Master of Computer Applications
Semester–III

Course Code	Course Title	L	T	P	Credits
MCA-201A	**Data Mining and Integration using R** (Pre-requisite: Database Management System)	3	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to

MCA-201A.1	Understand the fundamental concepts of data warehousing and data mining;
MCA-201A.2	Acquire skills to implement data mining techniques;
MCA-201A.3	Learn schema matching, mapping and integration strategies;
MCA-201A.4	Implement data mining techniques in R to meet the market job requirements.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-201A.1	3	–	–	–	–	–	–	2
MCA-201A.2	3	3	2	2	–	–	–	2
MCA-201A.3	3	2	-	-	–	–	–	2
MCA-201A.4	3	3	3	3	–	-	-	2

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I **Contact Hours: 11**

Fundamentals of Data Warehous and Data Mining

Data Warehouse: A Brief History, Characteristics, Architecture for a Data Warehouse. Data Mining: Introduction: Motivation, Importance, Knowledge Discovery Process, Data Mining Functionalities, Interesting Patterns, Classification of Data Mining Systems, Major issues, Data Preprocessing: Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization, Outliers.

UNIT – II **Contact Hours: 11**

Data Mining Techniques and Neural Networks

Data Mining Techniques: Clustering- Requirement for Cluster Analysis, Clustering Methods- Partitioning Methods, Hierarchical Methods, Decision Tree- Decision Tree Induction, Attribute Selection Measures, Tree Pruning. Association Rule Mining- Market Basket Analysis, Frequent Itemset Mining using Apriori Algorithm, Improving the Efficiency of Apriori. Concept of Nearest Neighborhood and Neural Networks.

UNIT – III **Contact Hours: 12**

Data Integration, Schema Matching and Mapping

Data Integration: Architecture of Data Integration, Describing Data Sources: Overview and Desiderate, Schema Mapping Language (Global-as-View, Local-as-View, Global-and-Local-as-View), String Matching: Similarity Measures, Sequence based similarity, Set Based Similarity, Hybrid Similarity, Phonetic Similarity Measure, Schema Matching and Mapping: Problem Definition, Challenges, Matching and Mapping Systems, Data Matching: Rule- Based Matching, Learning- Based Matching, Matching by Clustering.

UNIT – IV **Contact Hours: 11**

Fundamentals of R Programing and implementing Data Mining techniques

R Programming: Advantages of R over other Programming Languages, Working with Directories and Data Types in R, Control Statements, Loops, Data Manipulation and integration in R, Exploring Data in R: Data Frames, R Functions for Data in Data Frame, Loading Data Frames, Decision Tree packages in R, Issues in Decision Tree Learning, Hierarchical and K-means Clustering functions in R, Mining Algorithm interfaces in R.

Text Books:

1. J Hanes, M. Kamber, *Data Mining Concepts and Techniques*, Elsevier India.
2. A.Doan, A. Halevy, Z. Ives, *Principles of Data Integration*, Morgan Kaufmann Publishers.
3. Acharya, *Data Analytics Using R*, McGraw Hill Education (India) Private Limited.

Reference Books:

1. G.S. Linoff, M.J.A. Berry, *Data Mining Techniques*, Wiley India Pvt. Ltd.
2. Berson, S.J. Smith, *Data Warehousing, Data Mining & OLAP*, Tata McGraw-Hill.
3. J.Horbulyk, *Data Integration Best Practices*.
4. Jared P. Lander, *R For Everyone*, Pearson India Education Services Pvt. Ltd.

Course Code	Course Title	L	T	P	Credits
MCA-271A	Data Mining and Integration using R Lab (Pre-requisite: MS-Excel, CSV Files)	0	0	4	2
		CIE	SEE		Total
		50	50		100

Course Outcomes (COs): At the end of this course, students will be able to

MCA-271A.1	Understand the basics of R Programming
MCA-271A.2	Learn to apply data manipulation & visualization using R.
MCA-271A.3	Acquire skills to apply linear regression on real world problems.
MCA-271A.4	Learn to apply classification and clustering.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-271A.1	3	–	–	–	–	–	–	2
MCA-271A.2	3	2	2	2	–	–	–	2
MCA-271A.3	3	2	2	2	–	–	–	2
MCA-271A.4	3	2	2	2	–	–	–	2

List of Experiments

No.	Experiment Detail
1.	Installation of R and R-studio.
2.	Working with variables and data structure in R. • Vector • List • Matrix • Array • Dataframe
3.	Demonstrate the usages of inbuilt functions in R.
4.	Demonstrate the usages of control statements in R.
5.	Demonstrate the usages of user defined functions in R.
6.	Data manipulation on CVS files: • Filtering • Aggregation • Summarization etc.
7.	Data visualization using R: • Histograms • Dot plots • Bar plots • Line charts • Pie Charts • Box Plots • Scatter plots etc.

8.	Demonstrate the usage of packages related to the decision tree.
9.	Implement simple linear regression to show the relationship between a dependent and indepent variable.
10.	Implement K-Means clustering functions in R to predict the species of Iris flower.
11.	Implement hierarchical clustering functions in R.
12.	Implement neural network to predict Square root of a number.
13.	Implement k-Nearest Neighbors (KNN) algorithm in R using the class package. Use the classic Iris dataset for classification.

Text Books:

1. J Hanes, M. Kamber, *Data Mining Concepts and Techniques*, Elsevier India.
2. A.Doan, A. Halevy, Z. Ives, *Principles of Data Integration*, Morgan Kaufmann Publishers.
3. Acharya, *Data Analytics Using R*, McGraw Hill Education (India) Private Limited.

Reference Books:

1. G.S. Linoff, M.J.A. Berry, *Data Mining Techniques*, Wiley India Pvt. Ltd.
2. Berson, S.J. Smith, *Data Warehousing, Data Mining & OLAP*, Tata McGraw-Hill.
3. J.Horbulyk, *Data Integration Best Practices*.
4. 4. Jared P. Lander, *R For Everyone*, Pearson India Education Services Pvt. Ltd.

Course Code	Course Title	L	T	P	Credits
MCA-203A	AI and Machine Learning (Pre-requisite: None)	3	0	0	3
		CIE	SEE		Total
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to

MCA-203A.1	Understand the basics of problem solving using artificial intelligence.
MCA-203A.2	Acquaint with basic concepts of natural language processing.
MCA-203A.3	Understand the basics of machine learning and supervised learning.
MCA-203A.4	Acquaint with regression concepts and unsupervised learning using clustering algorithms.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-203A.1	3	2	-	2	–	–	–	-
MCA-203A.2	2	2	-	2	–	–	–	-
MCA-203A.3	3	3	3	3	–	–	–	2
MCA-203A.4	3	3	3	3	–	2	–	2

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I **Contact Hours: 10**

Introduction to Artificial Intelligence and search strategies

Evolution of AI as a discipline, Definitions and approaches, Ethical Issues and Responsible AI, Search strategies: state space, data driven and goal driven search, uninformed search (depth first, breadth first), informed search (Hill climbing, A* algorithm, mini-max), computational complexity, Properties of search algorithms - Admissibility, Monotonicity, Optimality, Dominance.

UNIT – II **Contact Hours: 10**

Introduction to Machine Learning, Regression techniques

Introduction to Machine Learning (ML), ML tasks, Applications of ML, supervised and unsupervised learning. Regression: Linear Regression- Predicting numerical value, Finding best fit line, over-fitting, regularization, Regression Tree, CART.

UNIT – III **Contact Hours: 14**

Classification techniques and performance evaluation metrics

Supervised Learning: Classification, Decision Tree classification, k-nearest neighbour, Support Vector Machine (SVM) Classification, Kernel functions, Naive Bayes Classification

Performance evaluation metrics, ROC Curves, Validation methods, Bias-variance decomposition, Model complexity.

UNIT – IV **Contact Hours: 11**

Clustering techniques and evaluation

Clustering: Introduction, basic clustering methods, K-Means Clustering, Expectation Maximization (EM) Clustering, Hierarchical Clustering, Density based Clustering. Cluster evaluation.

Text Books:

1. Dan W. Patterson, *Introduction to Artificial Intelligence and Expert system*, Pearson Education India
2. Elaine Rich, Kevin Knight, Shivashankar B Nair, *Artificial Intelligence*, Third edition, Tata McGraw Hill
3. Alpaydin, Ethem, *Introduction to machine learning*, MIT press
4. T. M. Mitchell, *Machine Learning*, McGraw Hill Education
5. Andreas C. Muller, Sarah Guido, *Introduction to Machine Learning with Python: A Guide for data Scientist*, O'Really

Reference Books:

1. Nils J. Nilsson, *Principles of Artificial Intelligence*, Narosa Publishing House.
2. George F. Luger, *Artificial Intelligence*, Pearson Education
3. Shai Shalev-Shwartz, Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge Press
4. Michalski, Ryszard S., Jaime G. Carbonell, and Tom M. Mitchell, eds. *Machine learning: An artificial intelligence approach*, Springer Science & Business Media

Course Code	Course Title	L	T	P	Credits
MCA-273A	AI and Machine Learning Lab (Pre-requisite: Programming with Python)	0	0	4	2
		CIE	SEE		Total
		50	50		100

Course Outcomes (COs): At the end of this course, students will be able to

MCA-273A.1	Implement uninformed and informed search for problem solving
MCA-273A.2	Apply Regression algorithm to fit a line
MCA-273A.3	Apply different Classification algorithms and compare their performances.
MCA-273A.4	Apply different types of clustering to small datasets.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-273A.1	3	2	–	2	–	–	–	-
MCA-273A.2	3	1	2	2	–	–	–	-
MCA-273A.3	3	3	3	3	–	–	–	2
MCA-273A.4	3	3	3	3	–	-	–	3

List of Programs

Note: Lab experiments are to be performed using python libraries.

No.	Program Detail
1.	Write a program to implement Depth first and Breadth first search.
2.	Write a program to implement A* algorithm for travelling salesman problem.
3.	Write a program to compare two heuristic functions (in terms of properties of search algorithms) with A* algorithm for 8-puzzle.
4.	Fit a line of regression using a toy dataset (iris, wine, titanic etc.) with train and test splits and compute mean squared error.
5.	Apply KNN classification on a toy dataset (iris, wine, titanic etc) with (i) train and test splits and (ii) cross validation
6.	Apply Decision Tree classification on a toy dataset (iris, wine, digits, diabetes etc,) with (i) train and test splits and (ii) cross validation
7.	Apply SVM classification with different kernels and parameter tuning on a toy dataset (iris, wine, titanic etc,) with (i) train and test splits and (ii) cross validation
8.	Apply K-means clustering on a toy dataset (iris, wine, diabetes, digits etc.) with (i) three different k values (ii) random K centres.
9.	Apply hierarchical clustering on a toy dataset (iris, wine, titanic etc.,) with different linkage possibilities.
10.	Apply dbscan clustering on a toy dataset considering three different parameter value combinations.
11.	**A case study/ minor project applying machine learning to real life datasets.**

Text Books:

1. Dan W. Patterson, *Introduction to Artificial Intelligence and Expert system*, Pearson Education India
2. Elaine Rich, Kevin Knight, Shivashankar B Nair, *Artificial Intelligence*, Third edition, Tata McGraw Hill
3. Alpaydin, Ethem, *Introduction to machine learning*, MIT press
4. T. M. Mitchell, *Machine Learning*, McGraw Hill Education
5. Andreas C. Muller, Sarah Guido, *Introduction to Machine Learning with Python: A Guide for data Scientist*, O'Really

Reference Books:

1. Nils J. Nilsson, *Principles of Artificial Intelligence*, Narosa Publishing House.
2. George F. Luger, *Artificial Intelligence*, Pearson Education
3. Shai Shalev-Shwartz, Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge Press
4. Michalski, Ryszard S., Jaime G. Carbonell, and Tom M. Mitchell, eds. *Machine learning: An artificial intelligence approach*, Springer Science & Business Media

Course Code	Course Title	L	T	P	Credits
MCA-251A(i)	**Full Stack Development (MERN)** (Pre-requisite: Web Technology (HTML, CSS, JavaScript))	3	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-251A(i).1	Understand the core concepts of the MERN stack, including React.js, Express.js, Node.js, and MongoDB.
MCA-251A(i).2	Develop front-end applications using React.js, including state management and component-based architecture.
MCA-251A(i).3	Build RESTful APIs with Express.js and integrate MongoDB for backend data storage and retrieval.
MCA-251A(i).4	Implement authentication, middleware, and deployment techniques for full-stack applications.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-251A(i).1	3	2	2	3	-	-	–	3
MCA-251A(i).2	3	2	3	3	2	–	–	3
MCA-251A(i).3	3	3	3	3	2	2	3	2
MCA-251A(i).4	2	3	3	3	3	2	3	3

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I **Contact Hours: 12**

Introduction to MERN Stack & Node.js

Overview of Full Stack Development and MERN Stack.Node.js: Introduction, history, features, and its role in MERN. Comparison between JavaScript Client-side vs. Server-side programming. Installation of Node.js and npm, writing and executing basic scripts. Understanding JavaScript fundamentals: Variables, functions, loops, and arrays. Event-driven architecture and the Node.js runtime environment.

UNIT – II **Contact Hours: 11**

Frontend Development with React.js basics

React.js Introduction: Why React? Virtual DOM, React Setup (Create React App).JSX & Components: Functional vs. Class Components, Props, State. React Hooks: useState, useEffect, useContext, handling side effects. Event Handling & Forms: Controlled vs. Uncontrolled components. React Router: Navigation, dynamic routing, route parameters. State Management in React: Context API, Prop Drilling, Lifting State Up.

UNIT – III **Contact Hours: 12**

Backend Development with Node.js & Express.js

Node.js Modules: Core modules, global modules, and user-defined modules.Express.js: Introduction, routing, request handling, middleware. Template Engines (EJS) for rendering dynamic web pages. Middleware: Introduction to Express.js middleware and error handling. Database Integration: Introduction to MongoDB, performing CRUD operations with Mongoose. Using Postman for API testing.

UNIT – IV **Contact Hours: 10**

Advanced Concepts & Deployment

Asynchronous Programming: Callback, Promises, Async/Await, Event loop in Node.js. Mongoose ORM: Schema and model creation, advanced queries. Authentication & Authorization: JSON Web Tokens (JWT), bcrypt, Role-based authentication. State Management in React: Context API, Redux basics. File Handling & APIs: Using `multer` for file uploads, building Search APIs. Deployment: Hosting MERN applications using services like Vercel, Netlify, and AWS.

Text Books:

1. Basarat Ali Syed, *Beginning Node.js*, Apress.
2. Adam Boduch, Roy Derks, *React and React Native*, Packt Publishing.
3. Ethan Brown, *Learning JavaScript Design Patterns*, O'Reilly.
4. Vasan Subramanian, *Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node,* Apress

Reference Books:

1. Boronczyk, Naramore, *Beginning PHP, Apache, MySQL Web Development*, Wiley India Pvt.Ltd.
2. Kyle Simpson, *You Don't Know JS: Up and Going*, O'Reilly.
3. David Flanagan, *JavaScript: The Definitive Guide,* O'Reilly Media.
4. Simon Holmes, Clive Harber, *Getting MEAN with Mongo, Express, Angular, and Node*, Manning Publications.

Course Code	Course Title	L	T	P	Credits
MCA-275A(i)	**Full Stack Development (MERN) Lab** (Pre-requisite: Web Technology (HTML, CSS, JavaScript))	0	0	4	2
		CIE	**SEE**		**Total**
		50	50		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-275A(i).1	Implement Node.js applications
MCA-275A(i).2	Write programs implementing Express.js
MCA-275A(i).3	Write programs implementing React.js
MCA-275A(i).4	Deploy a Full stack development application

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-275A(i).1	3	2	2	3	-	-	–	2
MCA-275A(i).2	3	3	3	3	1	1	1	2
MCA-275A(i).3	3	2	3	3	2	–	–	2
MCA-275A(i).4	2	3	3	3	2	2	2	3

List of Experiments

No.	Experiment Detail
1.	Write a simple 'Hello World' program in Node.js.
2.	Create a Node.js script that reads and writes files using the `fs` module.
3.	Build a basic Express.js server with different routes.
4.	Implement middleware in Express.js for logging request details.
5.	Create a RESTful API in Express.js to perform CRUD operations on a MongoDB database.
6.	Implement authentication using JWT in an Express.js application.
7.	Upload and retrieve files/images using `multer` in Express.js.
8.	Set up a basic React application and create a functional component.
9.	Implement React state and props in a simple To-Do List app.
10.	Build a multi-page React app using React Router.
11.	Fetch data from an API and display it using React (Axios or Fetch API).
12.	Implement global state management using the Context API in React.
13.	Implement form validation and handle user input in React.
14.	Connect a React frontend with a Node.js/Express backend using Axios.
15.	Deploy a full-stack MERN application (frontend + backend) using Vercel and Netlify.

Text Books:

1. Basarat Ali Syed, *Beginning Node.js*, Apress.
2. Adam Boduch, Roy Derks, *React and React Native*, Packt Publishing.
3. Ethan Brown, *Learning JavaScript Design Patterns*, O'Reilly.
4. Vasan Subramanian, *Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node*, Apress

Reference Books:

1. Boronczyk, Naramore, *Beginning PHP, Apache, MySQL Web Development*, Wiley India Pvt.Ltd.
2. Kyle Simpson, *You Don't Know JS: Up and Going*, O'Reilly.
3. David Flanagan, *JavaScript: The Definitive Guide*, O'Reilly Media.
4. Simon Holmes, Clive Harber, *Getting MEAN with Mongo, Express, Angular, and Node*, Manning Publications.

Course Code	Course Title	L	T	P	Credits
MCA-251A(ii)	**Data Analysis and Visualization using Python** (Pre-requisite: None)	3	0	0	3
		CIE	SEE		Total
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-251A(ii).1	Apply python to real-world data analysis tasks.
MCA-251A(ii).2	Customize visualizations and pre-processing of data to enhance readability and presentation.
MCA-251A(ii).3	Provide strong foundation in statistical techniques for data-driven decision-making in business, science, and research.
MCA-251A(ii).4	Analyse and visualize time series data including date handling, plotting, and other analytical techniques.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-251A(ii).1	3	-	3	2	1	1	–	2
MCA-251A(ii).2	3	2	2	2	2	2	–	2
MCA-251A(ii).3	3	2	2	3	2	–	–	2
MCA-251A(ii).4	3	3	3	3	2	–	2	3

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I **Contact Hours: 12**

Python Fundamentals and Manipulation with NumPy and Pandas

Array operations using NumPy (Arithmetic, Logical, Slicing, Indexing), Pandas Data Structures – Series: Creating, Indexing, slicing, Arithmetic operations, Statistical operations, conditional filtering, Update, modify, check for Null values, sorting and ranking. Data Frames: Creating, viewing data, statistical operations, accessing columns and rows, filtering, adding and modifying, deleting rows and columns, sorting, aggregation and grouping, merging and joining, and handling missing data.

UNIT – II **Contact Hours: 11**

Data Visualization and Pre-processing

Data Visualization with Matplotlib and Seaborn - Basic Plotting (Line, Bar, Scatter, Histograms), Customizing Plots (Labels, Titles, Colors), Subplots and Grids. Data Loading and Reading from various sources (CSV, Excel, Databases), Data Cleaning and Manipulation, Data Filtering, Sorting, and Indexing, Data Aggregation and GroupBy operations.

UNIT – III **Contact Hours: 12**

Statistical Analysis

Descriptive Statistics -Mean, Median, Mode, Standard Deviation, Probability Distributions-Normal distribution and Binomial distribution, Correlation and Regression Analysis, Hypothesis Testing – z-test, t test, and chi-square test. Data transformation, scaling and normalization. Feature Engineering, and Univariate and Bivariate Analysis.

UNIT – IV **Contact Hours: 10**

Time Series Data Analysis and Visualization

Autocorrelation with pandas, Plotting Line plot for Time Series data, Resampling, Detecting Seasonality using Auto Correlation, Detecting Stationarity, Smoothening the data using Differencing and Moving Average, Date and Time Data Types and Tools.

Text Books:

1. Reema Thareja, *Data Science and Machine Learning using Python*, Mc Graw Hill
2. William McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython*, O'Reilly

Reference Books:

1. Anil Maheshwari, *Data Analytics*, Mc Graw Hill
2. Bharti Motwani, *Data Analytics using Python*, Wiley
3. Rituraj Dixit, *Data Analytics using Python*, BPB

Course Code	Course Title	L	T	P	Credits
MCA-275A(ii)	Data Analysis and Visualization using Python Lab (Pre-requisite: Python)	0	0	4	2
		CIE	SEE		Total
		50	50		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-275A(ii).1	Apply pandas and series to solve real-world tasks.
MCA-275A(ii).2	Customize visualizations using matplotlib and seaborn to enhance presentation of data.
MCA-275A(ii).3	Applications of statistical and exploratory techniques for analysis of data in real life problems of various domain.
MCA-275A(ii).4	Interpret and represent time series data using date processing, visualization, and analytical techniques.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-275A(ii).1	2	-	3	2	1	1	–	1
MCA-275A(ii).2	3	2	2	2	2	2	–	2
MCA-275A(ii).3	3	2	2	3	2	–	–	2
MCA-275A(ii).4	3	3	3	3	2	–	–	2

List of Experiments

No.	Experiment Detail
1.	Create a DataFrame that contains information about employees at a company like data = { 'Employee_ID': [101, 102, 103, 104, 105], 'Name': ['John', 'Sarah', 'Mike', 'Emma', 'Laura'], 'Department': ['HR', 'IT', 'Finance', 'IT', 'HR'], 'Salary': [50000, 60000, 55000, 70000, 48000], 'Date_of_Joining': ['2018-01-10', '2019-03-15', '2020-07-01', '2021-05-20', '2022-09-10'] } Calculate i. Filter Employees by Department ii. Calculate the Average Salary per Department
2.	For data frame describe in assignment no. 1compute the following: i. Add a New Column for Experience ii. Find Employees with Salary Greater Than a Certain Amount iii. Sort Employees by Salary
3.	Create a Series representing the sales of a store in a week: sales_data = [500, 600, 700, 800, 750, 650, 900] i. Create a Series with Custom Indexes ii. Slicing the Series iii. Accessing Multiple Elements iv. Adding a Constant to All Elements v. Filter Series Based on Condition

4.	Plotting a Simple Line Graph using matplotlib for Sample data x = [1, 2, 3, 4, 5] y = [1, 4, 9, 16, 25] and also customizing with line style, multiple lines, adding grids & legends and subplots.
5.	Plot a bar graph using matplotlib for sample data categories = ['A', 'B', 'C', 'D', 'E'] values = [3, 7, 2, 5, 8]
6.	Plot a pie chart for sample data sizes = [25, 30, 45] labels = ['Category A', 'Category B', 'Category C'] colors = ['gold', 'yellowgreen', 'lightcoral'] using matplotlib.
7.	Using seaborn library Create a Simple Distribution Plot (Histogram) for 'tips' dataset. Create a Box Plot to compare total bill across different days using 'tips' dataset. Design a scatter plot to show the relationship between total_bill and tip and also add hue to differentiate by smoker status. (https://github.com/mwaskom/seaborn-data/blob/master/tips.csv)
8.	Create a Bar Plot using seaborn library for i. to compare average tip per day ii. to show the number of male and female customers iii. to show the distribution of tips for each day iv. FacetGrid to plot the relationship between total_bill and tip by day Regression plot to show the relationship between total_bill and tip
9.	Create a simple dataset using a dictionary data = { 'Age': [23, 45, 56, 67, 45, 33, 44, 25, 64, 40], 'Salary': [50000, 60000, 80000, 120000, 70000, 50000, 75000, 45000, 110000, 65000] } Compute statistics of the entire dataset – mean, median, mode, max, min, variance, quartile and standard deviation.
10.	Calculate correlation matrix for 'tips' dataset (https://github.com/mwaskom/seaborn-data/blob/master/tips.csv).
11.	Create a contingency table of gender (Male, Female) and beverage preference data = {'Coffee': [30, 20], 'Tea': [20, 30]} and perform the chi-square test of independence.
12.	Create a sample dataset with two features data = { 'Feature1': [100, 200, 300, 400, 500, 600, 700, 800, 900, 1000], 'Feature2': [5, 15, 25, 35, 45, 55, 65, 75, 85, 95] }. From scikit-learn i. Apply StandardScaler to standardize the data: ii. Use the MinMaxScaler to apply Min-Max scaling iii. Use the RobustScaler to apply robust scaling
13.	To create a scatter time series plot from a DataFrame, I. A datetime column as the x-axis. II. A numerical column as the y-axis.
14.	Compute Simple Autocorrelation with pandas and Plot Autocorrelation using statsmodels with Realistic

	Data
15.	Plotting Line plot for Time Series data, Resampling, Detecting Seasonality and Stationarity, Smoothening the data using Differencing and Moving Average https://www.geeksforgeeks.org/time-series-data-visualization-in-python/

Text Books:

1. William McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Python*, O'Reilly
2. George Box, Gwilym M. Jenkins, Gregory Reinsel, *Time Series Analysis: Forecasting & Control*, Pearson

Reference Books:

1. Anil Maheshwari, *Data Analytics*, Mc Graw Hill
2. Bharti Motwani, *Data Analytics using Python*, Wiley
3. Rituraj Dixit, *Data Analytics using Python*, BPB

Course Code	Course Title	L	T	P	Credits
MCA-251A(iii)	**Cyber Security** (Pre-requisite: Computer Networks)	3	0	0	3
		CIE	SEE		Total
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-251A(iii).1	Understand various types of cyber-attacks and cyber-crimes
MCA-251A(iii).2	Learn IT ACT (Cyber Law) and concepts of cyber forensics.
MCA-251A(iii).3	Get an overview of the Phishing and Identity theft
MCA-251A(iii).4	Demonstrate the network defence tools to provide security of information and study the privacy issues.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-251A(iii).1	2	2	–	2	–	–	–	–
MCA-251A(iii).2	2	2	2	2	–	–	2	–
MCA-251A(iii).3	2	2	2	–	–	–	–	–
MCA-251A(iii).4	3	2	3	3	–	–	2	2

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I **Contact Hours: 12**

Introduction to Cyber Security

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy

UNIT – II **Contact Hours: 11**

Introduction to Cybercrime and Laws

Origins of Cybercrime, Classifications of Cybercrimes, information Security, Cybercriminals, Criminals Plan for Attacks, Cybercafe, Botnets, Attack Vector, The Indian IT ACT 2000 and amendments.
Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Dig

UNIT – III **Contact Hours: 12**

Phishing and Identity Theft, Tools and Methods used in Cybercrime

Introduction to Phishing, Methods of Phishing, Phishing Techniques, Phishing Toolkits and Spy Phishing. Identity Theft: PII, Types of Identity Theft, Techniques of ID Theft. Introduction to Intellectual Property Law – The Evolutionary Past - The IPR Tool Kit- Para -Legal Tasks in Intellectual Property Law – Ethical obligations in Para Legal Tasks in Intellectual Property Law –types of intellectual property rights.

Tools and Methods used in Cybercrime: Introduction, Proxy Server and Anonymizers, Password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, DOS and DDOS attack, SQLinjection.

UNIT – IV **Contact Hours: 10**

Network Defence tools and Privacy Issues

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, Virtual Private Networks, Linux Firewall, Windows Firewall, Snort Detection System.

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc

Text Books:

1. Nina Godbole and SunitBelpure, *Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, *Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives*, CRC Press

Reference Books:

1. James Graham, Richard Howard and Ryan Otson , *Cyber Security Essentials*, CRC Press.
2. Chwan-Hwa (john) Wu, J. David Irwin, *Introduction to Cyber Security*, CRC Press Taylor & Francis Group

Course Code	Course Title	L	T	P	Credits
MCA-275A(iii)	**Cyber Security Lab** (Pre-requisite: None)	0	0	4	2
		CIE	**SEE**		**Total**
		50	50		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-275A(iii).1	Understand core cyber security concepts, threats, and vulnerabilities
MCA-275A(iii).2	Demonstrate the use of basic tools and techniques for network and system security
MCA-275A(iii).3	Perform and analyze basic cyber-attacks and counter measures using simulated environments
MCA-275A(iii).4	Apply principles of secure communication and system protection

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-275A(iii).1	2	2	–	2	–	–	–	–
MCA-275A(iii).2	3	2	2	2	–	–	2	2
MCA-275A(iii).3	3	2	2	–	–	–	–	2
MCA-275A(iii).4	3	3	3	3	2	–	2	3

List of Experiments

No.	Experiment Detail
1.	Identifying Vulnerabilities & Threats
2.	Understanding packet capturing and understanding use of wireshark
3.	Create a Fake Phishing Page
4.	Examples of Buffer Overflow
5.	Basic Email Header Analysis
6.	Understanding File permissions in Linux and Windows
7.	Examples of privilege escalation to obtain a root shell.
8.	DVWA based web security exercises
9.	Example on ARP protocol and ARP poisioning
10.	Example on setting up Firewall on Linus and Windows.
11.	Snort IDS Basic Setup and Rules
12.	VPN Setup Using OpenVPN or WireGuard
13.	Report Analysis of a Real-World Cybercrime Case
14.	Understanding creating public/private key repair, creating Digital Certificate, analysing digital certificates of websites

Text Books:

1. Nina Godbole and SunitBelpure, *Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives,*Wiley

2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, *Computer and Cyber Security:Principles, Algorithm, Applications, and Perspectives*, CRC Press

Reference Books:

1. James Graham, Richard Howard and Ryan Otson , *Cyber Security Essentials*, CRC Press.

2. Chwan-Hwa (john) Wu, J. David Irwin, *Introduction to Cyber Security*, CRC Press Taylor & Francis Group

Course Code	Course Title	L	T	P	Credits
MCA-251A(iv)	**Image Processing and Computer Vision** (Pre-requisite: Computer Graphics)	3	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-251A(iv).1	Understand fundamentals of image processing and computer vision.
MCA-251A(iv).2	Understand and apply concepts of Image formation and Image Enhancement.
MCA-251A(iv).3	Understand and apply image segmentation and feature extraction methods.
MCA-251A(iv).4	Implement the concepts of classification through object detection.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-251A(iv).1	2	2	–	–	–	–	–	–
MCA-251A(iv).2	3	3	2	2	–	–	–	2
MCA-251A(iv).3	3	3	3	2	–	–	–	2
MCA-251A(iv).4	3	3	3	2	–	–	–	2

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I — Contact Hours: 11

Introduction to Digital Image processing and Image enhancement techniques

Introduction: Digital Image fundamentals, Image Sensing and acquisition, Sampling and Quantization, Image formation models, Overview of Computer Vision, Applications of Image processing and Computer Vision.

Image Enhancement: Image enhancement in spatial domain, Basic grey level Transformations, Histogram Processing Techniques, Spatial Filtering, Image smoothing and Image Sharpening- The Laplacian,

UNIT – II — Contact Hours: 11

Filtering in Spatial and Frequency Domain

Image enhancement process in frequency domain, Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Lowpass, High pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Low pass Filters; Sharpening Frequency Domain Filters – Gaussian high pass filters; Homomorphism Filtering.

UNIT – III — Contact Hours: 11

Image Segmentation, Edge and Line Detection techniques

Image Segmentation: Region Extraction, Pixel-Based Approach, Multi-level Threshold, Local Threshold, Region-based Approach.

Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking, and Edge Following, Edge Elements Extraction by Threshold, Edge Detector Performance, Line Detection, Corner Detection, Image Registration.

UNIT – IV **Contact Hours: 12**

Feature Extraction, Clustering, and Classification techniques

Feature Extraction: Representation, Topological Attributes, importance of features, Geometric Attributes Description, Boundary-based Description, Region based Description, and Relationship. Background subtraction techniques, Image Matching, Principal Component Analysis (PCA).

Object Recognition, Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Prentice Hall
2. E. Trucco and A. Verri, *Introductory Techniques for 3D Computer Vision*, Prentice Hall

Reference Books:

1. Robert J. Schalkoff, *Digital Image Processing, and Computer Vision*, John Wiley and Sons
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice-Hall, Upper Saddle River, NJ

Supplementary learning Material:

NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc19_ee55/preview

2. https://onlinecourses.nptel.ac.in/noc21_ee23/preview

Course Code	Course Title	L	T	P	Credits
MCA-275A (iv)	**Image Processing and Computer Vision Lab** (Pre-requisite: Computer Graphics, Python)	0	0	4	2
		CIE	**SEE**		**Total**
		50	50		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-275A(iv).1	Develop Python programs using data types, input/output, operators and control structures
MCA-275A(iv).2	Implement ordered and unordered data objects in
MCA-275A(iv).3	Design functions, packages, and process data files.
MCA-275A(iv).4	Create Python programs using Object oriented, exceptions, assertions, and data base connectivity with SQLite

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-275A(iv).1	2	1	–	–	–	–	–	2
MCA-275A(iv).2	3	3	2	2	–	–	–	2
MCA-275A(iv).3	3	3	3	2	–	–	–	3
MCA-275A(iv).4	3	3	3	2	–	–	2	3

List of Experiments

No.	Experiment Detail
1.	Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)
2.	Implementation of Transformations of an Image (Scaling, Rotation etc)
3.	Contrast stretching of a low contrast image, Histogram, and Histogram Equalization
4.	Display of bit planes of an Image.
5.	Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
6.	Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)
7.	Implementation of image sharpening filters.
8.	Implement Histogram of Oriented Gradient (HOG) for Feature extraction.
9.	To create a program to eliminate the high frequency components of an image.
10.	To create a program performs discrete wavelet transform on image.
11.	To create a program for segmentation of an image.
12.	Implement Principal Component Analysis for the computation of Eigenvector to reduce the dimensionality.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Prentice Hall
2. E. Trucco and A. Verri, *Introductory Techniques for 3D Computer Vision*, Prentice Hall

Reference Books:

1. Robert J. Schalkoff, *Digital Image Processing, and Computer Vision*, John Wiley and Sons
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice-Hall, Upper Saddle River, NJ

Course Code	Course Title	L	T	P	Credits
MCA-253A(i)	**Blockchain Technology** (Pre-requisite: Basic programming knowledge (Python/Java/C++), data structures & algorithms, computer networks, cryptography basics)	3	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-253A(i).1	Understand the cryptographic foundations of blockchain technology.
MCA-253A(i).2	Analyze and compare major blockchain platforms, including Bitcoin, Ethereum, and Hyperledger, along with their consensus mechanisms.
MCA-253A(i).3	Develop and deploy smart contracts using Solidity and Hyperledger Fabric while addressing blockchain security concerns.
MCA-253A(i).4	Explore blockchain applications across industries, including finance, healthcare, supply chain, and governance

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-253A(i).1	2	–	–	–	–	–	–	–
MCA-253A(i).2	2	2	2	2	2	–	–	–
MCA-253A(i).3	2	2	2	2	–	–	–	2
MCA-253A(i).4	3	2	2	2	–	–	–	2

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I — Contact Hours: 12

Introduction to Blockchain, Cryptographic, architecture and platforms

Introduction to Blockchain: Definition and Evolution of Blockchain,Types of Blockchain (Public, Private, Consortium, Hybrid), Features, Benefits, and Challenges of Blockchain, Issues and Limitations of Blockchain

Cryptographic Foundations: Hash Functions: Properties and Working, Digital Signatures and Cryptographic Keys, Merkle Trees and Patricia Trees, Zero-Knowledge Proofs (ZKPs) and their applications in privacy-focused blockchains.

Blockchain Architecture & Important Blockchains: Consensus Mechanisms: Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS, PBFT, Federated Byzantine Agreement (FBA), Blockchain Lifecycle: Transactions, Blocks, Mining, Validation, Blockchain Network Components: Nodes, Peer-to-Peer Networks

Blockchain Platforms: Bitcoin: First-generation blockchain and its impact, Ethereum: Smart contracts and decentralized applications (DApps), Hyperledger Fabric: Enterprise blockchain for permissioned networks.

UNIT – II — Contact Hours: 11

Cryptocurrencies, Bitcoin, Ethereum, Hyperledger and Enterprise Blockchains, Consensus Mechanisms

Cryptocurrencies: Bitcoin, Ethereum, Binance Coin (BNB), Ripple (XRP), Cardano, Solana, Polkadot, Stablecoins (USDT, USDC), Bitcoin Blockchain: Transactions, Mining, Block Rewards, Alternatives to Bitcoin: Ethereum, Ripple, Litecoin

Bitcoin and Ethereum Blockchain: Bitcoin Scripting Languages, Ethereum Architecture: Ethereum Virtual Machine (EVM), Gas Fees, GHOST Protocol

Hyperledger & Enterprise Blockchains: Hyperledger Fabric: Architecture (Peers, Orderers, Channels, Chaincode), Consensus Mechanisms in Hyperledger, Transactions and Smart Contracts in Hyperledger Fabric, Hyperledger vs. Ethereum vs. Bitcoin

Advanced Consensus Mechanisms: Proof of Work (PoW) vs. Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Practical Byzantine Fault Tolerance (PBFT)

UNIT – III **Contact Hours: 12**

Smart Contracts, Blockchain Security and Regulations

Smart Contracts with Solidity & Hyperledger: Introduction to Smart Contracts and Their Lifecycle, Solidity Programming Basics, Data Types, Variables, Functions, Control Structures and Error Handling, Ethereum Contract ABI, Smart Contract Deployment using Truffle Suite and Ganache.

Blockchain Security and Regulations: Security Challenges in Blockchain: 51% Attacks, Sybil Attacks, Double Spending , Cryptographic Key Management.

UNIT – IV **Contact Hours: 10**

Blockchain Applications across Industries

Government Use Cases**:** Digital Identity Management, Land Record Keeping, Public Distribution and Social Welfare Systems, E-Governance and Voting Systems, Enterprise Applications: Internet of Things (IoT) Integration, Smart Healthcare, Supply Chain Management, Transportation and Smart Cities, Triple-Entry Accounting, Auto-Executing Contracts & Decentralized Finance (DeFi)

Text Books:

1. Daniel Drescher, *Blockchain Basics: A Non-Technical Introduction in 25 Steps*, Apress.
2. Andreas Antonopoulos, *Mastering Bitcoin: Unlocking Digital Currencies*, O'Reilly Media Inc.
3. Hyperledger Foundation, *Hyperledger Fabric Documentation*, Linux Foundation.
4. Melanie Swan, *Blockchain: Blueprint for a New Economy*, O'Reilly Media.
5. Imran Bashir, *Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications*, Packt Publishing.
6. Narayan Prusty, *Building Blockchain Projects*, Packt Publishing.

Reference Books:

1. Mark Gates, *Blockchain: Understanding Bitcoin, Cryptocurrencies, and Smart Contracts*, Wise Fox Publishing.
2. Frank Walrtin, *Blockchain: The Comprehensive Beginner's Guide*, ABC Publications.
3. Paul Vigna & Michael J. Casey, *The Age of Cryptocurrency*, St. Martin's Press.
4. Various Authors, *Latest Research Papers and Industry Reports on Blockchain, Web3, and Hyperledger*, IEEE & Springer.

Course Code	Course Title	L	T	P	Credits
MCA-253A (ii)	**Cloud Computing and Internet of Things** (Pre-requisite: None)	3	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-253A(ii).1	Understand Cloud computing's characteristics, benefits, and historical developments, including distributed systems and virtualization.
MCA-253A(ii).2	Master Cloud computing architecture, Service models, Deployment models and Emerging computing paradigms
MCA-253A(ii).3	Understand IoT Concepts, Services, Characteristics, Applications and Challenges.
MCA-253A(ii).4	Analyse IoT protocols, Sensors, Identification and Service Technologies

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-253A(ii).1	3	2	2	3	–	–	1	3
MCA-253A(ii).2	3	2	3	3	–	–	1	3
MCA-253A(ii).3	3	2	2	3	–	–	1	3
MCA-253A(ii).4	3	3	2	3	–	–	-	2

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I

Contact Hours: 11

Introduction to Cloud Computing

Introduction to Cloud & Cluster Computing, Cloud Computing vs Cluster Computing, Historical developments and evolution of Cloud computing, principles of Cloud Computing, Cloud Computing architecture, Cloud computing applications. Cloud service models (IaaS, PaaS, SaaS), Could Deployment Models (Public, Private, hybrid& community models), Major Cloud Providers (AWS, Microsoft Azure, GCP etc.)

UNIT – II

Contact Hours: 12

Cloud Computing Service Platforms and emerging computing paradigms

Cloud Computing Service Platforms: compute services, storage services, database services, application services, queuing services, e-mail services, notification services, media services, content delivery services, analytics services, deployment & management services, identity & access management services and their case studies.

Introduction to emerging computing paradigms: Edge Computing, Mobile Cloud Computing, Fog Computing etc, Security in cloud computing: issues, threats, data security and information security.

UNIT – III **Contact Hours: 11**

Introduction to Internet of Things, Protocols, and System Design

Introduction to IoT: Concepts, Services, Characteristics, Challenges and Applications of IoT- Smart City, Health-Care, Architecture of IoT - ITU, IWF, Integration of OT and IT technologies, IoT Data Flow

IoT Protocols: Protocols Architecture of IoT, IoT Protocol Standards, Categorization of IoT protocols, Non-IP Network Technologies of IoT, IP Network Technologies, Service Discovery Protocols for IoT, Application Protocols

IoT System Design: Components of IoT System, Communications Models of IoT, IoT Platforms- Open-Source & Proprietary Platforms

UNIT – IV **Contact Hours: 11**

Sensor, Identification, and Service Technologies of IoT

Sensor and Identification Technologies of IoT: Edge Devices of IoT- Sensors and Actuators, WSN, RFID, Integration of RFID and WSN Network Technologies, Connectivity of IoT-Wireless IoT- Infrastructure WN and Ad hoc Networks

Service Technologies of IoT: Edge and Fog Computing in IoT, Cloud Computing in IoT. IoT Security, Security Requirements, Challenges in IoT Security, Vulnerabilities and Threat Analysis, Layered Attacker model, Mirai Botnet, DDoS Attacks, Secure IoT Architecture.

Text Books:

1. Pankaj Sharma, *Cloud Computing*, S. K. Kataria and Sons.
2. Barrie Sosinsky, *Cloud Computing Bible*, Wiley India Pvt. Ltd.
3. Olivier Hersent, *The Internet of Things Key Applications and Protocols*, Wiley
4. Sudip Misra, *Introduction to IoT*, Cambridge University Press
5. David Hanes, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, *Mastering Cloud Computing: Foundations and Applications Programming*, Morgan Kaufmann Publishers, Illustrated edition
2. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, *Cloud Computing: Concepts, Technology & Architecture*, Prentice Hall
3. Arshdeeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-on Approach*, Universities Press
4. Raj Kamal, *Internet of Things: Architecture and Design Principles*, McGraw Hill
5. Kai Hwang, Min Chen, *Big Data Analytics for Cloud, IoT and Cognitive Computing*, Wiley

Course Code	Course Title	L	T	P	Credits
MCA-253A (iii)	**Compiler Design** (Pre-requisite: None)	3	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-253A(iii).1	Design various finite automata with and without output and interpret Regular languages
MCA-253A(iii).2	Design, analyze and interpret Context Free languages, Expression and Grammars
MCA-253A(iii).3	Understand the basic functioning of Compiler and its tools
MCA-253A(iii).4	Implement various parsing techniques

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-253A(iii).1	3	2	2	–	–	–	-	–
MCA-253A(iii).2	3	3	2	–	–	–	-	–
MCA-253A(iii).3	2	2	2	2	-	–	-	2
MCA-253A(iii).4	3	3	3	2	2	-	-	2

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I **Contact Hours: 12**

Finite State Machines mechanism

Finite State Machines: Finite Automata, Designing of DFA and NDFA, NFA with E-Transitions, Equivalence of DFA and NFA with proof, Regular Expressions and Regular languages, Laws of Regular Expressions, Kleene's Theorem 1 and 2, Properties and Limitations of FSM.

FSM with Output: Moore and Mealy Machines, Arden's Theorem with proof, Closure Properties of Regular Sets, Pumping Lemma for Regular Grammars, Minimization of FA.

UNIT – II **Contact Hours: 11**

Formal Grammars

Definition, Construction of Regular & Context Free Grammar, Derivation, Parse Trees, Ambiguity, Removal of Ambiguity, Simplification of Context Free Grammar, CNF and GNF, Closure properties of CFL.

UNIT – III **Contact Hours: 12**

Translator, Compiler and Lexical Analyzer

Introduction To Translator and Compiler, Difference between Interpreter, Assembler and Compiler, Overview and Use of Linker and Loader, Types of Compilers, Phases of Compiler, Bootstrapping, Compiler Construction Tools.

Lexical Analysis: Role of Lexical Analyzer, Design of Lexical Analyzer, Specification and Recognition of Tokens, Language for Specifying Lexical Analyzers, Lex tool, Input Buffering, Implementation of Lexical Analyzer,

UNIT – IV **Contact Hours: 10**

Syntax Analysis

Role of Parser, Definition of Parsing, Parsing Techniques: Construction of Syntax Trees, Top Down Parsing and Bottom-Up Parsing, Operator Precedence Parsing, LR Parsers, SLR Parser.

Text Books:

1. Hopcroft, Ullman, "*Introduction to Automata Theory, Languages and Computation*", Pearson Education.
2. Alfred V Aho, *Principles of Compiler Design*, Narosa Publishing House.
3. Jean Paul Tremblay and Sorenson, *The Theory and Practice of Compiler Writing*, McGraw Hill.
4. Alfread V. AHO, Ravi Sethi & J.D. Ullman, *Compilers Principle, Techniques & Tools*, Addison Wesley

Reference Books:

1. K.L.P. Mishra and N.Chandrasekaran, "*Theory of Computer Science Automata, Languages and Computation*", PHI.
2. Tremblay & Sorenson, *Theory and practice of compiler writing*, Mc. Graw Hill.
3. M. Joseph, *Elements Compiler Design*, University Science Press
4. Fischer, *Crafting a Compiler in C*, Pearson Education.

Course Code	Course Title	L	T	P	Credits
MCA-253A(iv)	**Massive Open Online Course (MOOC)** (Pre-requisite: None)	0	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Guidelines for MOOC Course:

National Programme on Technology Enhanced Learning (NPTEL) is a project of MHRD initiated by seven Indian Institutes of Technology (Bombay, Delhi, Kanpur, Kharagpur, Madras, Guwahati and Roorkee) along with the Indian Institute of Science, Bangalore in 2003, to provide quality education to anyone interested in learning from the IITs. The main goal was to create web and video courses in all major branches of engineering and physical sciences at the undergraduate and postgraduate levels and management courses at the postgraduate level.

NPTEL Online Certification Courses

Since 2013, through an online portal, 4, 8, or 12 week online courses, typically on topics relevant to students in all years of higher education along with basic core courses in sciences and humanities with exposure to relevant tools and technologies, are being offered. The enrolment to and learning from these courses involves no cost. An in-person, proctored certification exam (optional) will be conducted at Rs. 1000/- per course and a certificate is provided through the participating institutions and industry, when applicable.

Assessment Criteria to get a certificate

1. Average Assignment score (X) = 25% of average of best 6 assignments out of the total 8 assignments of the course.
2. Exam score (Y) = 75% of the proctored certification exam score out of 100
   Note:
3. Internal Marks (CIE) = $\frac{X}{25} \times 40$ (40% of X)
4. External Marks (SEE) = $\frac{Y}{75} \times 60$ (60% of Y)
5. Final Marks = CIE marks + SEE marks

Note:

a. You will be eligible for a certificate only if Average assignment score>= 10 out of 25 and Exam score >= 30 out of 75.

b. Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Madras. It will be e-verifiable at nptel.ac.in/noc

Course Code	Course Title	L	T	P	Credits
MCA-253A(v)	**Quantum Computing** (Pre-requisite: None)	3	0	0	3
		CIE	**SEE**		**Total**
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-253A(v).1	Gain knowledge about quantum computing and quantum mechanics
MCA-253A(v).2	Understand the concepts of quantum gates & Circuits
MCA-253A(v).3	Learn quantum circuits optimization and Deustch Algorithm
MCA-253A(v).4	Learn about Grover and Shor's algorithms

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-253A(v).1	3	-	2	–	–	–	-	–
MCA-253A(v).2	3	2	–	–	–	–	-	2
MCA-253A(v).3	3	2	2	2	2	–	–	2
MCA-253A(v).4	3	3	3	3	2	–	-	3

Instructions for Paper Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

UNIT – I **Contact Hours: 12**

Basics of Quantum Computing and Quantum States

Basics of Quantum Computing, Types of Qubits, Quantum Computing Vs Classical (Qbits Vs Bits), Quantum applications Vector spaces, Probability, Complex numbers and mathematical preliminaries, Postulates of quantum mechanics, Quantum States & Superposition (Bra-Ket Notation), Measurements, Composite systems, Bells state, Entanglement, Bloch sphere, Pure and Mixed states

UNIT – II **Contact Hours: 11**

Quantum circuits designing and Error Correction

Geometry of quantum states, Complexity classes, Turing machine concepts, Quantum gates, Quantum circuits, Quantum circuits design, Noise & Decoherence, Quantum Error Correction (QEC) Basics (Surface Codes)

UNIT – III **Contact Hours: 12**

Quantitative measurement and analysis of Quantum Circuits, parallelism algorithms

Quantitative measures of circuit, Analysis of quality of Circuits, Circuit optimization, Introduction to quantum parallelism, Deustch Algorithm, Deutsch Jozsa algorithm,

UNIT – IV **Contact Hours: 10**

Quantum Teleportation, Fourier transformation and algorithms

Introduction to Grover algorithm, quantum Teleportation, quantum fourier transform, shor's algorithm (Integer factorization & impact on cryptography)

Text Books:

1. M. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press
2. Vishal Sahni, *Quantum Computing*, Tata McGraw-Hill
3. Chris Bernhardt, *Quantum Computing for Everyone*, The MIT Press

Reference Books:

1. P. Kaye, R. Laflamme, and M. Mosca, *An Introduction to Quantum Computing*, Oxford University Press, New York
2. N. David Mermin, *Quantum Computer Science*, Cambridge University Press
3. Federico Grasselli, *Quantum Cryptography: From Key Distribution to Conference Key Agreement***,** Springer.
4. Daniel J. Bernstein, Johannes Buchmann, Erik Dahmen , *Post Quantum Cryptography*, Springer-Verlag Berlin and Heidelberg

Course Code	Course Title	L	T	P	Credits
MCA-277A	**Industrial Internship** (Pre-requisite: None)	0	0	0	4
		CIE	SEE		Total
		50	50		100

Course Outcomes (COs): At the end of this course, students will be able to	
MCA-277A(v).1	Examine and evaluate problems given by industry.
MCA-277A(v).2	Learn professional skills such as teamwork, communication, and project management in an industry setting.
MCA-277A(v).3	Employ industry-standard tools and technologies to successfully complete assigned tasks and projects.
MCA-277A(v).4	Develop comprehensive documentation summarizing project outcomes, and detailing the skills acquired during the internship.

Course Outcomes (CO) to Program Outcomes (PO) mapping (scale 1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
MCA-277A(v).1	2	2	-	–	–	1	–	–
MCA-277A(v).2	2	–	–	3	2	3	–	3
MCA-277A(v).3	3	3	3	3	2	2	-	2
MCA-277A(v).4	2	–	3	3	2	–	2	3

Guidelines for Industrial Internship:

This course requires students to participate in professional employment-related activity or work experience or co-operative education activity with an entity external to the educational institution, normally under the supervision of an employee of an organization or an individual professional. A key aspect of the internship is induction into actual, formal, and organized work situation to provide opportunities for students to actively engage in on-site experiential learning.

a) The candidate shall be required to undergo industrial trainings /internships of the specified duration, provided in the Scheme of Studies and Examinations, in an industry/ business enterprise/ organization approved by the Head of the Department.

b) If the concerned Department perceives any limitations from the industry to accommodate all the enrolled students, a student may be permitted to complete a skill-oriented e-content course (of sufficient duration) relevant to the industry or undertake a project-based / research project under the supervision of a faculty of a premier Institute (such as I.I.T., I.I.Sc.) with prior approval from the competent authority.

c) The Training will be completed under the supervision of the officer (herein called Co. Training Supervisor) of the Company/ Organization under whose guidance and supervision the training was allotted to the candidate.

d) The industrial training/ internship shall be of 45-60 days duration after the second semester.

e) The candidates are required to submit a comprehensive report Training Supervisor within two weeks of completion of the training along with Co. Training Supervisor's Certificate in the beginning of the report stating that the report is an outcome of the work done by the candidate during his/her training.

f) The viva-voce shall be held by one External and one Internal Examiner within two weeks after submission of the report.

g) The CIE and SEE components of the industrial training/ internship shall be conducted as given in Table-1.

Table-1: Relative Weightages of Industrial Internship

Component	Description of the Component		Relative Weightage (Out of 100)
CIE	i)	Internship Synopsis Evaluation within 10 days of start of Internship	10
	ii)	Mid-Term Internship Evaluation	15
	iii)	Final Presentation and Internship Evaluation	25
		CIE Total	**50**
SEE	Performance in Presentation and External Viva-voce		**50**
		Grand Total	**100**