Bachelor of Computer Applications

(Data Science)

Semester–IV

Course Code	Course Title	L	T	P	Credits
BCA-222A	Statistical Foundation for Data Science (Pre-requisite: Basic math concepts)	3	0	0	3
		CIE	SEE		Total
		40	60		100

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

BCA-222A.1	Understand the basic concepts of Statistics
BCA-222A.2	Acquire the knowledge of probability including Bayes' Theorem.
BCA-222A.3	Understand the concepts of Sampling and Sampling Techniques,
BCA-222A.4	Analyze variable relationships through correlation and regression, and test categorical data using chi-square tests.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
BCA-222A.1	3	-	-	-	-	-	-	-
BCA-222A.2	3	-	-	-	-	-	-	2
BCA-222A.3	3	2	-	-	-	-	-	2
BCA-222A.4	3	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 Statistics

Introduction to Statistics: Types (Descriptive vs. Inferential), Scales of Measurement: Nominal, Ordinal, Interval, Ratio, Measures of Central Tendency: Mean, Median, Mode, Measures of Dispersion: Range,, Variance, Standard Deviation, IQR, Frequency Distributions and Graphical Representation: Histogram, Boxplot

UNIT-II **Contact Hours: 11**

Basic Probability Concepts

Basic Probability Concepts: Experiment, Sample Space, Events, Rules of Probability, Conditional Probability and Bayes' Theorem, Random Variables: Discrete vs. Continuous, Probability Distributions:, Discrete: Binomial, Poisson, Continuous: Normal Distribution, Expectation and Variance of Random Variables.

UNIT-III **Contact Hours: 12**

Sampling Techniques

Concept of Sampling and Sampling Techniques, Sampling Distribution and Central Limit Theorem Estimation: Point Estimation and Confidence Intervals, Hypothesis Testing:, Null and Alternative Hypotheses. Type I and Type II Errors, p-value and Statistical Significance, t-test and z-test (1-sample, 2-sample).

UNIT-IV **Contact Hours: 10**

Correlation and Regression

Correlation: Pearson and Spearman Correlation Coefficients, Simple Linear Regression:, Regression Line Coefficient of Determination (R^2), Residual Analysis, Introduction to Multiple Linear Regression (conceptual only), Chi-Square Test for Independence and Goodness of Fit.

Text Books:

1. Paul Newbold, William Carlson, Betty Thorne, *Statistics for Business and Economics*, Pearson
2. S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons
3. David S. Moore and George P. McCabe, *Introduction to the Practice of Statistics*, W. H. Freeman & Co Ltd.
4. Peter Bruce and Andrew Bruce, *Practical Statistics for Data Scientists*, Shroff/O'Reilly

Reference Books:

1. Ronald E. Walpole, *Probability and Statistics for Engineers and Scientists*, Pearson
2. Andy Field, Jeremy Miles, Zoë Field, *Understanding Statistics Using R*, SAGE Publications India Pvt Ltd.
3. Richard A. Johnson and Dean W. Wichern, *Applied Multivariate Statistical Analysis*, Pearson
4. Allen B. Downey, *Think Stats: Exploratory Data Analysis*, Shroff/O'Reilly

Course Code	Course Title	L	T	P	Credits
BCA-224A	Data Mining and Warehousing (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

BCA-224A.1	Understand the basics of Data Warehousing fundamentals
BCA-224A.2	Acquire knowledge about various Data Pre-processing methods
BCA-224A.3	Learn the Data Clustering Techniques
BCA-224A.4	Understand the Data Classification and Association Rules Techniques

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
BCA-224A.1	3	-	-	-	-	-	-	-
BCA-224A.2	3	-	2	-	-	-	-	2
BCA-224A.3	3	3	2	2	-	-	-	2
BCA-224A.4	3	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

Basics of Data Warehousing

Data Warehouse: Basic concepts, The Data Warehouse - A Brief History, Characteristics, Difference between Operational Database Systems and Data Warehouse, Architecture for a Data Warehouse, Fact and Dimension Tables, Data Warehouse Schemas, Data Cube : A Multidimensional Data Model, Data Cube Computation Methods, Typical OLAP Operations.

UNIT-II — Contact Hours: 11

Data Mining and Pre-processing

Data Mining: Introduction: Motivation, Importance, Knowledge Discovery Process, Data Mining Functionalities, Interesting Patterns, Classification of Data Mining Systems, Major issues, Data Objects and Attribute Types. Data Preprocessing: Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

UNIT-III — Contact Hours: 12

Clustering Techniques

Data Mining Classical Techniques: Statistics – Similarity Models, Steps for Designing Similarity Models, Table Lookup Model. Clustering- Requirement for Cluster Analysis, Clustering Methods- Partitioning Methods, Hierarchical Methods, Density-Based Methods, Evaluation of Clustering. Nearest Neighborhood-

Memory Based Reasoning.

UNIT-IV **Contact Hours: 10**

Classification and Association Rules Techniques

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, Neural Network- Bayesian Belief Networks, Classification by Backpropagation. Data Mining Applications, Data Mining Trends and Tools.

Text Books:

1. J Hanes, M. Kamber, *Data Mining Concepts and Techniques*, Elsevier India.
2. G.S. Linoff, M.J.A. Berry, *Data Mining Techniques*, Wiley India Pvt. Ltd.
3. Acharya, *Data Analytics Using R*, McGraw Hill Education (India) Private Limited

Reference Books:

1. A. Berson, S.J. Smith, *Data Warehousing, Data Mining & OLAP*, Tata McGraw- Hill.
2. Jared P. Lander, *R For Everyone*, Pearson India Education Services Pvt. Ltd.

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Course Code	Course Title	L	T	P	Credits
BCA-292A	Data Mining and Warehousing Lab (Pre-requisite: C++)	0	0	4	2
		CIE	SEE		Total
		50	50		100

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

BCA-292A.1	Implement Data Pre-processing and Visualization on datasets
BCA-292A.2	Implement Data Clustering techniques
BCA-292A.3	Apply Data Clustering Techniques
BCA-292A.4	Implement Association Rules and Neural network.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
BCA-292A.1	3	2	-	-	-	-	-	-
BCA-292A.2	3	2	2	-	-	-	-	2
BCA-292A.3	3	2	2	2	-	-	-	2
BCA-292A.4	3	2	3	2	-	2	2	2

List of Experiments

No.	Experiment Detail
1.	Implement Data cleaning techniques on any raw data set
2.	Implement Data reduction techniques on any raw data set
3.	Implement Data manipulation on CVS files: • Filtering • Aggregation • Summarization etc.
4.	Perform following Data visualization: • Histograms • Dot plots • Bar plots • Line charts • Pie Charts • Box Plots • Scatter plots etc.
5.	Implement hierarchical clustering technique.
6.	Implement k-Nearest Neighbours (KNN) classification algorithm.
7.	Implement Density-Based clustering technique.
8.	Implement the decision tree classification algorithm.
9.	Implement Apriori Algorithm for Frequent Itemset Mining
10.	Implement Neural Network

Text Books:

1. J Hanes, M. Kamber, *Data Mining Concepts and Techniques*, Elsevier India.
2. G.S. Linoff, M.J.A. Berry, *Data Mining Techniques*, Wiley India Pvt. Ltd.
3. Acharya, *Data Analytics Using R*, McGraw Hill Education (India) Private Limited

Reference Books:

1. A. Berson, S.J. Smith, *Data Warehousing, Data Mining & OLAP*, Tata McGraw- Hill.
2. Jared P. Lander, *R For Everyone*, Pearson India Education Services Pvt. Ltd.

Course Code	Course Title	L	T	P	Credits
BCA-226A	Data 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

BCA-226A.1	Build a solid foundation in Python by mastering core programming concepts
BCA-226A.2	Gain proficiency in data manipulation and analysis using NumPy and Pandas for effective handling of structured data.
BCA-226A.3	Develop skills in effective data visualization and customization using Matplotlib.
BCA-226A.4	Master advanced data visualizations using Seaborn, including distribution, categorical, relational plots, and heatmaps.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
BCA-226A.1	3	-	-	-	-	-	-	3
BCA-226A.2	3	-	2	3	-	-	-	3
BCA-226A.3	3	2	3	3	-	-	-	3
BCA-226A.4	3	2	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**

Python Fundamentals

Python Fundamentals - Introduction to Python, Variables, Data Types, Operators, Control Flow (if-else, loops), Functions, Object-Oriented Programming (OOP) concepts- class, encapsulation, 'self' keyword, inheritance, polymorphism, Modules and Packages – creating and using module, aaccessing modules from a package and built-in vs. user-defined modules.

UNIT-II **Contact Hours: 11**

Manipulation with NumPy and Pandas

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-III **Contact Hours: 12**

Data Visualization with Matplotlib

Data Visualization with Matplotlib - Basic Plotting (Line, Bar, Scatter, Histograms), Customizing Plots

(Labels, Titles, Colors), Subplots, Multiple Axes (Subplots), Annotations, Styling with Themes and Grids. Data Loading and Reading from various sources (CSV, Excel, Databases)

UNIT-IV **Contact Hours: 10**

Data Visualization with Seaborn

Data Visualization with Seaborn - Seaborn vs Matplotlib, Integration with Pandas, Basic Plotting Concepts - Distribution Plots (Histogram, Box Plot, and Violin Plot), Categorical Plots (Bar Plot, Count Plot, and Strip Plot), Scatter Plots & Relationships (Scatter Plot, Line Plot, and Relational Plot), Heatmaps (Correlation Heatmap, Pair Plot, and Facet Grid), and Style & Themes.

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
BCA-294A	Data 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

BCA-294A.1	Implement the fundamental concepts of Python.
BCA-294A.2	Develop expertise in manipulating and analyzing structured data effectively using NumPy and Pandas.
BCA-294A.3	Apply data visualizations concepts using Matplotlib.
BCA-294A.4	Implement advanced visualizations with Seaborn, including distribution, categorical, relational plots, and heatmaps

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
BCA-294A.1	3	-	-	-	-	-	-	3
BCA-294A.2	3	3	2	3	-	-	-	3
BCA-294A.3	3	2	3	3	-	-	-	3
BCA-294A.4	3	2	3	3	-	2	-	3

List of Experiments

No.	Experiment Detail
1.	**Prime Number Checker** Write a function is prime(num) that: 1. Returns True if the number is prime, False otherwise 2. Use it in a loop to find all prime numbers from 1 to 100
2.	Bank Account Class with Encapsulation 1. Create a class BankAccount 2. It should have private attributes: __balance 3. Methods: deposit(amount), withdraw(amount), get_balance() 4. Use self to refer to instance variables
3.	**Inheritance Example: Person and Student** 1. Create a base class Person with name and age 2. Inherit a class Student that adds grade attribute 3. Method display_info() to print details
4.	**Shapes Area Calculator** 1. Create a base class Shape with method area() 2. Create derived classes Rectangle and Circle 3. Override the area() method in both
5.	**Basic Array Creation and Operations using NumPy:** 1. Slicing and Indexing 2. 2D Array and Logical Operations

6.	To track sales for the week using a pandas.Series. Perform operations on following data: sales = pd.Series([250, 300, np.nan, 400, 380, 500, 450], index=['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday']) 1. Creating the series 2. Indexing and slicing 3. Arithmetic operations 4. Statistical analysis 5. Filtering 6. Updating values 7. Checking for missing values
7.	Student Performance Tracker: Create a DataFrame with student data data = { 'Name': ['Alice', 'Bob', 'Charlie', 'David', 'Eva'], 'Math': [85, 78, 92, np.nan, 74], 'Science': [90, 88, np.nan, 84, 76], 'English': [78, 72, 88, 80, 82], 'Class': ['10A', '10B', '10A', '10B', '10A'] } Using student performance data perform followings: 1. View, modify, and filter data 2. Perform basic statistics 3. Sort and rank students 4. Handle missing scores
8.	Create Flipkart E-Commerce Sales Analysis project using given dataset and compute 1. Top Performing Products and Brands 2. Discount Analysis 3. Customer Activity by Time 4. Price Trends Over Months https://www.kaggle.com/datasets/mansithummar67/flipkart-product-review-dataset
9.	Create **Basic Line Plot using** matplotlib for x = [1, 2, 3, 4, 5] y = [10, 12, 8, 15, 18] and perform following: 1. Line with Markers & Style 2. Multiple Lines in One Plot 3. Changing Axis Limits & Ticks 4. Annotating Points 5. Subplots with Line Plots

	6. Filled Area Under Line
10.	Design a Bar Plot – Comparing Values for Sales by Product Category using matplotlib for data categories = ['Electronics', 'Clothing', 'Books', 'Toys'] sales = [15000, 12000, 5000, 8000] and Design a Histogram – Value Distribution for Distribution of Exam Scores using data scores = [55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 72, 84, 68, 79, 91]
11.	Design a Pie Chart – Proportional Data for Market Share of Smartphone Brands using matplotlib for data brands = ['Apple', 'Samsung', 'Xiaomi', 'Others'] market_share = [30, 25, 20, 25]
12.	Learn to Customize Plots using simple sale dataset for matplotlib days = ['Mon', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat', 'Sun'] sales = [200, 250, 180, 300, 400, 350, 500] and visualize 1. Plot with custom figure size 2. Plot with custom color, style, marker 3. Title and axis labels with custom font sizes and styles 4. Add grid with custom style 5. Add legend with custom location and font 6. Annotate a specific point and 7. Add background color
13.	Visualizing for the Iris Dataset 1. Pair Plot 2. Distribution of Variables with Histograms and KDE 3. Heatmap to visualize the correlation matrix
14.	Seaborn's categorical plots using **Titanic** (Passenger Info) dataset 1. Bar plot to visualize mean survival rate per class 2. Count plot for gender breakdown, colored by survival 3. Strip plot for ages of passengers in each class
15.	Visualize for flights dataset 1. **Line plots** (to show trends over time) 2. **Scatter plots** (month vs passengers) 3. **Relational plots** (multivariate views with hue/style)
16	Design plotting for “tips” Dataset 1. Histogram and KDE for 'total_bill' 2. Box plot showing the distribution of 'tip' by 'day' using “tips” Dataset 3. Facet grid to compare the distribution of tips by time and day using “tips” Dataset

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
BCA-202A	Quantitative Aptitude (Pre-requisite: Basic math)	2	0	0	2
		CIE	SEE		Total
		40	60		100

Course Outcomes (COs): At the end of this course, students will be able to	
BCA-202A.1	Understand the concept of system of algebraic equations and clocks.
BCA-202A.2	Solve problems related to time-distance, work-time, and work-wages.
BCA-202A.3	Solve problems related to interest, partnership, sets, and trigonometric ratios.
BCA-202A.4	Apply the concepts of Permutations and Combinations, Probability, and Data interpretation

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
BCA-202A.1	3	-	-	-	-	-	-	2
BCA-202A.2	3	2	3	-	-	-	-	3
BCA-202A.3	3	2	3	-	2	-	-	3
BCA-202A.4	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: 8**

System of algebraic equations, Ages and Clocks problems

Linear Equations, Quadratic equations, System of algebraic equations in two variables and their applications in simple problems. Problems on ages, Clocks.

UNIT-II **Contact Hours: 7**

Time and distance, Work and Time problems

Time and distance: Problems based on trains, Boats and Streams, Pipes and Cistern. Work and time: Problems on work and time, work and wages.

UNIT-III **Contact Hours: 7**

Interest, Partnership, Sets, Height and Distance problems

Simple interest, Compound Interest, Partnership. Basic idea of set theory to solve practical problems. Trigonometric ratios and identities, Height and distance.

UNIT-IV **Contact Hours: 8**

Permutations and Combinations, Data interpretation

Basic idea of Permutations and Combinations. Events and sample space, Probability. Data interpretation: Raw and grouped data, Bar Graph, Pie Chart, Mean, Median and Mode.

Text Books:

1. R. S. Aggarwal, *Quantitative Aptitude*, S. Chand & Company Limited, New Delhi
2. A. Guha. *Quantitative Aptitude*, 7th Edition, McGraw-Hill Publications
3. V. Dyke, J. Rogers and H. Adams, *Fundamentals of Mathematics*, Cengage Learning

Reference Books:

1. A.S. Tussy, R. D. Gustafson and D. Koenig, *Basic Mathematics for College Students*, Brooks Cole
2. C. C. Pinter, *A Book of Set Theory*, Dover Publications

Course Code	Course Title	L	T	P	Credits
BCA-215A	Full Stack Development-1 (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	
BCA-215A.1	Understand the core concepts of the MERN stack, including React.js, Express.js, Node.js, and MongoDB.
BCA-215A.2	Develop front-end applications using React.js, including state management and component-based architecture.
BCA-215A.3	Build RESTful APIs with Express.js and integrate MongoDB for backend data storage and retrieval.
BCA-215A.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
BCA-215A.1	3	-	-	-	-	-	-	2
BCA-215A.2	3	-	3	3	-	2	-	2
BCA-215A.3	3	2	3	3	-	-	-	2
BCA-215A.4	3	2	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

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 and 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, 2019.

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
BCA-274A	Full Stack Development-1 (MERN) Lab (Pre-requisite: MERN Stack)	0	0	4	2
		CIE	SEE		Total
		50	50		100

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

BCA-274A.1	Implement Node.js applications
BCA-274A.2	Write programs implementing Express.js
BCA-274A.3	Write programs implementing React.js
BCA-274A.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
BCA-274A.1	3	2	2	2	-	-	-	2
BCA-274A.2	3	2	2	2	-	-	-	2
BCA-274A.3	3	3	2	2	-	-	-	2
BCA-274A.4	3	3	3	2	-	2	2	2

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, 2019.

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.