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

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	-	-

PROGRAM ELECTIVE-III & IV

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

Ext

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	-	-	-	-	-	-

Course Title: Introduction to Deep Learning							
Course Code: MCSEDAG224						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

To present the mathematical, statistical and computational challenges of building neural networks and study the concepts of deep learning to enable the students to know deep learning techniques to support real-time applications and examine the case studies of deep learning techniques.

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

Principles of ANN design, Basic network structure, Perceptron's input-output principles, Feedforward neural networks - deep model, Output units and hidden units.
Backpropagation algorithm: Gradient Descent (GD), Momentum-based GD, Nesterov Accelerated GD, Stochastic GD. Vanishing gradient problem.
New optimization methods: Adagrad, Adadelta, RMSprop, Adam

UNIT 2	**10 Hrs**

Training deep models: Hyperparameters and validation sets, Cross-validation, Overfitting and underfitting, Bias vs variance trade-off.
Regularization methods: Dropout, Batch Normalization, Early stopping Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Greedy Layerwise Pre-training, Better activation functions & weight initialization methods, Batch Normalization

UNIT 3	**10 Hrs**

Convolution operation, Pooling layers, Regularization in CNNs, Architectural overview of CNNs, Layers, filters, parameter sharing. Popular CNN architectures: AlexNet, VGGNet, GoogleNet, ResNet

UNIT 4	**10 Hrs**

Sequence learning with neural networks, Unrolling the recurrence, Training RNNs - Backpropagation Through Time (BPTT), Long Short-Term Memory (LSTM), Bidirectional LSTM, Gated Recurrent Units. Encoder-decoder sequence-to-sequence architecture, Attention mechanism, Attention mechanism over images. Introduction to unsupervised training of neural networks: Restricted Boltzmann Machines.

Recommended Books:

1. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
3. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
4. Hands–On Machine Learning with Scikit–Learn and TensorFlow 2e: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurelien Geron

Course Outcomes:

1. *Explain the fundamental concepts of artificial neural networks (ANNs), including perceptrons, feedforward networks, backpropagation, and optimization techniques such as gradient descent and Adam optimizer.*
2. *Apply deep learning techniques such as dropout, batch normalization, and regularization to design, train, and optimize neural network models while addressing issues like overfitting, vanishing gradients, and hyperparameter tuning.*
3. *Analyze/implement various deep learning architectures including CNNs and RNNs attention mechanisms, and encoder-decoder models for tasks involving images, sequences, and time-series data.*
4. *Evaluate machine learning models using cross-validation, ensemble methods, and clustering algorithms, and demonstrate understanding of advanced topics like reinforcement learning, PCA, generative models, and Bayesian inference.*

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	2
2	3	3	3	2	2	1	-	-	1	1	1	2
3	3	3	3	2	3	1	-	-	1	1	1	2
4	3	3	2	3	3	1	1	1	1	2	2	2

Course Title: Pattern Recognition							
Course Code: MCSEDAH224					**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

- *To introduce basic concepts of probability, random processes, and linear algebra relevant to pattern recognition.*
- *To study Bayes decision theory and statistical methods for parameter estimation.*
- *To understand clustering, unsupervised learning techniques, and sequential pattern recognition models like HMMs.*
- *To explore dimensionality reduction techniques, discriminant functions, and non-metric classification methods.*

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

Basics of Probability, Random Processes and Linear Algebra: Probability: independence of events, conditional and joint probability, Bayes' theorem; Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra; Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors.

UNIT 2	**10 Hrs**

Bayes Decision Theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features
Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case

UNIT 3	**10 Hrs**

Unsupervised learning and clustering: Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation; Maximum entropy estimation
Sequential Pattern Recognition: Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs
Nonparametric techniques for density estimation: Parzen-window method; K-Nearest Neighbour method

UNIT 4	**10 Hrs**

Dimensionality reduction: Fisher discriminant analysis; Principal component analysis; Factor Analysis
Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines
Non-metric methods for pattern classification: Non-numeric data or nominal data; Decision trees: CART

Recommended Books:

1. Devi V.S. Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R.O. Duda, P.E. Hart and D.G. Stork, Pattern Classification, John Wiley,2001.
3. Statistical Pattern Recognition; K. Fukunaga; AcademicPress,2000.
4. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4thEd., AcademicPress,2009.

Course Outcomes:

1. *Understand fundamental concepts of probability, random processes, and linear algebra for pattern recognition tasks.*
2. *Apply Bayes Decision Theory and statistical parameter estimation for designing classifiers.*
3. *Design and implement clustering algorithms, Hidden Markov Models (HMMs), and nonparametric density estimation methods.*
4. *Apply dimensionality reduction techniques and construct classifiers using linear and non-metric methods like decision trees and SVMs.*

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	1	1	1	1	1	1	2
2	3	3	3	2	3	1	1	1	2	1	1	2
3	3	3	3	3	3	2	2	1	2	1	1	3
4	3	3	3	3	3	2	2	1	2	2	1	3

Course Title: Audit Course							
Course Code: MCSEAXX224						Examination Scheme	
Total Number of Lecture Hours: 50						External	0
						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 Algorithms Lab								
Course Code: MCSELAL224						**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

The aim of the Lab is to develop the ability to design, implement, and analyze advanced algorithmic techniques for solving complex computational problems, including graph algorithms, greedy strategies, dynamic programming, number-theoretic algorithms, and NP-complete problem approximations.

List of Experiments

1. Implement and analyze basic sorting algorithms (e.g., Merge Sort, Quick Sort, Heap Sort) with time and space complexity evaluation.
2. Implement BFS & DFS for traversal and shortest path computation in unweighted graphs.
3. Implement Dijkstra's algorithm for finding the shortest paths in weighted graphs.
4. Implement a Greedy algorithm for MST using Kruskal's and Prim's algorithms.
5. Implement graph matching algorithms (e.g., basic augmenting paths and Edmond's Blossom Algorithm for maximum matching).
6. Solve the Maximum Flow Problem using Ford-Fulkerson Method and Edmond-Karp Algorithm.
7. Implement Floyd-Warshall algorithm for finding all-pairs shortest paths.
8. Apply Chinese Remainder Theorem (CRT) for solving modular arithmetic problems.
9. Implement efficient Integer Multiplication using Schonhage-Strassen algorithm (basic version or an optimized large number multiplication).
10. Solve Linear Programming problems using the Simplex Method manually and/or using available libraries like SciPy. optimize. linprog.
11. Study and simulate an NP-complete problem (e.g., Vertex Cover or Subset Sum problem)
12. Implement an Approx. Algorithm for a classical NP-hard problem (e.g., Vertex Cover, TSP).
13. Implement a basic Randomized Algorithm (e.g., Randomized QuickSort or Randomized Selection Algorithm).

***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. *Implement sorting algorithms (Merge, Quick, Heap), graph algorithms (BFS, DFS, Dijkstra), and perform time-space complexity analysis.*
2. *Implementation of solutions for problems like MST (Kruskal's/Prim's), graph matching, maximum flow (Ford-Fulkerson, Edmond-Karp), and shortest paths (Floyd-Warshall).*
3. *Solve modular arithmetic and number-theoretic problems using efficient algorithms, apply Chinese Remainder Theorem, perform efficient integer multiplication (Schonhage-Strassen), and solve linear programming problems using Simplex Method.*
4. *Explore and simulate NP-complete problems, approximation, and randomized algorithms Students will investigate NP-hard problems (like Vertex Cover), implement approximation and randomized algorithms, and evaluate their computational complexity and performance.*

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	2	-	-	-	1	1	-	2
3	3	3	2	2	2	1	-	1	-	1	-	3
4	3	3	2	2	1	-	-	-	1	1	1	3

Course Title: Data Visualisation Lab							
Course Code: MCSELAA224						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 students to the core principles of visual perception, Gestalt principles, and their application to effective data visualization design.*
- *To equip students with the skills necessary to design and implement diverse data visualizations, leveraging interaction techniques and visual mapping strategies.*
- *To explore emerging trends, advanced techniques, and real-time data visualization technologies in order to develop innovative visualization applications.*

List of Experiments

1. Implement basic visualizations (bar charts, line graphs) using Python (Matplotlib, Seaborn) for one- and multi-dimensional datasets.
2. Create visualizations applying Gestalt principles (proximity, similarity, continuity) and analyze their impact on data interpretation.
3. Develop interactive visualizations using filtering, zooming, and linking with tools like Tableau or Plotly for multi-dimensional data.
4. Visualize geographic data (maps, heatmaps) using tools like GeoPandas or ArcGIS to represent spatial information effectively.
5. Visualize complex data (volumetric data, vector fields) using tools like Mayavi or Paraview for scientific applications.
6. Develop a collaborative system for real-time data interaction and shared visualization views.
7. Create dynamic visualizations that update with live data (e.g., stock market) and explore performance challenges.
8. Compare visualization methods (scatter plots, heatmaps) and assess their effectiveness for different data types.

Course Outcomes:

CO1: Apply visual perception principles and Gestalt laws in designing efficient and meaningful data visualizations.
CO2: Develop and evaluate effective interactive visualizations using different data types and interaction techniques
CO3: Visualize complex datasets, including volumetric data, GIS data, and dynamic processes, using advanced tools and techniques.
CO4: Understand and implement emerging trends in data visualization, including immersive technologies and real-time visualization systems.

Level of CO-PO Mapping

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

Course Title: Big Data Analytics Lab							
Course Code: MCSELAB224					**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. *Hands-on experience in Hadoop ecosystem components.*
2. *Practice with Spark-based big data processing.*
3. *Build simple real-time analytics pipelines.*

List of Experiments

1. HDFS File Operations and Word Count using MapReduce
2. Data Loading using Flume and Sqoop
3. Querying Big Data using HiveQL
4. Processing large datasets with Spark Core and Spark SQL
5. Real-time data stream processing using Spark Streaming and Kafka
6. Sentiment analysis using Spark MLlib
7. Building a Recommendation Engine using collaborative filtering

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

Course Outcomes:

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

CO1: *Demonstrate HDFS and Hadoop ecosystem usage*

CO2: *Perform batch and real-time processing using Spark*

CO3: *Design and implement big data analytics workflows*

CO4: *Apply machine learning algorithms using*

Level of CO-PO Mapping

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

Course Title: Data Warehouse and Data Mining Lab							
Course Code: MCSELAC224					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 data preprocessing and transformation methods.*
2. *To practice data mining algorithms using open-source tools like Weka, Python*
3. *To evaluate and visualize mining results effectively.*

List of Experiments

1. Data Cleaning and Preprocessing using Pandas
2. Dimensionality Reduction using PCA
3. Implementation of Apriori Algorithm and FP-Growth
4. Classification using Decision Tree and Naive Bayes
5. Clustering using k-Means and DBSCAN
6. Text Classification using NLP
7. Data Visualization with Matplotlib and Seaborn
8. Association Rule Mining using Weka
9. Predictive Modeling with Logistic Regression

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

Course Outcomes:

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

1. *Perform preprocessing and transformation on various datasets.*
2. *Implement and evaluate data mining algorithms using tools.*
3. *Analyze the performance and visualization of mining techniques.*

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	3	3	2	-	-	-	2	-	-	2
3	2	3	3	2	-	-	-	-	-	2	-	-

Course Title: Data Security & Access Control Lab							
Course Code: MCSELAD224					**Examination Scheme**		
Total Number of Lecture Hours: 30					**External**		**36**
					Internal		**14**
Lecture (L)	**0**	**Practical (P)**	**4**	**Tutorial (T)**	**0**	**Total Credits**	**2**

List of Experiments

1) Simulate Access Control Lists (ACLs) using Python dictionaries, and compare Discretionary Access Control (DAC) with Mandatory Access Control (MAC).
2) Implement simple access control policies using Python scripts, and test them with simulated user requests.
3) Simulate Attribute-Based Access Control (ABAC) using user attributes in Python, and compare it with traditional ACL methods.
4) Analyse a real-world access control implementation (e.g., in healthcare or government) and prepare a brief report on its effectiveness.
5) Develop a basic Role-Based Access Control (RBAC) system by mapping users, roles, and permissions using Python.
6) Extend the RBAC system to include role hierarchies and permission inheritance for more efficient access management.
7) Compare the behaviour of RBAC, DAC, and MAC models through simple Python simulations and discuss their respective strengths and weaknesses.
8) Review a case study of a real-world RBAC implementation (e.g., in a banking environment) and document its key features in a report.
9) Simulate Biba's integrity model in Python.
10) Simulate the Clark-Wilson security model using Python

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

Computing Resources

- **Operating Systems:** Windows, Linux (e.g., Ubuntu)
- **Programming Language:** Python
- **Virtualization Tools (Optional):** VirtualBox or Docker

Course Title: Web Analytics & Development Lab							
Course Code: MCSELAE224						**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 impart practical skills for collecting, analyzing, and interpreting web data using industry-standard tools and techniques.*
2. *To enable students to implement web tracking mechanisms like cookies, session tracking, and user behavior monitoring.*
3. *To train students in using analytics platforms such as Google Analytics for deriving actionable insights from user interaction data.*
4. *To develop hands-on expertise in creating dashboards and reports for evaluating web performance and supporting data-driven decisions.*

List of Experiments

1. Create a basic responsive website using HTML, CSS, and JavaScript.
2. Implement form validation and interactivity with JavaScript.
3. Develop a simple web application using a backend framework (Node.js/PHP).
4. Connect a web application to a database and retrieve data.
5. Set up Google Analytics for a test website.
6. Track website traffic, bounce rate, and user flow.
7. Set goals, create dashboards, and interpret analytics data.
8. Perform A/B testing using Google Optimize.
9. Analyze SEO performance using Google Search Console.
10. Visualize web traffic using heatmap tools (e.g., Hotjar/Clarity).

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

Course Outcomes:

1. *Develop and deploy dynamic and responsive web applications.*
2. *Integrate Google Analytics and other tools for web tracking.*
3. *Analyze web traffic data and interpret reports.*
4. *Perform testing and optimization for improving website performance.*

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	-	2
2	2	3	2	3	3	-	-	-	-	2	-	2
3	2	3	3	3	2	1	-	1	-	2	1	2
4	2	2	3	3	3	-	1	-	-	3	-	2

Course Title: Knowledge Discovery Lab							
Course Code: MCSELAF224						**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 practice data preprocessing techniques on real-world datasets.*
2. *To implement and evaluate classification and clustering algorithms.*
3. *To apply association rule mining on transactional datasets.*
4. *To develop and present a complete knowledge discovery pipeline.*

List of Experiments

1. Data cleaning and preprocessing using Python or R.
2. Implementation of classification algorithms (e.g., Decision Tree, Naive Bayes).
3. Implementation of clustering algorithms (e.g., K-Means, DBSCAN).
4. Association rule mining using Apriori and FP-Growth.
5. Web and text mining using open-source tools.
6. Mini project: Apply data mining pipeline on a real-world dataset.

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

Course Outcomes:

1. *Perform preprocessing and feature selection techniques on datasets.*
2. *Build and evaluate machine learning models for classification and clustering.*
3. *Implement and interpret association rules.*
4. *Design a mini-project involving end-to-end data mining.*

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	-	-	-	-	-	-	-
2	3	2	3	2	2	-	-	-	-	-	-	-
3	2	2	2	2	2	-	-	-	-	-	-	-
4	3	3	3	3	3	2	-	-	2	1	-	2

Course Title: Introduction to Deep Learning Lab								
Course Code: MCSELAG224						**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 enable students with both theoretical understanding and practical implementation skills in modern neural network architectures, building a single-layer perceptron from scratch for binary classification, and implementing a basic Artificial Neural Network (ANN) using TensorFlow and Keras for tasks like handwritten digit recognition with the MNIST dataset.

List of Experiments

1. Design a single unit perceptron for classification of a linearly separable binary dataset without using pre-defined models.
2. Design and implement a basic Artificial Neural Network (ANN) using TensorFlow & Keras for a simple classification task (e.g., handwritten digit recognition using MNIST dataset).
3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
4. Design and implement an Image classification model to classify a dataset of images using Deep Feed Forward NN. Record the accuracy corresponding to the number of epochs. Use the MNIST datasets.
5. Design and implement a CNN model to classify multi category image datasets. Record the accuracy corresponding to the number of epochs. Use the MNIST, CIFAR-10 datasets.
6. Use the concept of Data Augmentation to increase the data size from a single image.
7. Implement the standard VGG-16 & 19 CNN architecture model to classify multi category image dataset and check the accuracy.
8. Implement RNN for sentiment analysis on movie reviews
9. Implement Bi-directional LSTM for sentiment analysis on movie reviews.
10. Implement Auto encoders for image denoising on MNIST dataset.

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 the fundamentals of neural networks and perceptron-based models for solving linearly separable classification problems.*
2. *Design, develop, and evaluate deep neural network architectures including feedforward networks and convolutional neural networks for image classification tasks.*
3. *Apply advanced deep learning models such as RNN and Bi-LSTM for natural language processing tasks like sentiment analysis.*
4. *Demonstrate the application of autoencoders for unsupervised learning tasks such as image denoising and feature extraction.*

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	-	-	1	1	1	-	2
2	3	3	3	2	3	1	-	1	2	2	1	2
3	3	3	3	3	3	1	-	1	2	2	1	3
4	3	2	3	3	3	1	-	1	2	2	1	2

Course Title: Pattern Recognition Lab								
Course Code: MCSELAH224						**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 practically implement pattern recognition algorithms and methods.*
- *To build classifiers and clustering models based on different approaches (Bayesian, nonparametric, machine learning models).*
- *To analyze and interpret results obtained from various pattern recognition methods.*
- *To develop skills for applying pattern recognition techniques on real-world datasets*

List of Experiments

1. Implement and visualize basic probability distributions (e.g., Gaussian, Binomial) and random processes.
2. Implement Bayes Classifier for two-class classification using Gaussian assumption.
3. Estimate parameters (mean, variance) from data using Maximum Likelihood Estimation (MLE) and Bayesian Estimation.
4. Develop a K-Means Clustering algorithm from scratch and compare it with scikit-learn's KMeans.
5. Train and test a simple Hidden Markov Model (HMM) using discrete observations (e.g., Weather prediction).
6. Build a K-Nearest Neighbor (KNN) Classifier from scratch and validate it on a real dataset (e.g., Iris Dataset).
7. Apply Principal Component Analysis (PCA) for dimensionality reduction and visualize 2D projections.
8. Implement Linear Discriminant Analysis (LDA) for classification tasks.
9. Build and evaluate a Support Vector Machine (SVM) classifier using a sample dataset.

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 fundamental statistical models for pattern recognition.*
2. *Design and evaluate supervised learning models using Bayesian and nonparametric methods.*
3. *Implement clustering algorithms and validate unsupervised learning models.*
4. *Apply dimensionality reduction techniques and construct interpretable models*
5. *Use advanced classifiers like SVMs, Decision Trees, and HMMs to solve practical problems.*

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	1	1	1	1	1	2
2	3	3	3	2	3	2	1	1	1	1	1	2
3	3	3	3	3	3	2	1	1	1	1	1	2
4	3	3	3	3	3	2	1	1	1	1	1	3
5	3	3	3	3	3	2	2	1	1	1	1	3