcomes

1. *Understand the foundational concepts of data mining and knowledge discovery processes.*
2. *Apply data preprocessing techniques to prepare data for analysis.*
3. *Design and implement data mining algorithms for classification, clustering, and association rule mining.*
4. *Evaluate and interpret the results from real-world data mining applications*

Level of CO-PO Mapping

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	1	2	1	-	-	-	-	-	-	-
2	3	3	2	2	2	-	-	-	-	-	-	-
3	3	3	3	2	3	-	-	-	-	-	-	-
4	3	2	2	3	2	1	-	-	-	-	-	-