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: 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

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

3rd Semester

PROGRAM ELECTIVE-V

Course Code: MCSEDAA324	Course Title: Big Data Processing Frameworks							
Total Number of Lecture Hours: 50						Examination Scheme		
						External	54	
Lecture (L)	3	Practical (P)	0	Tutorial (T)		Internal	21	
					0	Total Credits		3

Course Objectives

1. *To understand the core concepts and architecture of big data processing frameworks.*
2. *To enable students to process and analyze massive datasets using distributed computing tools like Hadoop and Spark.*
3. *To develop practical skills in data ingestion, transformation, and real-time analytics using modern big data frameworks.*
4. *To apply scalable algorithms and best practices in big data application development.*

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

Introduction to Big Data and Hadoop Ecosystem

Characteristics of Big Data: Volume, Velocity, Variety, Veracity, Value, Challenges in Big Data Management, Hadoop Architecture: HDFS, MapReduce, YARN, Hadoop Ecosystem Tools: Hive, Pig, HBase, Flume, Sqoop

UNIT 2	**12 Hrs**

Apache Spark Fundamentals

Spark Architecture and Components: Driver, Executor, Cluster Manager, RDDs and DataFrames, Transformations and Actions, Spark SQL and DataFrames, Introduction to Structured Streaming

UNIT 3	**12 Hrs**

Data Processing and Analytics in Spark

Data ingestion using Kafka, Flume, and Sqoop, ETL operations in Spark, Machine Learning with Spark MLlib, Graph Processing with GraphX, Spark Tuning and Performance Optimization

UNIT 4	**14 Hrs**

Real-Time Processing and Case Studies

Real-time Data Processing using Spark Streaming, Integration with NoSQL databases: Cassandra, HBase, Case Studies: Log Analysis, Fraud Detection, Recommendation Systems, Industry Use Cases and Trends in Big Data Frameworks

Recommended Books:

1. *Tom White, "Hadoop: The Definitive Guide," O'Reilly Media.*
2. *Holden Karau, Andy Konwinski, Patrick Wendell, and Matei Zaharia, "Learning Spark," O'Reilly Media.*
3. *Bill Chambers and Matei Zaharia, "Spark: The Definitive Guide," O'Reilly Media.*
4. *Chuck Lam, "Hadoop in Action," Manning Publications*

Course Outcomes

1. *Understand and explain big data architecture, tools, and frameworks.*
2. *Develop and deploy big data applications using Hadoop and Spark.*
3. *Perform batch and real-time analytics using Spark SQL and Streaming.*
4. *Evaluate and apply big data frameworks to solve real-world business problems.*

Level of CO-PO Mapping

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

Course Title: Cloud Computing								
Course Code: MCSEDAB324						**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

- *introduce the basic concepts and principles of Cloud Computing, its architecture, and service models.*
- *develop the ability to design and deploy scalable, reliable, and cost-efficient cloud-based applications.*
- *impart knowledge about various cloud deployment models (public, private, hybrid) and cloud architecture patterns.*

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

Overview of Computing Paradigm: Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloudcomputing, business driver for adopting cloud computing. **Introduction to Cloud Computing:** Introduction to Cloud Computing (NIST Model), History of Cloud Computing, Cloud service providers. Properties, Characteristics & Disadvantages, Role of Open Standards. **Cloud Computing Architecture:** Cloud computing stack: Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Roleof Networks in Cloud computing, protocols used, Role of Web services. Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service(PaaS), Software as a Service(SaaS)

UNIT 2	**10 Hrs**

Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud
Infrastructure as a Service (IaaS): IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, and Virtual Machine (VM). **Resource Virtualization:** Server, Storage, Network. Virtual Machine (resource) provisioning andmanageability, storage as a service, Data storage in cloud computing (storage as a service). Examples: Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers

UNIT 3	**10 Hrs**

Platform as a Service (PaaS): What is PaaS? Service Oriented Architecture (SOA). Cloud Platform and Management: Computation, Storage. Examples: Google App Engine, MS Azure
Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study SaaS

UNIT 4	**10 Hrs**

Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data **Cloud Security:** Infrastructure Security: Network level security, Host level security, Application level security. Data security and Storage: Data privacy and security Issues, Jurisdictional issues raisedby Data location. Identity & Access Management. Authentication in cloud computing.
Case Study on Open Source & Commercial Clouds: Eucalyptus, Microsoft Azure, Amazon EC2

Recommended Books:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
2. Cloud Computing: Principles & Paradigms, Editors: R. Buyya, J. Broberg, Andrzej, Wile, 2011
3. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

Course Outcomes:

1: *Explain cloud computing principles and service models.*
2: *Successfully deploy and manage cloud-based applications.*
3: *Apply best practices for cloud service management.*
4: *Assess the economic aspects of cloud computing platforms*

Level of CO-PO Mapping

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

Course Title: Distributed Databases

Course Code: MCSEDAC324	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 architecture and key concepts of distributed databases.*
2. *To explore query processing and optimization techniques in distributed environments.*
3. *To study transaction management, concurrency control, and recovery mechanisms in distributed systems.*
4. *To examine distributed data storage, replication, and distributed system reliability.*

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

Introduction to Distributed Databases

Distributed database concepts and architecture, Goals and challenges of distributed databases, Types of distributed databases, Data fragmentation, allocation, and replication

UNIT 2	**12 Hrs**

Distributed Query Processing

Query decomposition and data localization, Query optimization techniques, Join strategies in distributed databases, Cost models for distributed query optimization

UNIT 3	**12 Hrs**

Transaction Management in Distributed Databases

ACID properties in distributed context, Distributed transactions and commit protocols (2PC, 3PC), Concurrency control: locking mechanisms, timestamp ordering, Deadlock detection and resolution

UNIT 4	**14 Hrs**

Reliability, Replication, and Current Trends

Distributed database recovery techniques, Database replication: models and consistency, Fault tolerance and system reliability, Trends: NoSQL and NewSQL in distributed environments

Recommended Books

1. *M. Tamer Özsu and Patrick Valduriez,* Principles of Distributed Database Systems, *Springer, 4th Ed.*
2. *Stefano Ceri and Giuseppe Pelagatti,* Distributed Databases: Principles and Systems, *McGraw-Hill*
3. *Elmasri and Navathe,* Fundamentals of Database Systems, *Pearson*
4. *Recent papers and articles on distributed data management from IEEE/ACM Digital Libraries*

Course Outcomes: After successful completion of this course, the student will be able to:

1. *Explain the architecture, models, and design issues of distributed databases.*
2. *Analyze distributed query processing and optimization strategies.*
3. *Apply concurrency control and recovery techniques in a distributed setting.*
4. *Evaluate data fragmentation, replication, and consistency models in distributed 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	2	0	0	0	0	0	0	1
2	3	3	3	2	2	0	0	0	0	1	0	1
3	2	3	3	3	3	0	0	0	0	1	0	1
4	2	2	3	2	3	1	0	1	1	1	0	2

Course Title: Natural Language Processing								
Course Code: MCSEDAD324						**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 students with a comprehensive understanding of the key concepts, techniques, and tools used in Natural Language Processing (NLP).*
2. *To familiarize students with linguistic resources and statistical models used in various NLP tasks.*
3. *To explore advanced topics like discourse analysis, machine translation, & ethical challenges in NLP.*

Course Content	No. of Teaching Hours
UNIT 1	**14 Hrs**
Human languages, ambiguity, and language processing paradigms. Phases in natural language processing and key applications. Text representation and encoding schemes in computers. Linguistic resources – corpus creation, balanced corpora. Regular expressions and finite state automata for word recognition and lexical analysis. Morphological analysis and finite state transducers. Introduction to statistical approaches – n-gram models, smoothing techniques, and entropy. Overview of classification models – HMM, Maximum Entropy, and CRF. Part-of-speech tagging – stochastic tagging, HMM-based tagging, and transformation-based tagging (TBL); handling unknown words and named entities.	
UNIT 2	**12 Hrs**
Overview of natural language grammars; basic linguistic elements – lexemes, phonemes, phrases, idioms. Grammatical constructs – word order, agreement, tense, aspect, and mood. Context-free grammars and their role in natural language syntax. Parsing strategies – unification-based parsing and probabilistic parsing using TreeBank data. Introduction to semantics – meaning representation, lexical semantics, and the use of WordNet. Word Sense Disambiguation.	
UNIT 3	**12 Hrs**
Discourse analysis – reference resolution, co-reference constraints, pronoun resolution, and discourse coherence. Applications of NLP – spell-checking, text summarization, and information retrieval. Vector space model, term weighting, and linguistic challenges such as synonymy and polysemy. Introduction to machine translation – basic methods and challenges.	
UNIT 4	**10 Hrs**
Formal language theory and the Chomsky hierarchy in the context of NLP. Overview of structured prediction with Conditional Random Fields. Challenges in NLP – ambiguity, sparse data, low-resource language processing, and multilingual NLP. Ethical issues in NLP – bias, fairness, and interpretability in language technologies. Recent trends – pre-trained transformers (e.g., BERT, GPT), large-scale language modeling, and emerging directions in NLP research	

Recommended Books

1. ***"An Introduction to Natural Language Processing, Third Edition"*** *by Daniel Jurafsky and James H. Martin, Tata McGraw-Hill*
2. ***"Computational Linguistics and Speech Recognition"*** *by James H. Martin, Pearson Education*
3. ***"Natural Language Processing with Python"*** *by S Bird, E Klein, and Edward Loper O'Reilly Media*
4. ***"Foundations of Statistical Natural Language Processing"*** *Christopher D. Manning and Hinrich Schutze, MIT Press*

Course Outcomes

CO1: Understand the foundational concepts and techniques in NLP, including text representation and linguistic resources.

CO2: Apply NLP methods such as part-of-speech tagging, parsing, and word sense disambiguation.

CO3: Solve practical problems in information retrieval, discourse analysis, and machine translation.

CO4: Identify & evaluate challenges in NLP, including ambiguity, resource limitations, and ethical issues.

Level of CO-PO Mapping

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

Course Title: Social Network Data Analytics								
Course Code: MCSEDAE324						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 basic concepts and models of social network analysis.*
2. *To explore methods for analyzing the structure and dynamics of social networks.*
3. *To study algorithms for mining data from large-scale social networks.*
4. *To gain insight into real-world applications like influence maximization, link prediction, and recommendation.*

Course Content	No. of Teaching Hours
UNIT 1	10 Hrs

Introduction to Social Networks

Social network definition and types (online/offline, explicit/implicit), Graph theory basics: nodes, edges, degree, paths, Properties of social networks: small world, scale-free, clustering, Examples: Facebook, Twitter, LinkedIn, citation networks

UNIT 2	12 Hrs

Network Measures and Models

Centrality measures: degree, betweenness, closeness, eigenvector, Community detection: modularity, hierarchical clustering, Random graph models: Erdős–Rényi, Watts–Strogatz, Barabási–Albert, Influence and homophily in networks

UNIT 3	12 Hrs

Mining Social Network Data

Crawling social network data, Link prediction techniques, Influence maximization models (independent cascade, linear threshold), Recommendation systems in social networks.

UNIT 4	14 Hrs

Applications and Tools

Real-world applications: marketing, health, security, Case studies: misinformation detection, political polarization, Tools: Gephi, NetworkX, SNAP, Neo4j, Ethical issues in social network analysis (privacy, bias, fairness)

Recommended Books:

1. ***Charu C. Aggarwal,*** Social Network Data Analytics, *Springer*
2. ***David Easley and Jon Kleinberg,*** Networks, Crowds, and Markets, *Cambridge University Press*
3. ***Stanley Wasserman and Katherine Faust,*** Social Network Analysis: Methods and Applications, *Cambridge University Press*
4. ***Matthew A. Russell,*** Mining the Social Web, *O'Reilly Media*
5. *Research papers from ACM/IEEE conferences (WSDM, KDD, WWW)*

Course Outcomes

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

1. *Explain the fundamentals and types of social networks and their properties.*
2. *Apply network analysis metrics and models to interpret social graphs.*
3. *Implement and evaluate algorithms for mining social network data.*
4. *Analyze applications of social network analysis in various domains such as marketing, recommendation, and cybersecurity.*

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	0	0	1	0	0	0	1
2	3	3	2	2	2	1	1	1	0	1	0	2
3	3	3	3	3	3	1	1	1	1	1	1	2
4	3	2	3	2	3	1	1	2	1	2	1	-

Course Title: GPU Computing							
Course Code: MCSEDAF324					**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

- *Introduction to parallel computing paradigms with a focus on GPU*
- *Harness the massively parallel GPU architecture for solving computationally demanding tasks.*
- *Introduction to NVIDIA CUDA and industry standard OpenCL frameworks.*
- *Understanding GPU programming through scientific computational problems.*

Course Content	No. of Teaching Hours
UNIT 1	**12 Hrs**
Review of traditional computer architecture, Brief history, GPU Architecture, Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Kernels Launch parameters, Thread hierarchy, Warps/Wavefronts, Threadblocks/Workgroups, Streaming multiprocessors, 1D/2D/3D thread mapping, Device properties, Simple programs	
UNIT 2	**12 Hrs**
Memory hierarchy, Locality of reference, Spatial and temporal locality, DRAM / global, local / shared, private / local, textures, Constant memory, Pointers, Parameter passing, Arrays and dynamic memory, Multi-dimensional arrays, Memory allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories, Unified virtual memory	
UNIT 3	**12 Hrs**
Synchronization: Memory consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction, Programs for concurrent data, Structures such as worklists, linked-lists. Synchronization across CPU and GPU, Functions: device functions, host functions, kernels functions, Using libraries (such as Thrust), and developing libraries.	
UNIT 4	**12 Hrs**
Programming support, Debugging GPU programs, Profiling, Profile tools, Performance aspects, Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default stream, Synchronization with streams, Events, Event-based synchronization - Overlapping data transfer and kernel execution, pitfalls, Case studies: Image Processing, Graph algorithms, Simulations, Deep learning	

Recommended Books:

- David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors: A Hands-On Approach, 2nd Edition, Publisher: Morgan Kaufman, 2012.
- Shane Cook, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, Morgan Kaufman; 2012.
- The CUDA Handbook: A Comprehensive Guide to GPU Programming: 1st edition, 2nd edition.

Course Outcomes:

1. *Understand parallel computing paradigms including GPU architecture and development frameworks viz. CUDA and OpenCL.*
2. *Analyse memory hierarchy and comprehend advanced concepts like unified virtual memory.*
3. *Implement efficient algorithms for common application kernels, such as matrix multiplication.*
4. *Highlight the important role of GPUs in domains such as image processing, deep learning, etc.*

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	0	0	0	0	0	0	1
2	3	3	3	3	2	0	0	1	0	0	0	2
3	3	3	3	3	3	0	0	0	0	1	0	2
4	3	2	2	2	3	1	1	2	1	2	1	3

OPEN ELECTIVE

(MCSEOXX324)

Course Title: Business Analytics									
Course Code: MCSEOBA324						**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

- *Understand the role of business analytics within an organization.*
- *Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization. Gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.*
- *To become familiar with processes needed to develop, report, and analyze business data.*
- *Use decision-making tools/Operations research techniques.*
- *Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.*

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

Business analytics: Overview and scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process & organisation, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Review of probability distribution and data modelling, sampling & estimation methods overview. Trendiness & Regression Analysis: Modelling Relationships & Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, Visualizing & Exploring Data, Business Analytics Technology.

UNIT 2	**10 Hrs**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT 3	**10 Hrs**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT 4	**10 Hrs**

Decision Analysis: Formulating Decision Problems, Decision Strategies with Outcome Probabilities, Decision Trees, Value of Information, Utility and Decision Making. Recent Trends in: Embedded & collaborative business intelligence, Visual data recovery, Data Storytelling & Data journalism.

Recommended Books:

1. *Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.*
2. *Business Analytics by James Evans, persons Education.*

Course Outcomes: *After completing this course the students will:*

1. *demonstrate knowledge of data analytics.*
2. *demonstrate the ability of think critically in making decisions based on data and deep analytics.*
3. *demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.*
4. *demonstrate the ability to translate data into clear, actionable insights.*

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

Course Title: Industrial Safety							
Course Code: MCSEOIS324						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 provide fundamental knowledge of industrial safety measures, accident prevention techniques, and legal safety frameworks.*
- *To introduce maintenance engineering concepts, like cost, wear, corrosion, and prevention strategies.*
- *To develop skills for systematic fault tracing and maintenance of industrial machinery and equipment.*
- *To promote the practice of periodic and preventive maintenance for enhancing equipment life and operational efficiency.*

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

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

UNIT 2	**10 Hrs**

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment. Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT 3	**10 Hrs**

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

UNIT 4	**10 Hrs**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Recommended Books:

1. *Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.*
2. *Maintenance Engineering, H. P. Garg, S. Chand and Company.*
3. *Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.*

Course Outcomes: *After completing this course the students will:*

1. *Understand the causes, effects, and prevention methods for industrial accidents, and explain relevant safety regulations.*
2. *Apply maintenance engineering concepts to reduce equipment failures and extend service life.*
3. *Develop and use decision trees for effective fault diagnosis in mechanical, hydraulic, pneumatic, thermal, and electrical systems.*
4. *Plan and implement periodic and preventive maintenance schedules for different types of industrial equipment.*

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

Course Title: Operations Research							
Course Code: MCSEOOR324						**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:

1. *To introduce students to mathematical modelling and optimization techniques for decision-making.*
2. *To provide foundational knowledge of linear, non-linear, and dynamic programming problems and their solution methods.*
3. *To develop analytical skills using tools such as network flow models, scheduling, inventory control, and game theory.*
4. *To enable students to apply operations research techniques in real-life engineering and computational scenarios using simulation and algorithmic strategies.*

Course Content	No. of Teaching Hours
UNIT 1	**10Hrs**
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	
UNIT 2	**10 Hrs**
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	
UNIT 3	**10 Hrs**
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	
UNIT 4	**10 Hrs**
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	

Recommended Books:

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

Course Outcomes: *After completing this course the students will:*

1. *Formulate and solve linear programming problems using simplex, dual simplex, and sensitivity analysis methods.*
2. *Apply techniques of nonlinear programming, CPM/PERT, to solve optimization problems.*
3. *Analyze inventory, scheduling, & queuing models to optimize resource allocation & service efficiency. Use advanced topics such as game theory, dynamic programming, simulation, and graph theory to model complex decision-making 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	2	1	1	1	1	2	1	2
2	3	3	3	3	3	2	1	1	2	2	1	2
3	3	3	3	3	2	2	1	1	1	2	1	2
4	3	3	3	3	3	2	2	2	2	2	2	3

Course Title: Cost Management of Engineering Projects

Course Code: MCSEOCE324	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 provide foundational knowledge of strategic cost management & its role in engineering projects.*
- *To develop an understanding of cost concepts in decision-making & their application in project execution.*
- *To equip students with the skills for cost estimation, budgeting, and cost control throughout a project's lifecycle.*
- *To introduce tools like ERP, TQM, and optimization methods (LP, PERT/CPM) for efficient project and cost management.*

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

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT 2	**10 Hrs**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types & contents. Project execution Project cost control. Bar charts & Network diagram. Project commissioning: mechanical and process.

UNIT 3	**10 Hrs**

Cost Behaviour and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning,

UNIT 4	**10 Hrs**

Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Recommended Books:

1. *Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi*
2. *Charles T. Horngren and George Foster, Advanced Management Accounting*
3. *Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting*
4. *N.D. Vohra, Quantitative Techniques* in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcomes: *After completing this course the students will:*

4. *Understand strategic cost management principles and various cost concepts applicable in decision-making.*
5. *Explain phases of project execution & identify causes of cost overruns and control mechanisms.*
6. *Apply marginal costing, break-even analysis, & pricing strategies to support managerial decisions.*
7. *Implement quantitative techniques such as Linear Programming, PERT/CPM, and simulation for cost optimization.*

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

Course Title: Composite Materials							
Course Code: MCSEOCM324					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 fundamentals, classification, and characteristics of composite materials.*
- *To develop understanding of different reinforcement materials and their roles in composites.*
- *To familiarize students with manufacturing techniques for metal, ceramic, polymer, and carbon-carbon matrix composites.*
- *To impart knowledge on mechanical behavior, strength analysis, and failure criteria of composite structures.*
- *To enhance students' skills in analyzing the properties and performance of composite materials for various engineering applications.*

Course Content	No. of Teaching Hours
UNIT 1	**10Hrs**
INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	
UNIT 2	**10 Hrs**
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	
UNIT 3	**10 Hrs**
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	
UNIT 4	**10 Hrs**
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	

Recommended Books:

1. *Material Science and Technology – Vol 13 – Composites by R. W. Cahn – VCH, West Germany.*
2. *Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.*
3. *Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.*

Course Outcomes: *After completing this course the students will:*

1. *Understand the classification, advantages, and functional requirements of composite materials.*
2. *Analyze the properties and preparation methods of various reinforcement fibers and particles.*
3. *Evaluate manufacturing techniques for different types of matrix composites and their applications.*
4. *Analyze mechanical behaviour and apply rules of mixtures to predict composite performance.*

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

Course Title: Waste to Energy							
Course Code: MCSEOWE324						**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 fundamental concepts and classification of waste materials suitable for energy production.*
- *To understand the various thermal, thermochemical, and biochemical technologies used for energy conversion from waste.*
- *To impart knowledge about design, construction, and operational features of gasifiers, combustors, and biogas plants.*
- *To analyze and evaluate different waste-to-energy processes for sustainable energy solutions.*
- *To familiarize students with national biomass energy programs and real-world applications of waste-to-energy technologies.*

Course Content	**No. of Teaching Hours**
UNIT 1	**10Hrs**
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	
UNIT 2	**10 Hrs**
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	
UNIT 3	**10 Hrs**
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	
UNIT 4	**10 Hrs**
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	

Recommended Books:

1. *Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.*
2. *Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.*
3. *Biomass Conversion and* Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes: *After completing this course the students will:*

1. *Understand classification of waste and the technologies used for converting waste into energy.*
2. *Analyze the design and operation of various biomass gasification and combustion systems.*
3. *Evaluate the construction and working of pyrolysis devices and biogas plants.*
4. *Compare different biomass conversion methods including thermochemical and biochemical processes.*

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

Course Title: Big Data Processing Frameworks Lab							
Course Code: MCSELAA324						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 provide hands-on experience in using Hadoop and Spark frameworks.*
2. *To implement data processing workflows using Hive, Pig, and Spark SQL.*
3. *To practice developing streaming applications and integrating with Kafka.*
4. *To apply performance tuning techniques and visualize insights.*

List of Experiments

1. Setup and configuration of Hadoop and Spark environments
2. Implementing HDFS file operations and MapReduce programs
3. Writing HiveQL scripts for data analytics
4. Data ingestion with Flume and Sqoop
5. Data processing using Spark RDDs and DataFrames
6. ETL workflow implementation in Spark
7. Real-time streaming data processing with Spark Streaming
8. Integration of Spark with Kafka
9. Machine Learning using Spark MLlib
10. Mini-project using big data pipelines (e.g., recommendation engine, fraud detection)

Course Outcomes:

1. *Demonstrate Hadoop and Spark setup and perform data operations.*
2. *Implement data ingestion, transformation, and querying on big datasets*
3. *Develop real-time processing applications using Spark Streaming.*
4. *Apply and test big data solutions for real-world analytics problems.*

Level of CO-PO Mapping

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

Course Title: Cloud Computing Lab							
Course Code: MCSELAB324					**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. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8. Install Hadoop single node cluster and run simple applications like wordcount.

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

Course Title: Distributed Databases Lab							
Course Code: MCSELAC324					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 distributed database functionalities such as fragmentation, replication, and distributed queries.*
2. *To simulate distributed transaction and concurrency control mechanisms.*
3. *To gain hands-on experience with modern distributed database platforms (e.g., MongoDB).*
4. *To provide practical exposure to NoSQL/NewSQL systems and replication strategies.*

List of Experiments

1. **Fragmentation and Allocation:** Simulate horizontal and vertical fragmentation and perform allocation over multiple nodes.
2. **Distributed Query Execution:** Write and execute distributed queries involving joins and aggregates using PostgreSQL or MySQL clusters.
3. **Replication:** Implement basic master-slave and peer-to-peer replication models.
4. **Two-Phase Commit Protocol (2PC):** Simulate distributed transactions and 2PC.
5. **Concurrency Control:** Demonstrate concurrency control using distributed locking or timestamp ordering.
6. **NoSQL Experimentation:** Create, replicate, and query collections in MongoDB or Cassandra.
7. **Fault Tolerance:** Simulate node failure and recovery using distributed replication strategies.
8. **Case Study or Demo:** Compare query performance in a centralized vs. distributed setup.

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 lab, students will be able to:

1. *Simulate fragmentation, replication, and data allocation schemes.*
2. *Construct and evaluate distributed queries.*
3. *Demonstrate distributed transaction management protocols and concurrency control.*
4. *Experiment with NoSQL databases and replication techniques.*

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	0	0	0	0	0	0	1
2	3	3	3	2	3	0	0	0	1	1	0	1
3	2	3	3	2	3	0	0	0	1	1	0	2
4	2	2	2	2	3	1	0	1	1	1	-	-

Course Title: Natural Language Processing Lab							
Course Code: MCSELAD324					**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 provide students with hands-on experience in implementing foundational NLP techniques like regular expressions, finite state automata, and statistical models for text processing.
2. To familiarize students with modern NLP techniques, including **BERT-based models**, for advanced tasks like text classification, named entity recognition, and machine translation.
3. To equip students with the skills to apply and fine-tune pre-trained transformer models (like BERT) for real-world NLP applications such as sentiment analysis, discourse analysis, and information retrieval.

Suggested List of experiments

1. Implement regular expressions and finite state automata for word recognition and lexical analysis.
2. Perform morphological analysis using finite state transducers.
3. Apply statistical models such as n-grams, HMM, and CRF for tasks like part-of-speech tagging and named entity recognition.
4. Implement context-free grammar parsing and probabilistic parsing for syntactic analysis.
5. Perform word sense disambiguation using both machine learning and dictionary-based approaches.
6. Work on discourse analysis tasks like reference resolution and co-reference resolution.
7. Apply text summarization techniques for extracting key information from documents.
8. Implement BERT-based models for text classification, named entity recognition, and question answering tasks.
9. Fine-tune pre-trained BERT models on custom datasets for tasks like sentiment analysis and machine translation.
10. Complete a mini-project on an advanced NLP application, utilizing transformer-based models (e.g., BERT, GPT).

Course Outcomes:

CO1: Students will be able to implement basic NLP techniques such as word recognition, part-of-speech tagging, and syntactic parsing using traditional models and finite state automata.

CO2: Students will develop proficiency in using BERT and other transformer-based models for tasks such as text classification, named entity recognition, and question answering.

CO3: Students will be able to perform text summarization, discourse analysis, and information retrieval using modern NLP techniques and statistical models.

CO4: Students will gain experience in fine-tuning pre-trained models like BERT on custom datasets to solve real-world problems, including sentiment analysis and machine translation.

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

Course Title: Social Network Data Analytics Lab								
Course Code: MCSELAE324						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 provide hands-on experience with social network data collection, visualization, and analysis.*
2. *To implement core algorithms for centrality, community detection, and influence analysis.*
3. *To use modern tools and libraries for real-world social network data mining.*
4. *To enable students to extract insights from real-world social datasets through analysis and visualization.*

List of Experiments

1. **Graph Basics:** Represent and visualize simple networks using NetworkX or Gephi.
2. **Centrality Measures:** Compute degree, closeness, betweenness, and eigenvector centrality.
3. **Community Detection:** Apply modularity-based and label propagation algorithms.
4. **Network Structure:** Identify small-world and scale-free properties in real-world datasets.
5. **Graph Visualization:** Use Gephi to visualize Twitter or Facebook datasets.
6. **Social Media Crawling:** Extract data from Twitter using Tweepy API.
7. **Link Prediction:** Implement Jaccard, Adamic-Adar, and common neighbor algorithms.
8. **Influence Maximization:** Simulate Independent Cascade and Linear Threshold models.
9. **Recommender Systems:** Create a basic friend or content recommendation engine using graph proximity.
10. **Case Study:** Analyze retweet/repost networks during a trending event (e.g., elections, disasters).

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

Recommended Books:

Course Outcomes:

After completing the lab, students will be able to:

1. *Represent and analyze social networks using real-world tools and libraries.*
2. *Apply algorithms for centrality, community detection, and graph metrics.*
3. *Extract, process, and visualize social media data using APIs and visualization tools.*
4. *Analyze influence, recommend connections, and derive insights from large-scale networks.*

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	0	0	1	0	0	0	1
2	3	3	3	2	2	1	1	1	1	1	0	2
3	3	3	3	3	3	1	1	1	1	1	1	2
4	3	3	3	3	3	1	1	2	1	2	1	3

Course Title: GPU Computing Lab							
Course Code: MCSELAF324					**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 understand and explore GPU architecture and the CUDA programming model.*
2. *To develop efficient parallel code using CUDA/OpenCL/OpenACC for various computing problems.*
3. *To understand GPU memory hierarchy and optimize memory usage for performance.*
4. *To implement and test parallel algorithms on real-world data using GPU acceleration.*

List of Experiments

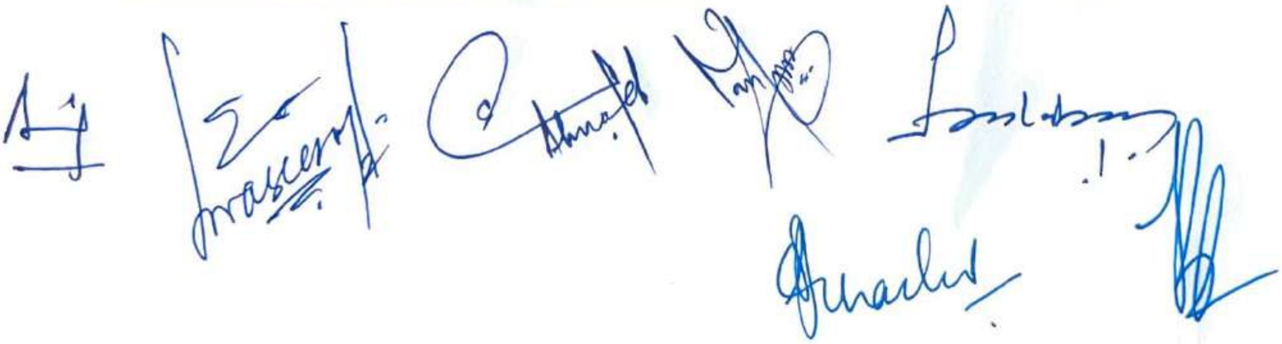
1. Write simple programs using CUDA to understand kernel launches and thread hierarchies.
2. Programs using 1D, 2D, and 3D thread mapping to manipulate arrays and matrices.
3. Implement matrix operations using GPU with global memory and shared memory.
4. Use different memory types (global, shared, constant) and evaluate their performance.
5. Parallel implementation of scan and reduction algorithms using thread synchronization.
6. Explore memory consistency and atomic functions in CUDA.
7. Use NVIDIA Nsight / Visual Profiler to debug and optimize GPU programs.
8. **Mini-Project:** Choose one of the following: image filtering, graph BFS/DFS, deep learning kernel simulation, or numerical simulation using GPU.

Course Outcomes:

1. *Understand the architecture of modern GPUs and fundamentals of GPU programming*
2. *Develop and debug CUDA programs with proper use of memory hierarchy*
3. *Implement parallel algorithms using thread synchronization and shared memory*
4. *Optimize GPU programs using profiling tools and asynchronous execution models*

Level of CO-PO Mapping

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



Course Title: Dissertation-I/ Industrial Project							
Course Code: MCSEPDI324					Examination Scheme		
Total Number of Lecture Hours: 30					External	252	
					Internal	98	
Lecture (L)	6	Practical (P)	16	Tutorial (T)	0	Total Credits	14
Description							

- In the Dissertation-I, students shall choose a specific topic/area for their dissertation and carry out the literature survey of the chosen area. Students are encouraged to work towards some real-life problem or issue/s of societal importance in order to ensure relevant research. Each student shall submit a dissertation report at the end of the third semester and appear in presentation/viva voce before the Departmental Committee. The dissertation report should also contain the problem specification and milestones to be achieved in solving theproblem.
- At the beginning of the third semester, a supervisor will be assigned to each student. The Supervisor shall provide a syllabus and plan of study including relevant research papers to the student. The student shall have to maintain a proper diary reflecting the activities and progress accomplished in his/her work and update the same regularly.
- The Supervisor shall monitor the progress of the student on weekly basis. Out of the 98 marks stipulated for Internal Semester Evaluation (ISE) of the Dissertation-I, fifty percent shall be awarded on the basis of continuous assessment by the respective Supervisor, while the remaining fifty percent shall be evaluated during the presentation/viva-voce to be held before the Departmental Committee.
- The External Semester Evaluation (ESE) shall be held by an approved external examiner. The External Semester Evaluation (ESE) shall be of 252 marks. The break-up of ESE 252 marks shall be as follows:

  Presentation: 20% marks
  Viva-voce: 40 % marks
  Dissertation writing based on state of art, fundamentals of the topic and its viability: 40 % marks

4th Semester

Course Title: Dissertation-II/ Industrial Project								
Course Code: MCSEPDI424						**Examination Scheme**		
Total Number of Lecture Hours: 30						**External**	**396**	
						Internal	**154**	
Lecture (L)	**8**	**Practical (P)**	**20**	**Tutorial (T)**	**4**	**Total Credits**		**22**
Description								

- Dissertation-II shall commence with the fourth semester wherein a student accumulates 22 credits on successful completion of the same. This is in addition to the Dissertation-I duringthe third semester wherein a student shall choose a specific research topic/area andundertake its study.
- A thesis outlining the entire problem, including a survey of literature (results from Dissertation-I) and the various results obtained along with their solutions is expected to be produced by each student. A Thesis Committee shall check the thesis for its completeness. A soft copy of the thesis in PDF format (in specific style) should be sent to the Thesis Committee, before its final submission. The Thesis Committee can recommend for modifications of the thesis or offer suggestions for improvement of the same for resubmission The Thesis committee shall also examine for suitability of publication (including any possible plagiarism) before the thesis goes in print and for binding.
- Consequent to the thesis being accepted and approved by the Thesis Committee, the Viva-voce examination of the student shall be conducted by an approved Examiner. Thecandidates who fail to submit the dissertation work within the stipulated time have to submit the same at the time of next ensuing examination.
- Out of the 154 marks stipulated for Internal Semester Evaluation (ISE) of the Dissertation-II, fifty percent shall be awarded on the basis of continuous assessment by the respective Supervisor, while the remaining fifty percent shall be evaluated during thepresentation/viva-voce to be held before the Departmental Committee. Out of the 396 marks stipulated for the External Semester Evaluation (ESE), fifty percent marks shall be awarded on the basis of viva-voce and fifty percent marks for general evaluation of thesis