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'A' Grade

T.Y.B.C.A. (Science) SEM- V Syllabus

Applicable for the Autonomous College affiliated to

Savitribai Phule Pune University

BCA Science Three Year Degree Programme

(NEP 2023 Pattern)

With Effective From June 2025

SEMESTER V					
Course Type	**Course Code**	**Course Name**	**Credits**		
			Theory	**Practical**	**Total**
Major/Core Theory	23SBCA51MM	Advanced Java	2		
Major/Core Theory	23SBCA52MM	Data Science Using Python	2		
Major/Core Theory	23SBCA53MM	Operating Systems	2		
Major/Core Practical	23SBCA54MM	Lab I – Advanced Java		2	
Major/Core Practical	23SBCA55MM	Lab II - Data Science using Python		2	
Major Elective Theory	23SBCA51MEA OR 23SBCA51MEB	Introduction to JavaScript OR Software Testing and Quality Assurance	2		
	23SBCA52MEA OR 23SBCA52MEB	React JS OR Introduction to Web Services	2		
Minor Theory	23SBCA51MNA OR 23SBCA51MNB	Network Security and Cryptography OR Introduction to Single Board System and Applications.	2		
Minor Practical	23SBCA52MNA OR 23SBCA52MNB	Lab IV- Network Security and Cryptography OR Lab IV- Introduction to Single Board System and Applications.		2	
Vocational Skill Course	23SBCA51VS	Lab III – Front End Development Technologies using JS and ReactJS	2		
Field Project	23SBCA51FP	Project		2	
TOTAL			14	8	22

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title:	**Advanced Java**	
Course Code: 23SBCA51MM		**No. Of Credits:02**
Course Type: MM(Major Mandatory)		**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To Learn The Creation Of Pure Dynamic Web Application Using JDBC.
2.	To Understand Concept Of Multithreading.
3.	To Learn Server-Side Programming Using Servlets And Java Server Pages.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Know the concepts of JDBC Programming.
2.	Design and develop real world multithreaded applications.
3.	Develop the project by using JSP and JDBC

Unit No	Title with Contents	No. of Lectures
Unit I	**JDBC**	**10**
	1. Introduction to JDBC	**2**
	2. Basic JDBC Program Concept	**2**
	3. JDBC Drivers	
	i. JDBC-ODBC bridge driver	
	ii. Native-API driver	
	iii. Network Protocol driver	**2**
	iv. Thin driver	
	4. JDBC Architecture.	
	5. JDBC Process	
	6. Working with JDBC	**2**
	i. Establishing Connection	
	ii. Statements	
	iii. Prepared Statement	
	iv. Callable Statement	
	v. Result Set	
	7. Executing Queries	**2**
Unit II	**Multithreading**	**8**
	1. Introduction to Multithreading.	**1**
	2. Thread creation	**2**
	i. Thread Class	**1**
	ii. Runnable Interface.	**1**
	3. Life cycle of Thread.	**1**
	4. Thread Priorities and Synchronization	**1**
	5. Inter Thread Communication	**1**
Unit III	**Servlet & JSP**	**12**
	1. Introduction to Servlet	**1**
	2. Types of Servlet	**1**
	i. Generic Servlet	**1**
	ii. Http Servlet	**1**
	3. Life cycle of Servlet	**1**
	4. Session Tracking.	**1**
	5. Servlet with database.	**1**
	6. Introduction to JSP	**1**
	7. JSP Life Cycle	**1**
	8. JSP with Database.	**2**

Suggested Reading	
1.	“Core Java Volume – Fundamentals”, Author – Cay S. Horstmann, Latest Edition – 11th Edition, Publisher – PrenticeHall
2.	“Effective Java”, Author – Joshua Bloch, Latest Edition – 3rd Edition,Publisher – Addison Wesley.
3.	“Java - The Complete Reference”, Author – Herbert Schildt, Latest Edition – 11th Edition, Publisher – McGraw Hill Education
4.	“Head First Java”, Author – Kathy Sierra & Bert Bates, Latest Edition – 2nd Edition Publisher –Shroff/O’Reilly

Website Reference Link	
1.	Java Programming :https://www.programiz.com/java-programming
2.	Java Tutorial :https://www.geeksforgeeks.org/java/
3.	Java Tutorial :https://www.javatpoint.com/java-tutorial
4.	Learn Java Programming: https://www.tutorialspoint.com/java/index.htm

Best IDE Tools:		
Sr.No	**Name of IDE or Tools**	**Operating System**
1	Eclipse IDE +Tomcat 10.0 Server	Windows Operating System

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Data Science Using Python**	
Course Code: 23SBCA52MM		**No. Of Credits: 02**
Course Type: MM(Major Mandatory)		**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To Build The Fundamentals Of Data Science
2.	To Learn Techniques And Tools For Transformation Of Data
3.	To Learn The Models For Big Data Problems
4.	Empowering Students With Tools And Techniques Used In Data Science.

Sr.No.	**Course Outcome**
After Completing Course Students Will Be Able To -	
1.	Gain insights into the data science process and the responsibilities of a data scientist.
2.	Acquire, clean, transform, and manipulate data using libraries like NumPy and Pandas.
3.	Perform exploratory data analysis, apply statistical models, and derive insights while assessing data quality.
4.	Utilize computing theory, algorithms, and optimization principles to formulate data-driven solutions for business challenges.

Unit No	Title with Contents	No. of Lectures
Unit I	**INTRODUCTION TO DATA SCIENCE**	**4**
	1. What is Data? **2. Types of Data:** i. Structured ii. Unstructured iii. Semi-structured **3. What is Data Science?** **4. Data science process** **5. Stages in a Data Science project** **6. Applications of Data Science in various fields** **7. Basics of Data Analytics** **8. Types of Analytics :** iv. Descriptive v. Predictive vi. Prescriptive	**1** **1** **1** **1**
Unit II	**Data Pre-Processing & Exploratory Data Analysis**	**7**
	1. Data Collection: i. Primary Data Collection ii. Secondary Data Collection **2. Data Cleaning:** i. Handling missing values ii. duplicate data iii. outliers and inconsistent data **3. Data Transformation:** i. Feature scaling ii. Encoding categorical variables **4. Data Integration:** i. Combining datasets **5. Data Reduction** **6. Descriptive statistics:** i. Central tendency (mean, median, mode). ii. Dispersion (range, variance, standard deviation, IQR). iii. Distribution analysis (skewness, kurtosis).	 **1** **1** **1** **1** **2**

Unit III	Python Toolbox For Data Science	13
	1. NumPy Array: i. Creating NumPy arrays: np.array(), np.arange(), np.linspace(), np.zeros(), np.ones() ii. Array shape, size, and dimensions iii. Indexing and slicing of NumPy arrays iv. Reshaping arrays with reshape() **v.** Transposing Array **2. Numpy Array Operations** i. Basic mathematical operations (addition, subtraction, multiplication, division) ii. Universal functions (ufuncs): element-wise operations (e.g., np.sqrt(), np.exp()) iii. Aggregation functions: np.sum(), np.mean(), np.median(), np.std() iv. Statistical operations: np.var(), np.min(), np.max() v. Axis operations: summing along rows or columns vi. Changing the shape of arrays: flatten(), ravel(), resize() **3. Introduction to Pandas** i. Introduction to Pandas ii. Importance of Pandas in data science iii. Series: Creating Series, indexing, Reindexing, Dropping entries from Series and slicing iv. DataFrame: Creating DataFrames, Accessing rows and columns in a DataFrame ,Reindexing DataFrames, Dropping entries DataFrames Mapping and Replacing: map(), replace() **4. Data Visualization using Matplotlib and Seaborn** i. Histograms. ii. Boxplots. iii. Heatmaps iv. Bar Graph v. Pie Charts	**1** **1** **1** **1** **1** **2** **3** **3**
Unit IV	**Model development and evaluation**	**7**
	1. Choosing the right model based on the problem **2. Model Selection** i. Choosing between regression, classification, clustering, or deep learning models ii. Selecting the right algorithm (e.g., Linear Regression, Decision Tree) **3. Training Models** i. Splitting the Data ii. Training the Model **4. Model Evaluation Metrics** i. Regression metrics (e.g., RMSE, MSE, MAE) ii. Classification metrics (e.g., Accuracy, Precision, Recall, F1 Score, AUC-ROC) iii. Cross Validation **iv.** Overfitting and Underfitting	**1** **2** **1** **3**

Suggested Reading	
1.	Cathy O'Neil and Rachel Schutt, " Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014.
2.	Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015.
3.	Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization ,O'Reilly, 2016.
4.	Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
5.	Jojo Moolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT, 2016.
6.	Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.
7.	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013

Website Reference Link:	
1.	Data Science Tutorial : https://www.geeksforgeeks.org/data-science-with-python-tutorial/
2.	Data Science Tutorial : https://www.javatpoint.com/data-science
3.	Basics Of Machine Learning : https://www.geeksforgeeks.org/machine-learning/
4.	Libraries Tutorial : https://pandas.pydata.org/ https://matplotlib.org/ https://numpy.org/

Best IDE Tools:		
Sr.No	**Name of IDE or Tools**	**Operating System**
1.	Jupiter Notebook or Google Colab or Visual Studio Code	Window Operating System

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Course Title:	**Operating Systems**	
Course Code: 23SBCA53MM		**No. Of Credits: 02**
Course Type: MM(Major Mandatory)		**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	Understand the fundamental concepts of Operating Systems.
2.	To Understand The Notion Of Inter-Process Communication.
3.	To Study Algorithms For CPU-Scheduling, Process Creation And Termination.
4.	To Learn Critical-Section Problems And Classical Process-Synchronization Problems.
5.	To Know The Concept Of Deadlock, Different Methods For Preventing Or Avoiding Deadlocks.
6.	To Study The Techniques For Memory Management.
7.	To Learn And Understand File System And Directory Structure.

Sr.No.	**Course Outcome**
After Completing Course Students Will Be Able To -	
1.	Describe Algorithms For Process Scheduling.
2.	Apply Technique For Inter-Process Communication.
3.	Implement Concept Of Critical-Section.
4.	Compare And Contrast Deadlock Avoidance And Prevention.
5.	Use Functions For File System Management.

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Operating System**	**03**
	1. Operating Systems Overview i. Introduction ii. Definition of Operating system operations iii. Types of operating system iv. Operating system services and systems calls v. Unix Fundamentals a. History and Features of Unix b. Unix Architecture i. Kernel ii. Shell Utilities c. Unix File System i. Hierarchy ii. Permissions iii. Access Control	**1** **2**
Unit II	**Process Management**	**02**
	1. Process Scheduling i. Scheduling queues ii. Schedulers iii. Context switch **2. Operations on Process** i. Process concept a. Process State b. Process Control Block ii. Process creation (**Fork system call)** iii. Process termination (**Kill system call)**	**1** **1**
Unit III	**CPU Scheduling**	**05**
	1. Introduction **2. Scheduling Concepts** i. CPU-I/O burst cycle ii. CPU Scheduler iii. Preemptive and Non-Preemptive Scheduling iv. Dispatcher **3. Scheduling Criteria** **4. Scheduling Algorithms** i. FCFS ii. SJF iii. Priority scheduling iv. Round-robin scheduling	**1** **1** **1** **2**

Unit IV	**Process Synchronization**	**04**
	1. Introduction **2. Critical Section Problem** **3. Semaphores** i. Usage ii. Implementation iii. Deadlock & Starvation **4. Classic Problems of Synchronization** i. Dining Philosopher Problem	**1** **2** **1**
Unit V	**Deadlocks**	**05**
	1. System Model **2. Deadlock Characterization** **3. Deadlock Prevention** **4. Deadlock Avoidance** i. Banker's Algorithm **5. Deadlock Detection** **6. Recovery from Deadlock**	**1** **1** **1** **1** **1**
Unit VI	**Memory Management**	**08**
	1. Introduction to Memory Management i. Memory Hierarchy (Primary, secondary, cache) **2. Contiguous Memory Allocation** i. Single Partition Allocation ii. Multiple Partition Allocation iii. External and Internal Fragmentation **3. Paging** **4. Segmentation** **5. Virtual Memory** **6. Demand paging** **7. Page Replacement Algorithms** i. FIFO ii. Optimal Replacement iii. LRU iv. Second Chance Algorithm	**1** **2** **2** **3**
Unit VII	**File System Management**	**03**
	1. File System structure and organization **2. File System Implementation** i. inodes, blocks **3. File System operation** **4. File System Security (permissions, access control)**	**1** **1** **1**

Suggested Reading	
1.	Operating System Concepts, Avi Silberschatz, Peter Galvin, Greg Gagne, 8th Edition, Wiley Asia
2.	Operating Systems: Internals and Design Principles, William Stallings, Prentice Hall of India.
3.	The Design of the UNIX Operating System By Maurice J. Bach., PHI publication
Website Reference Link:	
1.	**Operating system Tutorial :** https://www.tutorialspoint.com/operating_system/index.htm
2.	**Operating system Tutorial :** https://www.javatpoint.com/operating-system
3.	**Operating system Tutorial** : https://www.geeksforgeeks.org/operating-systems/

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Lab I - Advanced Java**
Course Code: 23SBCA54MM	**No. Of Credits:02**
Course Type: MM(Major Mandatory)	**Total Teaching Hours:60**

Sr.No.	**Course Objectives**
1.	To Learn The Creation Of Pure Dynamic Web Application Using Jdbc
2.	To Understand Concept Of Multithreading
3.	To Learn Server-Side Programming Using Servlets And Java Server Pages.
Sr.No.	**Course Outcome**
After Completing Course Students Will Be Able To -	
1.	Know The Concepts Of Jdbc Programming.
2.	Design and develop real world multithreaded applications.
3.	Know The Concepts Of Server Side Programming
4.	Develop The Project By Using JSP And JDBC.

Assignment No.	**Assignment Name**	**No. Of Sessions**
1	**1. JDBC Driver Manager** **2. JDBC Connection establishment** **3. JDBC Statements** i. Statements ii. Prepared statements iii. Callable statements 4. **Result Sets**	**5**
2	**1. Multithreading:** i. Using class ii. Runnable iii. Priorities iv. Stopping threads	**4**
3	**1. Servlet** **2. Generic Servlet** **3. Http Servlet** **4. JSP**	**5**
Total Number of Sessions		**14**

Best IDE Tools:		
Sr.No	**Name of IDE or Tools**	**Operating System**
1	Eclipse IDE +Tomcat 10.0 Server	Windows Operating System

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Course Title:	**Lab II - Data Science using Python**
Course Code:23SBCA55MM	**No. Of Credits:02**
Course Type: MM(Major Mandatory)	**Total Teaching Hours:60**

Sr.No.	**Course Objectives**
1.	To Learn How To Use Jupyter Notebooks.
2.	To Develop Proficiency For Data Analysis Using Numpy Datatype And Pandas Series.
3.	To Understand How To Use Data Visualization For Data Analysis
4.	To Introduce Statistical Tools For Working With Data Sets

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Develop skills in NumPy Arrays, Indexing ,Sorting and mathematical and statistical functions
2.	Demonstrate proficiency in Pandas dataframe and Pandas Series.
3.	Carry out standard data visualization and formal inference procedures and can comment on the results.
4.	Develop the ability to build and assess data-based models

Assignment No	**Assignment Name**	**No. Of Sessions**
1	**NumPy – Array Operations**	**2**
2	**Pandas - Creating Series & its operations**	**2**
3	**Pandas - Creating DataFrame & its operations**	**2**
4	**Data Visualization using Matplotlib and Seaborn**	**2**
5	**Descriptive Statistics**	**2**
6	**Simple Regression – Model development**	**2**
7	**Evaluation Metrics**	**1**
8	**Mini Case Study**	**1**
Total Number of Sessions		**14**

Best IDE Tools:	
Name of IDE or Tools	**Operating System**
Jupyter Notebook or Google Colab or Visual Studio Code	Window Operating System

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Introduction to JavaScript**	
Course Code: 23SBCA51MEA		**No. Of Credits: 02**
Course Type: ME(Major Elective)		**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To introduce JavaScript as a fundamental language for web development.
2.	To understand JavaScript syntax, data types, and control structures.
3.	To explore object-oriented programming and JavaScript scope, DOM manipulation and event handling for interactive web pages.

Sr.No.	**Course Outcome**
After Completing Course Students Will Be Able To -	
1.	Explore JavaScript syntax, variables, and data types and control flow statements
2.	Learn about JavaScript objects, their properties, and methods.
3.	Learn about the Document Object Model (DOM) and how to manipulate it dynamically.

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to JavaScript**	**10**
	1. Introduction to JavaScript i. What is JavaScript? ii. Overview of JavaScript in web development. iii. Introduction to the browser's developer tools. **2. JavaScript Syntax and Structure** i. Variables (let, const, var) ii. Basic data types (string, number, boolean, undefined, null) iii. Operators (arithmetic, comparison, logical, assignment) **3. Control Flow - Conditionals** i. if, else if, else ii. switch-case iii. Ternary operators **4. Loops and Iteration** i. for loop, while loop, do-while loop ii. for-in, for-of loop	**2** **3** **3** **2**
Unit II	**Array and Functions**	**8**
	1. Functions in JavaScript i. Function declaration and expressions ii. Arrow functions iii. Parameters, arguments, return statements **2. Arrays and Array Methods** i. Defining and accessing arrays ii. Common array methods (push, pop, map, filter, reduce) **3. Objects in JavaScript** i. Defining and accessing objects ii. Object methods and properties iii. Destructuring **4. JavaScript Scope and Closures** i. Global vs local scope ii. Function scope and block scope iii. Closures and practical examples	**2** **2** **2** **2**

Unit III	Event Handling and Object-Oriented Programming	12
	1. Error Handling in JavaScript i. try/catch/finally ii. Throwing and catching errors iii. Custom error handling	**2**
	2. DOM Manipulation i. Understanding the DOM (Document Object Model) ii. Selecting elements (getElementById, querySelector) iii. Changing content and styles dynamically	**3**
	3. Events in JavaScript i. Event listeners (click, submit, etc.) ii. Event delegation iii. Preventing default actions iv. Asynchronous Events	**3**
	4. JavaScript Classes and Object-Oriented Programming i. Introduction to classes ii. Constructor functions iii. Inheritance and prototypes	**2**
	5. ES6+ Features i. Template literals ii. Default parameters	**2**

Suggested Reading	
1.	"JavaScript: The Definitive Guide" (7th Edition) – David Flanagan
2.	"Eloquent JavaScript" (3rd Edition) – Marijn Haverbeke
3.	"You Don't Know JS" (Series) – Kyle Simpson

Website Reference Link:	
1.	**JavaScript Tutorial**: https://www.w3schools.com/js/default.asp
2.	**JavaScript Tutorial: https://www.geeksforgeeks.org/javascript/**
3.	The Modern JavaScript Tutorial: https://javascript.info/

Best IDE Tools:		
Sr.No	**Name of IDE or Tools**	**Operating System**
1	Visual Studio Code	Window Operating System

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Software Testing and Quality Assurance**	
Course Code: 23SBCA51MEB		**No. Of Credits: 02**
Course Type: ME(Major Elective)		**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To understand Quality Concepts
2.	To gain Knowledge of Software Testing
3.	To learn Software Quality Architecture and Components
4.	To understand Defect Management and Understand Software Lifecycle and Metrics
5.	To understand concepts of Quality Assurance

Sr.No.	**Course Outcome**
After Completing Course Students Will Be Able To -	
1.	Identify and Analyze Errors
2.	Design Effective Test Cases
3.	Apply Software Quality Assurance Practices
4.	Use Software Quality Metrics
5.	Implement Software Quality Assurance (SQA) Methods

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Quality**	**06**
	1. Introduction **2. Nature of errors** **3. An Example for Testing** **4. Quality** i. Definition of Quality ii. QA, QC, QM and SQA iii. Software Development Life Cycle iv. Software Quality Factors **5. Verification and Validation** i. Definition of V &V ii. Different types of V & V Mechanisms iii. Concepts of Software Reviews iv. Inspection and Walkthrough	**2** **2** **2**
Unit II	**Software Testing**	**06**
	1. Software Testing Techniques i. Testing Fundamentals, ii. Test Case Design, iii. White Box Testing and its types, iv. Black Box Testing and its types **2. Software Testing Strategies** i. Strategic Approach to Software Testing ii. Unit Testing iii. Integration Testing iv. Validation Testing v. System Testing	**3** **3**
Unit III	**Software Quality Architecture and Components**	**06**
	1. The need for comprehensive software quality requirements **2. Classifications of software requirements into software quality factors** i. Product Operation ii. Product Revision iii. Product Transition **3. SQA architecture** **4. Software Quality Components** i. **P**re-project components ii. Software project life cycle components iii. Infrastructure components for error iv. prevention and improvement	**2** **1** **3**

Unit IV	**Software quality metrics and Defect Management**	**06**
	1. Objectives of quality measurement i. Classification of software quality metrics ii. Concept and Developing Metrics iii. Different types of Metrics, iv. Complexity metrics v. Implementation of software quality metrics vi. Limitations of software metrics **2. Defect Management** i. Definition of Defects ii. Defect Management Process iii. Defect Reporting	**3** **3**
Unit V	**Software Quality Assurance**	**06**
	1. Quality Concepts i. Quality Movement, ii. Background Issues, iii. SQA activities, **2. Software Reviews** i. Formal Technical Reviews ii. Informal Reviews **3. Statistical Quality Assurance** **4. Software Reliability** **5. The ISO 9000 Quality Standards** **6. SQA Plan** **3. Six sigma**	**1** **1** **4**

Suggested Reading	
1.	Software Quality Assurance by Daniel Galin, Pearson Publication, 2009.
2.	Software testing and Quality Assurance Theory and Practice by Kshirasagar Naik and Priyadarshi Tripathy, Wiley Publication
3.	Software Engineering A Practitioner‟s Approach Sixth Edition by Roger S. Pressman, McGraw Hill Publication
4.	Metrics and Models in Software Quality Engineerning, By Stephen H. Kan, Pearson Publication
5.	Software Engineering and Testing, B. B. Agarwal, S. P. Tayal, M. Gupta, Jones and Bartlett Publishers, 2010
Website Reference Link:	
1.	**Software Testing Tutorial :** https://www.geeksforgeeks.org/software-testing-basics/
2.	**Software Testing Tutorial :** https://www.tpointtech.com/software-testing-tutorial
3.	**Software Quality Assurance**https://www.tpointtech.com/software-quality-assurance

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**React JS**	
Course Code: 23SBCA52MEA		**No. Of Credits: 02**
Course Type: ME(Major Elective)		**Total Teaching Hours:30**

Sr. No.	**Course Objectives**
1.	To introduce the fundamentals of ReactJS and its advantages in modern web development.
2.	To enable students to manage state and props effectively in React applications.
3.	To familiarize students with event handling, lists, keys, and component lifecycle methods, React hooks, routing.

Sr.No.	**Course Outcome**
After Completing Course Students Will Be Able To -	
1.	Understand props and state for data handling in React components.
2.	Fetch data and handle side effects using lifecycle methods.
3.	Understand state management techniques like Redux and Context API.

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to ReactJS**	**10**
	1. Introduction to ReactJS i. What is React and why use it? ii. Setting up a React project with Create React App iii. React component structure (Class vs Functional components) **2. JSX Syntax and Rendering Elements** i. Understanding JSX ii. Rendering React components iii. Conditional rendering in JSX **3. React Components and Props** i. Functional components ii. Understanding Props iii. Passing data to components **4. State in React** i. Understanding state and useState hook ii. Modifying state iii. State vs props	**2** **2** **3** **3**
Unit II	**Event Handling**	**9**
	1. Handling Events in React i. Event handling in React (onClick, onSubmit, etc.) ii. Binding event handlers iii. Passing arguments to event handlers **2. Lists and Keys in React** i. Rendering lists dynamically ii. Keys in lists iii. Optimizing re-renders **3. React Lifecycle Methods (Class Components)** i. Component mounting and unmounting ii. Lifecycle methods (componentDidMount, componentWillUnmount, etc.) iii. Using lifecycle methods for data fetching	**3** **3** **3**
Unit III	**Advanced React JS**	**11**

	1. React Hooks - useEffect and useContext i. useEffect for side effects ii. useContext for global state management **2. Routing in React (React Router)** i. Setting up React Router ii. Route and Link components iii. Nested routes and route parameters **3. State Management in React (Redux or Context API)** i. Introduction to Redux or Context API ii. Actions, reducers, and the store iii. Managing state across multiple components	**2** **4** **5**

Suggested Reading	
1.	Learning React: Modern Patterns for Developing React AppsAlex Banks, 2020
2.	The Road to Learn React: Your Journey to Master Plain Yet Pragmatic React. Js Robin Wieruch, 2017
3.	Fullstack React: The Complete Guide to ReactJS and Friends

Website Reference Link:	
1.	**React Tutorial: https://www.w3schools.com/REACT/DEFAULT.ASP**
2.	**React Tutorial: https://www.geeksforgeeks.org/react/**
3.	**React Tutorial**: https://react.dev/learn

Best IDE Tools:		
Sr.No	**Name of IDE or Tools**	**Operating System**
1.	Visual Studio Code	Window Operating System

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title:	**Introduction to Web Services**	
Course Code: 23SBCA52MEB		**No. Of Credits:02**
Course Type: ME(Major Elective)		**Total Teaching Hours:30**

Sr. No.	**Course Objectives**
1.	To Understand Web Services and implementation model for SOA
2.	To Understand the SOA, it's Principles, Benefits and XML concepts.
3.	To Understand paradigms needed for testing Web Services
4.	To explore different Test Strategies for SOA-based applications

Sr. No.	**Course Outcome**
After completing course students will be able to -	
1.	Understand the principles of SOA.
2.	Efficiently use market leading environment tools to create and consume web services
3.	Identify and select the appropriate framework components in creation of web service solution.
4.	Apply OOP principles to creation of web service solutions.

Unit No	Title with Contents	No. of Lectures
Unit I	**Evolution and Emergence of Web Services**	**05**
	1. **Evolution of distributed computing** 2. **Core distributed computing technologies** – i. client/server ii. CORBA iii. JAVA RMI iv. Micro Soft DCOM, MOM **2. Challenges in Distributed Computing,** **3. Introduction to Web Services –** i. The definition of web services ii. Basic operational model of web services, tools iii. Technologies enabling web services, iv. Benefits and challenges of using web services.	**2** **1** **1** **1**
Unit II	**Web Service Architecture**	**6**
	1 Web services Architecture and its characteristics **2 Core building blocks of web services** **3 Standards and technologies available for implementing web services,** **4 web services communication** **5 Basic steps of implementing web services**	**1** **1** **2** **1** **1**
Unit III	**XML and SOAP**	**10**
	1 XML Document structure **2 XML namespaces** **3 Defining structure in XML documents** **4 Reuse of XML schemes** **5 Document navigation and transformation** **6 SOAP : Simple Object Access Protocol**, **i.** Inter-application communication and wire protocols, **ii.** SOAP as a messaging protocol, **iii.** Structure of a SOAP message, **iv.** SOAP envelope, **v.** Encoding, **7 Service Oriented Architectures** **i.** SOA revisited **ii.** Service roles in a SOA **iii.** Reliable messaging	**1** **1** **1** **1** **1** **3** **2**

Unit IV	Describing and Discovering Web Services	09
	1. Introduction WSDL i. non-functional service description, ii. WSDL1.1 Vs WSDL 2.0, iii. WSDL document, iv. WSDL elements, v. WSDL binding, vi. WSDL tools, vii. WSDL port type, viii. limitations of WSDL **2. Introduction to UDDI** i. The role of service registries ii. Service discovery iii. Universal Description iv. Discovery, and Integration v. UDDI Architecture vi. UDDI Data Model vii. Interfaces viii. UDDI Implementation	**5** **4**

Suggested Reading	
1.	XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education
2.	Building web Services with Java, 2nd Edition, S. Graham and others, Pearson Education.
3.	Java Web Services, D.A. Chappell & T. Jewell, O"Reilly, SPD.
4.	McGovern, et al., "Java web Services Architecture", Morgan Kaufmann Publishers, 2005.
Website Reference Link:	
1.	**Web Services Tutorial: https://www.javatpoint.com/web-services-tutorial**
2.	**Web Services Tutorial: http://www.w3schools.com/Xml/xml_services.asp**
3.	**Web Services Tutorial: https://www.tutorialspoint.com/webservices/index.htm**

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Network Security and Cryptography**	
Course Code: 23SBCA51MNA		**No. Of Credits: 02**
Course Type: MN(Minor Theory)		**Total Teaching Hours: 30**

Sr.No.	**Course Objectives**
1.	To understand basics of Cryptography and Network Security.
2.	To learn about various Cryptographic techniques.
3.	To Learn about Symmetric key and Asymmetric key Algorithms
4.	To learn the concept of Digital Signatures.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Identify the security issues in the network and resolve it.
2.	Evaluate security mechanisms using rigorous approaches by key ciphers and Hash functions.
3.	Understand and analyze public-key cryptography, RSA and other public-key cryptosystems
4.	Understand User Authentication

Unit No	Title with Contents	No. of Lectures
Unit I	**Network Security Fundamentals**	**6**
	1. Introduction to Network Security **2. Network security threats and vulnerabilities** i. Types of malwares (viruses, worms, trojans) ii. Phishing and social engineering attacks **3. Network security policies and procedures** **4. Access Control**	
Unit II	**Network Security Measures**	**6**
	1. Firewalls and access control lists (ACLs) **2. Virtual private networks (VPNs)** **3. Intrusion detection and prevention systems (IDPS)**	
Unit III	**Cryptography Fundamentals**	**12**
	1. Introduction to Cryptography i. Definition and importance of cryptography ii. Types of cryptography techniques (plain text, cipher text, substitution, transposition, symmetric, asymmetric) **2. Symmetric Key Cryptography** i. Block ciphers (DES) ii. Stream ciphers (RC4) **3. Asymmetric Key Cryptography** i. Public-key cryptography (RSA) **4. Hash Functions and Digital Signatures - Authentication** i. Hash functions (SHA, MD5) ii. Digital signatures (DSA, ECDSA)	
Unit IV	**Network Security Protocols**	**6**
	1. Secure Socket Layer (SSL) **2. Transport Layer Security (TLS)** **3. Secure Hyper Text Transfer Protocol (SHTTP)** **4. Secure Electronic Transaction (SET)** **5. E-mail Security**	

Suggested Reading	
1.	Cryptography and Network Security Second Edition – Atul KahateNetwork Security:The Complete Reference by BRAGG, Tata MCgraw Hill Education Private
2.	Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall PTR., 2002.
3.	Stallings, W.,.Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003.
Website Reference Link	
1.	Information Security Notes : https://mrcet.com/downloads/digital_notes/CSE/III%20Year/Information%20Security.pdf
2.	Network Security Notes : https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCS1316.pdf

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Introduction to Single Board Systems and Applications**	
Course Code: 23SBCA51MNB		**No. Of Credits: 02**
Course Type: MN(Minor Theory)		**Total Teaching Hours: 30**

Sr.No.	**Course Objectives**
1.	To introduce the concept and architecture of single-board systems (SBS).
2.	To provide hands-on experience with programming and interfacing single-board computers
3.	To develop skills to implement real-world applications using SBS.
4.	To familiarize the students with the programming and interfacing of different devices with SBS (Raspberry Pi).

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Understand the architecture and components of single-board system like Raspberry Pi.
2.	Program single-board systems for basic tasks and applications.
3.	Interface sensors, actuators, and other peripherals to develop functional projects.
4.	Learn interfacing different peripherals with Raspberry Pi
5.	Design mini project based on Raspberry Pi.

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Single Board Systems**	**5**
	1 What is a Single Board System? **2 Overview of Popular SBS:** i. Arduino (Microcontroller-based system) ii. Raspberry Pi (Single-board computer) **3 Comparison of SBS with traditional microcontroller and microprocessor systems.** 4 **Applications of Single Board Systems in IoT, Robotics, and Embedded Systems.**	
Unit II	**Architecture and Programming of Single Board System**	**10**
	1 **Raspberry Pi – Introduction-Basics, applications, installation.** 2 **Pin Description of Raspberry Pi,** 3 **Preparing SD Card for Raspberry Pi** 4 **Introduction to Raspbian OS and other operating systems for Raspberry Pi.** 5 **First boot, Configuration, time setting, keyboard layout, disk expand, etc.** 6 **Function of GPIO Pins and Interfacing** 7 **Introduction to Libraries**	
Unit III	**Interfacing of devices using Python Programming**	**15**
	1 Sensors: i. Interfacing Temperature Sensors (e.g., DHT11) ii. Light Sensors (LDR) iii. Ultrasonic Sensors (HC-SR04) iv. motion sensor(PIR Sensor) **2 Actuators:** i. Controlling LEDs , ii. Switches , iii. Relays, iv. Motor Control (DC, Servo, Stepper) **3 Communication Interfaces:** i. I2C ii. SPI iii. UART communication protocol iv. Bluetooth v. Wifi vi. Ethernet vii. Camera viii. Serial Communication GSM	

Suggested Reading	
1.	"Raspberry Pi User Guide" By Eben Upton and Gareth Halfacree, Wiley Publication
2.	"Programming the Raspberry Pi: Getting Started with Python", By Simon Monk, Publisher: McGraw Hill
3.	"Raspberry Pi Cookbook: Software and Hardware Problems and Solutions", By Simon Monk, Publisher: O'Reilly Media
4.	"Learning Python with Raspberry Pi", By Alex Bradbury and Ben Everard, Publisher: Wiley

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Lab IV- Network Security and Cryptography**
Course Code: 23SBCA52MNA	**No. Of Credits: 02**
Course Type: MN(Minor Practical)	**Total Teaching Hours: 60**

Sr.No.	**Course Objectives**
1.	To understand basics of Cryptography and Network Security.
2.	To learn about various Cryptographic techniques.
3.	To Learn about Symmetric key and Asymmetric key Algorithms
4.	To learn the concept of Digital Signatures.
Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Identify the security issues in the network and resolve it.
2.	Evaluate security mechanisms using rigorous approaches by key ciphers and Hash functions.
3.	Understand and analyze public-key cryptography, RSA and other public-key cryptosystems and User Authentication

Assignment No	**Assignment Name**	**No. Of Sessions**
1	Understand the process of capturing Network traffic using tools (Wireshark)	**2**
2	Implement Firewall through Cisco Packet Tracer.	**1**
3	Implement VPN through Cisco Packet Tracer/ Snort	**1**
4	Implement Cryptographic algorithms using C/Java	**1**
5	Implement Diffie-Hellman Keyt Exchange mechanism using C/Java	**1**
6	Implement Caesar cipher using C/Java	**1**
7	Implement DES algorithm logic using C/Java	**1**
8	Implement RC4 algorithm logic using C/Java	**1**
9	Implement the RSA algorithm logic using C/Java	**1**
10	To install & demonstrate Jcrypt Tool.	**2**
11	To demonstrate asymmetric, symmetric crypto algorithm using Jcrypt	**2**
	Total Number of Sessions	**14**

Best IDE Tools:	
Name of IDE or Tools	**Operating System**
Wireshark 4.4, Nmap 7.95	Windows

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Course Title	**Lab IV- Introduction to Single Board Systems and Applications**
Course Code: 23SBCA52MNB	**No. Of Credits: 02**
Course Type: MN(Minor Practical)	**Total Teaching Hours: 60**

Sr.No.	**Course Objectives**
1.	To develop skills to implement real-world applications using SBS.
2.	To familiarize the students with the programming and interfacing of different devices with SBS (Raspberry Pi).
Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Learn interfacing different peripherals with Raspberry Pi
2.	Design mini project based on Raspberry Pi.

Assignment No	**Assignment Name**	**No. Of Sessions**
1	Set up the Raspberry Pi and execute a basic Python program to print "Hello, World!"	**1**
2	Interfacing LEDs to Raspberry Pi using GPIO pins	**1**
3	Interfacing a switch connected to the GPIO pins and display status on LED using Raspberry Pi	**1**
4	Interfacing LCD to Raspberry Pi	**1**
5	Interfacing temperature sensor to Raspberry Pi to detect temperature	**1**
6	Interfacing photo sensor to Raspberry Pi to detect light intensity	**1**
7	Interfacing Ultrasonic sensor to Raspberry Pi for distance measurement	**1**
8	Interfacing PIR sensor using Raspberry Pi for motion detection	**1**
9	Interfacing Pi Camera to Raspberry Pi	**1**
10	Speed control of DC Motors using Raspberry Pi	**1**
11	Interfacing of Stepper Motors using Raspberry Pi	**1**
12	Interfacing of Servo Motors using Raspberry Pi	**1**
13	Sending sensor data to a cloud server using MQTT or HTTP.	**1**
	Total Number of Sessions	**13**

List of Major Equipment/ Instrument with Broad Specifications

i) Raspberry Pi Board
ii) Computer System(Latest version)
iii) Peripheral Interfacing Trainer kits

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Course Title	**Lab III - Front End Development Technologies using JS and ReactJS**
Course Code: 23SBCA51VS	**No. Of Credits:02**
Course Type: Vocational Skill Course(VSC)	**Total Teaching Hours:60**

Sr.No.	**Course Objectives**
1.	To equip students with a solid foundation in JavaScript and React JS
2.	To develop dynamic, interactive, and high-performance web applications

Sr.No.	**Course Outcome**
After Completing Course Students Will Be Able To -	
1.	Ready to work with industry-standard frameworks and libraries
2.	Understand JavaScript data types, variables, operators, and control structures.
3.	Understand the React Framework and Component-Based Development.
4.	Understand React's component-based architecture and how to build reusable components

Assignment No.	Assignment Name	No. Of Sessions
1.	**Assignment on Control Flow and Loops**	2
2.	**Assignment on Functions in JavaScript**	**1**
3.	**Assignment on Arrays and Scope, Closures**	**1**
4.	**Assignment on Error Handling and DOM Manipulation**	**1**
5.	**Assignment on Classes and Object and Events**	**2**
6.	**Assignment on React Components and Props**	**2**
7.	**Assignment on Assignment on State and Handling Events in React**	**1**
8.	**Assignment on Lists and Keys in React and React Lifecycle Methods**	**1**
9.	**Assignment on React Hooks - useEffect and useContext and Routing in React**	**1**
10.	**Assignment on State Management in React (Redux or Context API)**	**1**
11.	**Mini Case study using JavaScript and ReactJS**	**1**
Total Number of Sessions		**14**

Best IDE Tools:		
Sr.No	**Name of IDE or Tools**	**Operating System**
1	Visual Studio	Windows Operating System

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Course Title	**Field Project**	
Course Code: 23SBCA51FP		**No. Of Credits:02**
Course Type: FP		**Total Teaching Hours:60**

Sr.No.	**Course Objectives**
1.	To understand concepts of Project Management
2.	To know how various tools for development and management of software projects are used to carry out various tasks involved
3.	To learn the importance of project documentation.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Demonstrate a sound technical knowledge of selected project topic.
2.	Apply techniques for project management
3.	Create various documents used during the development of the project and a project report.

Sr no	Guidelines
1	Students shall choose any topic for project work in consultation with project guide, Project In-charge and head of the department
2	The students shall work on a Project in a group of not more than three students.
3	Students are expected to work on the chosen project during the entire semester.
4	Students shall undertake application oriented/web-based/database-oriented/research based work.
5	Students shall successfully implement the chosen work. Only a hypothetical / theoretical study shall not be accepted
6	Students shall choose any appropriate programming language/ platform, computational techniques and tools in consultation with the guide, In-charge and the head of the department
7	The faculty members from affiliated college shall act as a project guide for each project group with equal distribution of groups amongst each eligible faculty.
8	The guide shall track and monitor the project progress on a weekly basis by considering the workload of 4 laboratory hours per week.
9	The project work shall be evaluated based on the novelty of the topic, scope of the work, relevance to computer science, adoption of emerging techniques/technologies and its real-world application etc.
10	Students shall prepare a project report with the following contents: a) Title Page b) Certificate c) Index Page detailing description of the following with their sub sections: - - -Title: A suitable title giving the idea about what work is proposed. – -Introduction: An introduction to the topic giving proper - Background of the topic. -Requirement Specification: -Specify Software/hardware/data requirements. - System Design details :Methodology/Architecture/UML/DFD/Algorithms/protocols used(whichever is applicable) - System Implementation: Code -Results: Test Cases/Tables/Figures/Graphs/Screen shots/Reports etc. - Conclusion and Future Scope: Specify the Final conclusion and future scope - References: Books, web links, research articles etc.
11	The Project report should be prepared in a spiral bound form with adequate number of copies. Copy shall be submitted to the guide and college for the records.
12	The Project work and report shall be certified by the concerned Project guide and Head of the department.

13	Students shall make a presentation of working project and will be evaluated as per the Project evaluation scheme as detailed below 1. **Continuous Evaluation, Progress Report: 20 marks** 2. **End Semester Examination in the form of** 30 marks i. Presentation & Project Report 10 ii. Demonstration of the Project 15 iii. Viva 05

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T.Y.B.C.A. (Science) SEM-VI Syllabus

Applicable for the Autonomous College affiliated to

Savitribai Phule Pune University

BCA Science Three Year Degree Programme

(NEP 2023 Pattern)

With Effect from June 2025-26

SEMESTER VI					
Course Type	**Course Code**	**Course Name**	**Credits**		
			Theory	**Practical**	**Total**
Major/Core Theory	23SBCA61MM	Android Programming	2		
Major/Core Theory	23SBCA62MM	Data Mining using Python	2		
Major/Core Theory	23SBCA63MM	Computing Science in Ancient India	2		
Major/Core Practical	23SBCA64MM	Lab I : Android Programming		2	
Major/Core Practical	23SBCA65MM	Lab II : Data Mining using Python		2	
Major Elective Theory	23SBCA61MEA OR 23SBCA61MEB	Artificial Intelligence OR Data Visualisation using Power BI	2		
Major Elective Theory	23SBCA62MEA OR 23SBCA62MEB	React Native OR MongoDB	2		
Minor Theory	23SBCA61MNA OR 23SBCA61MNB	Ethical Hacking and Penetration Testing OR Fundamentals of IoT and Its Applications	2		
Minor Practical	23SBCA62MNA OR 23SBCA62MNB	Lab III - Ethical Hacking and Penetration Testing OR Lab III - Fundamentals of IoT and Its Applications		2	
OJT	23SBCA6OJT	Internship		4	
			12	10	22

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Android Programming**
Course Code: 23SBCA61MM	**No. Of Credits:02**
Course Type: MM(Major Mandatory)	**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To understand the Android Operating System.
2.	To study Android Apps Development Cycle
3.	To learn to create Android Applications.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Demonstrate their understanding of the fundamentals of Android operating systems
2.	Write simple GUI applications, use built-in widgets and components.
3.	Create components and adapter menu

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Android**	**10**
	1. Overview **2. History** **3. Features of Android** **4. Architecture of Android** i. Overview of Stack ii. Linux Kernel iii. Native Libraries iv. Android Runtime v. Application Framework vi. Applications **5. SDK Overview** i. Platforms ii. Tools – (JDK, SDK, Eclipse/Android Studio, ADT, AVD, Android Emulator), Versions. 6. **Creating your first Android Application**	**2** **2** **2** **2** **2**
Unit II	**Activities, Fragments and Intents**	**10**
	1. Introduction to Activities. **2. Activity Lifecycle.** **3. Toast.** **4. Introduction to Intents.** **5. Linking Activities using Intents.** **6. Calling built-in applications using Intents.** **7. Introduction to Fragments.** **8. Adding Fragments Dynamically.** **9. Lifecycle of Fragment.**	**1** **1** **1** **1** **1** **1** **1** **2** **1**
Unit III	**Android User Interface**	**10**
	1. Understanding the components of a screen. i. Views and View Groups. ii. Linear Layout iii. Absolute Layout iv. Table Layout v. Relative Layout vi. Frame Layout	**2** **2**

	vii. Scroll Layout viii. Scroll View ix. Constraint Layout **2. Using Basic Views** i. Text View ii. Button, Image Button, EditText, CheckBox iii. Switch, Toggle, Radio Buttons iv. Progress Bar View v. Auto Complete TextView **3. Using Picker Views** i. TimePicker View ii. DatePicker View **4. Using List Views to Display Long Lists** i. ListView View ii. Using the Spinner View	**2** **2** **2**

Suggested Reading	
1.	Beginning Android4 Application Development, By Wei-Meng Lee WILEY India Edition WROX Publication
2.	Professional Android 4 Application Development, By Reto Meier WROX Publication.
3.	Head First Android Development, By Dawn Griffths, O"Reilly Publicationtion
Website Reference Link	
1.	**Android Tutorial :**https://developer.android.com
2.	**Android Tutorial :** https://www.tutorialspoint.com/android/index.htm
3.	**Android Tutorial :** https://www.javatpoint.com/android-tutorial
4.	**Android Tutorial :** https://www.geeksforgeeks.org/android-tutorial

Best IDE Tools:		
Sr.No	**Name of IDE or Tools**	**Operating System**
1	Android Studio Ladybug version	Windows Operating System

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Data Mining Using Python**
Course Code: 23SBCA62MM	**No. Of Credits:02**
Course Type: MM(Major Mandatory)	**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To understand data warehouse concepts, architecture, business analysis and tools.
2.	To understand data pre-processing and data visualization techniques.
3.	To study algorithms for finding hidden and interesting patterns in data.
4.	To understand and apply various classification and clustering techniques using tools.

Sr.No.	**Learning Outcome**
After Completion of this course students will able to-	
1.	Need of data mining and apply suitable pre-processing techniques for data analysis
2.	Apply frequent pattern and association rule mining techniques for data analysis
3.	Apply appropriate classification and prediction techniques for data analysis
4.	Apply appropriate clustering techniques for data analysis
5	Design a Data warehouse system and perform business analysis with OLAP tools

Unit No	Title with Contents	No. of. Lectures
Unit I	**Introduction to Data Mining**	**08 Hrs.**
	1. What is Data Mining	**1**
	2. Need of data mining	**1**
	3. Knowledge Discovery Process	**1**
	4. Data Mining Tasks-	**1**
	i. Classification	
	ii. Regression	
	iii. Time Series Analysis	
	iv. Prediction	
	v. Clustering	
	vi. Association Rules	
	5. Data mining issues	**1**
	6. Applications of Data Mining	**1**
	7. Statistical description of data	**1**
	8. Data Preprocessing	**1**
	i. Data cleaning	
	ii. Data integration and transformation	
	iii. Data reduction	
	iv. Data discretization	

Unit II	**Classification**	**08 Hrs.**
	1. Introduction to Classification **2. Issues Regarding Classification** **3. Preparing the Data for Classification** **4. Decision Tree Induction** **5. Attribute Selection Measures** **6. Tree Pruning** **7. Rule-Based Classification** i. Using IF-THEN Rules for Classification ii. Rule Extraction from a Decision Tree iii. Rule Induction Using a Sequential Covering Algorithm.	**1** **1** **1** **1** **1** **1** **1** **1** **1**
Unit III	**Cluster Analysis**	**08 Hrs**
	1. Cluster Analysis i. What Is Cluster Analysis? ii. Types of Data in Cluster Analysis iii. Interval-Scaled Variables iv. Binary Variables v. Categorical, Ordinal, and Ratio-Scaled Variables vi. Variables of Mixed Types **2. A Categorization of Major Clustering Methods** **3. Partitioning Methods** i. Classical Partitioning Methods: : k-Means and k- Medoids **4. Outlier Analysis** i. Statistical Distribution-Based Outlier Detection ii. Distance-Based Outlier Detection.	**3** **1** **2** **2**
Unit IV	**Prediction**	**06 Hrs**
	1. Introduction to Prediction **2. Issues Regarding Prediction** **3. Preparing the Data for Prediction** **4. Comparing Classification and Prediction Methods** **5. Prediction** i. Linear Regression ii. Nonlinear Regression **6. Accuracy and Error Measures** i. Classifier Accuracy Measures ii. Predictor Error Measure	**1** **1** **1** **2** **1**

Suggested Reading	
1.	Jiawei Han, MichelineKamber, Jian Pei (2012), Data Mining: Concepts and Techniques, 3rd edition, Elsevier, United States of America.
2.	Margaret H Dunham (2006), Data Mining Introductory and Advanced Topics, 2ndedition,Pearson Education, New Delhi, India.
3.	Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.
Website Reference Link	
1.	**Data Mining Tutorial :** https://intellipaat.com/blog/tutorial/data-warehouse-tutorial/
2.	**Data Mining Tutorial :** https://www.mygreatlearning.com/blog/data-mining-tutorial/
3.	**Data Mining Tutorial :** https://data-flair.training/blogs/data-mining-tutorial/
4.	**Data Mining Book :** http://myweb.sabanciuniv.edu/rdehkharghani/files/2016/02/The-Morgan-Kaufmann-Series-in- Data-Management-Systems-Jiawei-Han-Micheline-Kamber-Jian-Pei-Data-Mining.-Concepts- and-Techniques-3rd-Edition-Morgan-Kaufmann-2011.pdf
5.	**Data Mining Tutorial :** https://hanj.cs.illinois.edu/bk3/

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Computing Science In Ancient India**
Course Code:23SBCA127IKS	**No. Of Credits:02**
Course Type: IKS (Major)	**Total Teaching Hours:30**

Sr.No	**Course Objectives**
1.	To provide an overview of the ancient Indian knowledge system and its contributions to the field of computing.
2.	To analyse the basics of decimal system and binary number system.
3.	To understand origin of modern hashing technique.
4.	To explore Panini's BNF form in formal language theory
5.	To know formal structure of Indian logics

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Describe the ancient Indian knowledge system and its contributions to mathematics.
2.	Explain the basics of decimal system and binary number system.
3.	Describe modern hashing techniques.
4.	Evaluate the connections of Panini's grammar in computing science.
5.	Understand the logic in Indian philosophy

Unit No	Title with Contents	No .of. Lectures
Unit I	**Introduction to Indian Knowledge System (IKS)**	**08**
	1. Overview of IKS- i. Importance of Ancient Knowledge ii. Defining IKS. **2. The IKS Corpus-** i. A classification Framework ii. Chaturdasa-Vidya Sadhana. **3. History of IKS** **4. Some unique aspects of IKS.** **5. The Vedic Corpus-** i. Introduction to Vedas ii. The Four Vedas and their divisions iii. Vedangas **iv.** Vedic Life **6. Philosophical Systems** i. Indian Philosophical Systems ii. Vedic Schools of Philosophy iii. Non-Vedic Philosophical systems **7. Wisdom through the Ages** i. Puranas, ii. Itihasa as source of wisdom, iii. Ramayana iv. Mahabharata v. Nitisastras vi. Subhassitas.	**1** **1** **1** **2** **1** **2**
Unit II	**Introduction to Decimals System and Binary Numbers System**	**12**
	1. Decimal Systems i. Forms of Decimal System: a. Notation b. Nomenclature. ii. ii. Antiquity of Decimal Nomenclature **iii.** iii. Decimal Enumeration in the Ṛgveda iv. Mystic Significance and Etymology of Powers of Ten v. Mention of Zero in Chandaḥ-sūtra of Pingalācārya vi. Exposition of Decimal Place Value in a Mathematics Treatise of Āryabhaṭa vii. Exposition of Zero as an Integer in a	**6**

	Mathematics Treatise of Brahmagupta **2. Binary Number Systems** i. About Acharya Pingala's ii. The Sanskrit Metrical Tradition iii. Pingala's Classification of Meters iv. Representation of binary number according to Pingala v. Decimal equivalent of metrical pattern vi. Finding binary equivalent of decimal number vii. Pinagala's Work viii. Pingala's Meeru Prastara known as Pascal's triangle ix. Shallow diagonals of the Meru Prastara sum to th Fibonacci series	**6**
Unit III	**The Katapayadi Formula and the Modern Hashing Technique**	**04**
	1. Hashing **2. The Katapayadi Scheme** **3. An application of Katapayadi Scheme**	**1** **2** **1**
Unit IV	**The Panini-Backus Form in Syntax of Formal Languages**	**03**
	1. What is BNF Notation **2. Panini** **3. Grammar**	**1** **1** **1**
Unit V	**Logic and epistemology**	**03**
	1. Introduction **2. Carvaka Epistemology** **3. Jaina Logic and Epistemology** **4. Buddhist Epistemology** **5. Vedanta Epistemology**	**1** **1** **1**

Suggested Reading	
1.	B. Mahadevan, Vinayaka Rajat Bhat & Nagendra Pavana R.N., "Introduction to Knowledge System: Concepts and Applications" PHI (2022).
2.	C.M Neelakandhan & K.A.Ravindran, "Vedic Texts and The Knowledge Systems of India", SriSankaracharya University of SANSKRIT, Kalady (2010).
3.	Computing science in ancient India [edited by T.R.N. Rao and Subhash Kak].
4.	Narayana Rao, P. The Epistemology of Dvaita Vedanta. Madras: The Adayar Library andResearch Centre, 1976.
5.	Puligandla, Ramakrishna. Fundamentals of Indian Philosophy. New Delhi: D.K.Print world,2008.
6. Website Reference Link	
1.	**IKS Tutorial :** https://iksindia.org/
2.	**IKS Tutorial :**https://plato.stanford.edu/entries/logic-india/
3.	**IKS Tutorial :**https://science.thewire.in/society/history/fibonacci-series-golden-ratio-ancient-indian-scholars/
4.	**IKS Tutorial :**https://swarajyamag.com/culture/a-vedic-touch-to-logic-in-the-indian-thought

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Lab I : Android Programming**
Course Code: 23SBCA64MM	**No. Of Credits:02**
Course Type: MM(Major Mandatory)	**Total Teaching Hours:14**

Sr.No.	**Course Objectives**
1.	To understand the Android Operating System
2.	To study Android Apps Development Cycle
3.	To learn to create Android Applications.
4.	To Learn to create Alert Dialog,Radio Button,Toggle Button Switch Button.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Demonstrate their understanding of the fundamentals of Android operating systems.
2.	Write simple GUI applications, use built-in widgets and components.
3.	Create components and adapter menu
4.	To Learn to create Alert Dialog,Radio Button,Toggle Button Switch Button.

Assignment No	**Assignment Name**	**No. Of Sessions**
1	**Activity Assignments** i. Assignments on Activity and Activity Life Cycle ii. Assignments on Intent iii. Assignments on Toast iv. Assignments on Toggle Button v. Assignments on Switch Button vi. Assignments on Alert Dialog Box	**10**
2	**ADAPTER AND MENU** i. Spinner, List View	**2**
3	**Fragments** i. Internal Fragments ii. External Fragments	**2**
	Total Number of Sessions	**14**

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Lab II : Data Mining Using Python**
Course Code: 23SBCA65MM	**No. Of Credits:02**
Course Type: MM(Major Mandatory)	**Total Teaching Hours:14**

Sr.No.	**Course Objectives**
1.	To understand data warehouse concepts, architecture, business analysis and tools.
2.	To understand data pre-processing and data visualization techniques.
3.	To study algorithms for finding hidden and interesting patterns in data.
4.	To understand and apply various classification and clustering techniques using tools.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Need of data mining and apply suitable pre-processing techniques for data analysis.
2.	Apply frequent pattern and association rule mining techniques for data analysis
3.	Apply appropriate classification and prediction techniques for data analysis
4.	Apply appropriate clustering techniques for data analysis
5.	Design a Data warehouse system and perform business analysis with OLAP tools

Assignment No	**Assignment Name**	**No. Of Sessions**
1	**Assignment on Data Pre-processing**	**02**
2	**Assignment on Classification**	**03**
3	**Assignment on Predictions**	**03**
4	**Assignment on Association Rules**	**03**
5	**Assignment on Clustering**	**03**
Total Number of Sessions		**14**

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title	**Artificial Intelligence**
Course Code:23SBCA61MEA	**No. Of Credits:02**
Course Type: Major Elective(ME)	**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To learn various types of algorithms useful in Artificial Intelligence (AI).
2.	To convey the ideas in AI research related to emerging technology.
3.	To introduce ideas and techniques underlying the design of intelligent computer systems

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Apply the suitable algorithms to solve AI problems
2.	Identify and apply suitable Intelligent agents for various AI applications
3.	Build smart system using different informed search / uninformed search or heuristic approaches
4.	Represent complex problems with expressive language of representation

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Artificial Intelligence**	**05**
	1. Introduction to AI **2. Comparison of AI, Machine Learning, Deep Learning** **3. Applications of AI** **4. AI Techniques** **5. Intelligent Agents, Agents and Environments, Structure of Agents.**	**1** **1** **1** **1** **1**
Unit II	**Problems, Problem Spaces and search**	**05**
	1. Defining problem as a State Space Search **2. Production System** **3. Problem Characteristics** **4. Search & Control Strategies** **5. Problems – Water Jug problem, Missionary Cannibal** **6. Problem, Block words Problem, Monkey & Banana problem**	**1** **1** **1** **2**
Unit III	**Searching Algorithms**	**10**
	1. Uninformed Search Algorithms/Blind Search Techniques **2. Breadth-first Search** **3. Depth-first Search** **4. Informed (Heuristic) search Techniques** **5. Generate-and-test** **6. Simple Hill Climbing** **7. Best First Search** **8. Constraint Satisfaction** **9. Means End Analysis** **10. A* and AO***	**1** **1** **1** **1** **1** **1** **1** **1** **1** **1**
Unit IV	**Knowledge Representation**	**10**
	1. Introduction to prolog i. Arithmetic and lists. ii. Backtracking, cut, and negation. Search and cut	**2** **1**

	iii. Difference structures. **2. Definition of Knowledge** **3. Types of knowledge** i. Procedural knowledge ii. Declarative knowledge **4. Approaches to Knowledge Representation** **5. Knowledge representation using Propositional and Predicate logic** **6. Conversion to clause form** **7. Resolution in Propositional logic** **8. Resolution in Predicate logic**	**1** **1** **2** **1** **1** **1**

Suggested Reading	
1.	Artificial Intelligence, Tata McGraw Hill, Elaine Rich and Kevin Knight
2.	Computational Intelligence, Eberhart, Elsevier, ISBN 9788131217832
3.	Artificial Intelligence: A New Synthesis, Nilsson, Elsevier, ISBN 9788181471901
4.	Artificial Intelligence: A Modern Approach, Russel&Norvig, Pearson Education
5.	Introduction to Machine Learning, EthemAlpaydin, PHI
6.	**"Artificial Intelligence: A Guide to Intelligent Systems"**Author: Michael Negnevitsky

Website Reference Link	
1.	**Introduction to AI :** https://www.geeksforgeeks.org/What-is-ai-artificial-intelligence/
2.	**Problems, Problem Spaces and search :** https://www.brainkart.com/article/Various-Types-of-Artificial-Intelligence-Problems-and-their-Solutions_8873/#google_vignette
3.	**AI Tutorial** : https://intellipaat.com/blog/tutorial/artificial-intelligence-tutorial/
4.	**Searching Algorithms** : https://www.geeksforgeeks.org/search-algorithms-in-ai/

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T.Y.B.C.A (Science) SEM V (NEP Pattern-2023)

Course Title:	**Data Visualisation using Power BI**	
Course Code: 23SBCA61MEB		**No. Of Credits:02**
Course Type: ME(Major Elective)		**Total Teaching Hours:30**

Sr. No.	**Course Objectives**
1.	To understand the fundamentals of Microsoft Power BI.
2.	To understand the key components of Microsoft Power BI.
3.	Understanding of data modelling in Microsoft Power BI
4.	To learn Power BI charts and their role in data visualization.

Sr. No.	**Course Outcome**
After completing course students will be able to -	
1.	Apply the features of Power BI.
2.	Develop Interactive Reports.
3.	Do the data analysis and data visualization.
4.	Draw the charts of Power BI.

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction To Power BI**	**05**
	1. Introduction to Power BI – Need, Importance **2. Power BI – Advantages** **3. Features of Power BI** **4. Power BI Installation**	2 1 1 1
Unit II	**Components of Power BI**	**10**
	1. Introduction to components of Power BI **2. Power Query** **3. Power Pivot** **4. Power View** **5. Power BI Service**	**2** 2 2 2 2
Unit III	**Working with Data Modelling**	**10**
	1. Introduction to ETL **2. Working with Power Query Editor** **3. Data Types In Power BI** **4. Data Extraction** **5. Transforming Data** 6. **Load Data for Visualization**	3 2 2 2 3 2
Unit IV	**Introductions to Power BI Charts**	**05**
	1. Introduction to Charts in Power BI **2. How to create different charts in Power BI** **3. View data and Export data**.	1 2 2

Suggested Reading	
1.	Microsoft Power BI Complete Reference, PaperBack by Devin Knight
2.	Mastering Power BI: Build business intelligence applications powered with DAX calculations, insightful visualizations, advanced BI techniques, and loads of data sources - 2nd Edition Paperback – by Chandraish Sinha
3.	Microsoft Power BI Dashboards Step by Step First Edition by Pearson.
Website Reference Link:	
1.	**Introduction To Power BI** https://www.tutorialspoint.com/power_bi/power_bi_introduction.htm
2.	**Components of PBI** :https://ngenioussolutions.com/blog/components-of-power-bi/
3.	**Working with Data Modelling** https://www.geeksforgeeks.org/data-modelling-in-powerbi/
4.	**PBI Charts https://www.geekster.in/articles/basics-of-charts-in-powerbi/**

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T.Y.B.C.A (Science) SEM VI (NEP2023Pattern)

Course Title	**React Native**	
Course Code: 23SBCA62MEA		**No. Of Credits:02**
Course Type: ME(Major Elective)		**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	Understand the fundamentals of React Native and its components.
2.	Learn to create and use fundamental React Native components.
3.	Learn how to implement navigation between screens in a React Native app.
4.	Understand how to fetch data from APIs and manage state in React Native.
Sr.No.	**Course Outcome**
On completion of the course, student will be able to–	
1.	Understand the Fundamentals of React Native
2.	Work with Core React Native Components
3.	Implement Navigation in React Native Apps
4.	Understand and apply strategies for handling

Course Contents		
Unit I	**Introduction to React Native**	**14 Hrs**
	1. What is React Native? 2. Difference between React and React Native. 3. Advantages of React Native for mobile development. 4. Setting up the development environment. i. Installing Node.js, npm, Expo, and React Native CLI. ii. Emulator setup (Android/iOS). 5. React Native project structure. 6. Core Components: View, Text, Image, TextInput, Button, ScrollView, FlatList, etc. 7. Understanding Flexbox for layout. 8. Styling in React Native: Inline styles vs. StyleSheet API. Platform-specific styling (iOS/Android differences).	1 1 1 2 1 2 2 2 2
Unit II	**Navigation in React Native Working with APIs and Data Management**	**8 Hrs**
	1. Introduction to React Navigation library. 2. Stack navigation, tab navigation, and drawer navigation. 3. Passing data between screens. 4. Navigating with buttons and links. 5. Introduction to Fetch API and Axios for HTTP requests. 6. Using useState and useEffect for data fetching and state management. 7. Working with JSON data and asynchronous operations. 8. Introduction to Context API and Redux (for larger apps).	1 1 1 1 1 1 1 1
Unit III	**Advanced REACT NATIVE**	**8 Hrs**
	1. Handling User Input and Forms i. TextInput components and controlled components. ii. Form validation techniques. iii. Handling button clicks and gestures. iv. Keyboard handling (hiding and showing keyboard). **2. Advanced Features and Native Modules** i. Using device features: Camera, Geolocation, Push Notifications. ii. Introduction to Native Modules and bridging. iii. Working with third-party libraries and plugins. iv. Debugging and performance optimization techniques.	4 4

Suggested Reading	
1.	**"React Native in Action" by Nader Dabit**
2.	"Learning React Native" by Bonnie Eisenman
3.	**"React Native Cookbook" by Jonathan Lebensold**
4.	**"Fullstack React Native" by Houssein Djirdeh, Anthony Accomazzo, and Sophia Shoemaker**
Website Reference Link	
1.	**React Native Tutorial:** https://reactnative.dev/
2.	**React Native Tutorial:** https://www.tutorialspoint.com/react_native/index.htm
3.	**React Native Tutorial:** https://www.tutorialspoint.com/react_native/index.htm
4.	**React Native Tutorial:** https://www.javatpoint.com/react-native-tutorial

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**MongoDB**	
Course Code: 23SBCA62MEB		**No. Of Credits:02**
Course Type: ME(Major Elective)		**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	Introduce MongoDB: Understand MongoDB as a NoSQL database and how it differs from SQL databases.
2.	Learn CRUD Operations: Master basic operations like Create, Read, Update, and Delete in MongoDB.
3.	Basic Administration: Gain basic skills in managing MongoDB databases, collections, and users..
4.	Real-World Application: Apply MongoDB knowledge to simple real-world projects

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Understand MongoDB: Know what MongoDB is and how it differs from relational databases.
2.	Perform CRUD Operations: Be able to insert, read, update, and delete data in MongoDB.
3.	Write Queries: Use query operators to filter and sort data in MongoDB.
4.	Use Aggregation: Group and summarize data using the aggregation framework.
5.	Design MongoDB Schemas: Model data using Mongo DB's flexible document structure.
6.	Manage MongoDB: Perform basic tasks like creating databases, collections and backups.
7.	Apply MongoDB: Use MongoDB in simple projects and applications.

Unit No	Title with Contents	No. of. Lectures
Unit I	**Introduction to MongoDB**	**04 Hrs**
	1. What is MongoDB? i. Introduction to NoSQL databases ii. Differences between SQL and NoSQL databases iii. Why MongoDB? Benefits and use cases **2. Basic MongoDB Concepts** i. Databases, Collections, and Documents ii. Overview of BSON (Binary JSON) **3. Setting up MongoDB** i. Installing MongoDB on your system ii. Introduction to MongoDB Compass (GUI tool) iii. Using Mongo Shell for basic operations	**2** **1** **1**
Unit II	**CRUD Operations in MongoDB**	**08 Hrs.**
	1. Create Data i. **Inserting data**: insertOne(), insertMany() **2. Read Data** i. **Querying data:** find(), findOne() ii. **Filtering data**: using operators like $eq, $lt, $gt Sorting and limiting results **3. Update Data** i. **Updating documents**: updateOne(),updateMany(), $set **4. Delete Data** **i. Deleting documents**: deleteOne(), deleteMany()	**2** **2** **2** **1**
Unit III	**Basic Queries and Operators**	**06 Hrs**
	1. Query Operators i. Using $eq, $ne, $lt, $gt, $in, $nin ii. Combining conditions with $and, $or **2. Projection** i. Selecting specific fields with find() **3. Regular Expressions** **i.** Searching with patterns using $regex	**2** **2** **2**

Unit IV	**Aggregation Basics**	**04 Hrs**
	1. Introduction to Aggregation i. What is the Aggregation Pipeline? ii. Basic aggregation stages: $match, $group, $sort, $project **2. Simple Aggregation Examples** i. Grouping and summarizing data (e.g., total sales).	**2** **2**
Unit V	**Data Modeling in MongoDB and MongoDB Administration**	**06 Hrs.**
	1. Schema Design. i. Understanding document structure: Embedding vs ii. Referencing iii. Designing simple collections (e.g., users, orders) **2. Best Practices for Data Modeling** i. Keeping the design simple for scalability **3. Working with Databases and Collections** i. Creating, listing, and deleting databases and ii. collections iii. Basic user management (creating users and roles) **4. Backup and Restore** i. Simple backup/restore commands.	**2** **1** **2** **1**
Unit VI	**Real-World MongoDB Applications**	**02 Hrs**
	1. Basic Project Overview i. Use cases for MongoDB: E-commerce, blogs, etc.	**2**

Suggested Reading	
1	MongoDB for Beginners by John Doe (Example)
2	MongoDB: The Definitive Guide by Kristina Chodorow (Optional for advanced topics)
Website Reference Link	
1	**MongoDB Tutorial: https://www.mongodb.com/docs/**
2	**MongoDB Tutorial: https://learn.mongodb.com/**

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Ethical Hacking and Penetration Training**
Course Code: 23SBCA61MNA	**No. Of Credits:02**
Course Type: MN(Minor)	**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	Develop a Deep Understanding of Ethical Hacking Concepts.
2.	Equip Students with Tools and Techniques for Information Gathering and Scanning
3.	Enable Practical Knowledge in Exploiting Vulnerabilities and Post-Exploitation
4.	Enhance Understanding of Web Application Security

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Apply Ethical Hacking Techniques to Identify Vulnerabilities
2.	Demonstrate Practical Penetration Testing Skills

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Ethical Hacking**	**6**
	1. Overview of Ethical Hacking	**2**
	i. What is ethical hacking?	
	ii. Difference between ethical hackers, hackers, and cybercriminals.	
	2. Types of Hackers	
	i. White hat	
	ii. Black hat	
	iii. Grey hat, and others,	
	3. Ethical Hacking Phases	**2**
	i. Reconnaissance	
	ii. Scanning	
	iii. Gaining Access	
	iv. Maintaining Access	
	v. Covering Tracks.	
	4. Tools and Techniques in Ethical Hacking	**2**
	i. Kali Linux	
	ii. Metasploit	
	iii. Wireshark	
	iv. Nmap.	
	5. Cyber Laws and Ethics:	
	i. Legal aspects of hacking, ethical guidelines, and laws (e.g., IT Act 2000).	
Unit II	**Foot printing and Reconnaissance**	**8**
	1. Introduction to Information Gathering	**1**
	2. Types of information gathering	
	i. Active gathering	**1**
	ii. Passive gathering.	**1**
	3. Reconnaissance Methods	
	iii. DNS Interrogation	
	iv. WHOIS Lookup	**2**
	v. IP Location Tracing	
	vi. Social Engineering	
	vii. Google Dorking	
	4. Footprinting Tools	**1**
	viii. Nmap	
	ix. DNSdumpster	
	x. Whois	**1**

	xi. Other reconnaissance tools. **5. Network Footprinting** Identifying potential targets and vulnerabilities using network scanning.	**1**
Unit III	**Scanning and Enumeration**	**8**
	1. Scanning Techniques i. Port Scanning ii. Service Detection iii. OS Fingerprinting **2. Types of Scanners** i. Nmap (Network Mapper) ii. Netcat iii. Nessus (Vulnerability Scanning) **3. Enumeration** i. User enumeration ii. DNS enumeration iii. SNMP enumeration iv. SMB enumeration **4. Identifying Vulnerabilities** i. Introduction to Vulnerability assessment tools and techniques.	**2** **2** **2** **2**
Unit IV	**Exploitation and Post-Exploitation**	**8**
	1. Exploitation i. Exploiting Vulnerabilities in Web Applications ii. Exploiting Network Vulnerabilities(BufferOverflow, SQL Injection, XSS) iii. Exploiting Wireless Networks **2. Metasploit Framework** i. Introduction to exploitation frameworks and tools. **3. Post-Exploitation Techniques** i. Escalating Privileges ii. Creating Backdoors. iii. Stealth Techniques (Rootkits, Keyloggers) **4. Maintaining Access** i. Creating and using persistent backdoors, remote access Trojans (RATs).	**2** **2** **2** **2**
Unit V	**Web Application Penetration Testing**	**8**
	1. Web Application Security i. OWASP Top 10 vulnerabilities (SQL Injection, XSS, CSRF, etc.).	**1**

	2. Tools for Web Penetration Testing i. Burp Suite ii. OWASP ZAP iii. Nikto iv. DirBuster. **3. Web Application Exploits** i. SQL Injection ii. Cross-Site Scripting (XSS) iii. Cross-Site Request Forgery (CSRF) **4. Web Server Security** i. Securing Apache, ii. Nginx, iii. IIS. **5. Ethical Hacking of Web Applications** i. Techniques for finding and exploiting vulnerabilities in web applications.	**2** **2** **2** **1**

Suggested Reading	
1	The Web Application Hacke's Handbook: Finding and Exploiting Security Flaws.
2	Hacking: The Art of Exploitation.
3	Metasploit: The Penetration Tester's Guide.
4	Penetration Testing: A Hands-On Introduction to Hacking.
5	The Hacker Playbook 3: Practical Guide To Penetration Testing.
Website Reference Link	
1	**Ethical Hacking Tutorial :** https://www.hackthebox.eu
2	**Ethical Hacking Tutorial :** https://owasp.org
3	**Ethical Hacking Tutorial :** https://www.cybrary.it

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Fundamentals of IoT and Its Applications**
Course Code: 23SBCA61MNB	**No. Of Credits:02**
Course Type: MN(Minor)	**Total Teaching Hours:30**

Sr.No.	**Course Objectives**
1.	To understand the fundamental concepts of IoT and its architecture.
2.	To learn about IoT communication protocols and their applications.
3.	To develop skills using Arduino to control sensors, actuators, and communication modules for IoT applications.
4.	To explore real-world IoT applications and problem-solving techniques.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Understand Fundamentals of IoT
2.	Develop and debug programs for Arduino to control sensors, actuators, and perform robotic functions.
3.	Learn to Communication devices used in IoT Systems

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to IoT and Arduino**	**10**
	1. IoT Fundamentals i. Definition and Characteristics of IoT ii. Applications of IoT in various domains (e.g., healthcare, agriculture, smart cities). **2. Key Components of IoT Systems** i. Things/Devices ii. Gateway iii. Cloud/Server iv. Analytics v. User Interface **3. IoT Architecture** i. Sensing Layer ii. Network Interface Layer iii. Data Processing Layer iv. Application Layer **4. Applications of IoT** i. Smart Cities ii. Agriculture iii. Healthcare iv. Industry **5. Introduction to Arduino** i. Overview of Arduino boards (e.g., Uno, Nano, Mega) ii. Setting up iii. Arduino IDE and writing a basic program iv. Understanding GPIO pins v. Library functions	
Unit II	**Sensors and Actuators in IoT**	**15**
	1. Sensors for IoT i. PIR Motion Sensor ii. Sharp IR Distance Sensor iii. LDR Sensor iv. Gyro Sensor v. Ultrasonic Distance Sensor vi. DHT Sensor vii. Interfacing sensors with Arduino to collect data	

	2. Actuators for IoT i. DC motors ii. Servo motors iii. Stepper Motor iv. Motor Driver and role of Relay in Actuator Systems	
Unit III	**Communication in IoT Systems**	**5**
	1. Wireless communication protocols: i. Bluetooth, ii. Wi-Fi, iii. Zigbee. **2. Understanding ESP8266/ESP32 Wi-Fi modules for Arduino.** **3. Basics of IoT platforms:** i. ThingSpeak, ii. Blynk, iii. Google Cloud IoT etc.	

Suggested Reading	
1	"Getting Started with Arduino" by Massimo Banzi.
2	"Internet of Things with Arduino Cookbook" by Marco Schwartz.
3	"Mastering Arduino: Building IoT Projects" by Peter Dalmaris.
Website Reference Link	
1	Online Resources: Tutorials on Arduino and IoT platforms (ThingSpeak, Blynk). https://blynk.io/

M.C.E. Society's
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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Lab - III Ethical Hacking and Penetration Training**
Course Code: 23SBCA62MNA	**No. Of Credits:02**
Course Type: MN(Minor)	**Total Teaching Hours:14**

Sr.No.	**Course Objectives**
1.	Develop a Deep Understanding of Ethical Hacking Concepts
2.	Equip Students with Tools and Techniques for Information Gathering and Scanning
3.	Enable Practical Knowledge in Exploiting Vulnerabilities and Post-Exploitation
4.	Enhance Understanding of Web Application Security

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Apply Ethical Hacking Techniques to Identify Vulnerabilities
2.	Demonstrate Practical Penetration Testing Skills

Assignment No	**Assignment Name**	**No. Of Sessions**
1	**Footprinting and Information Gathering**	**2**
2	**Scanning and Vulnerability Assessment**	**2**
3	**Exploiting a Web Application Vulnerability**	**2**
4	**Metasploit Framework Usage**	**2**
5	**Cross-Site Scripting (XSS) Attack**	**2**
6	**Wireless Network Penetration Testing**	**2**
7	**Web Application Penetration Testing**	**2**
	Total Number of Sessions	**14**

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T.Y.B.C.A (Science) SEM VI (NEP Pattern-2023)

Course Title	**Lab III - Fundamentals of IoT and Its Applications**
Course Code: 23SBCA62MNB	**No. Of Credits:02**
Course Type: MN(Minor)	**Total Teaching Hours:14**

Sr.No.	Course Objectives
1.	To understand the fundamental concepts of IoT and its architecture.
2.	To learn about IoT communication protocols and their applications.
3.	To develop skills using Arduino to control sensors, actuators, and communication modules for IoT applications.

Assignment No	Assignment Name	No. Of Sessions
1	Blinking an LED at different time intervals.	1
2	Read digital input from a button and control an LED.	1
3	Interfacing of 16x2 LCD for Displaying message.	1
4	Interfacing PIR/ IR Sensors with Arduino to detect motion and turn on an LED.	1
5	Interfacing Ultrasonic Sensor with Arduino to measure distance and display it on the serial monitor / LCD display.	1
6	Interfacing DHT11/22 Sensor with Arduino to measure temperature and display it on serial monitor / LCD display.	1
7	Interfacing DHT11/22 Sensor with Arduino to measure humidity and display it on serial monitor / LCD display.	1
8	Interfacing servo motor with Arduino and Rotate the servo to specific angles based on input.	1
9	Interfacing stepper motor with Arduino and Control the motor to move a specific number of steps.	1
10	Use Relay with Arduino to control a 230V bulb	1
11	Connect an LDR sensor and display its analog values.	1
12	To study Arduino based LED switching using Mobile/Bluetooth Device.	1
13	Sending sensor data to a cloud platform	1
14	To study and interface Zig-bee for one Application using Arduino.	1
15	To Study and interface of RFID system using Arduino.	1
	Total Number of Sessions	15

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Course Title	**Internship**		
Course Code: 23SBCA6OJT			**No. Of Credits:04**
Course Type: OJT			**Total Teaching Hours:60**

Sr.No.	**Course Objectives**
1.	To apply theoretical knowledge gained in the classroom to real-world work environments, enhancing professional skills and understanding of industry practices.
2.	To improve key soft skills such as communication, teamwork, time management, and problem-solving, which are essential for future career success.
3.	To establish professional relationships with industry experts, mentors, and peers, which can provide guidance and potential job opportunities after graduation.

Sr.No.	**Course Outcome**
After completing course students will be able to -	
1.	Apply academic knowledge to real-world professional scenarios.
2.	Develop industry-specific skills relevant to their career field.
3.	Communicate effectively in a professional work environment.
4.	Communicate effectively in a professional work environment.
5.	Build a professional network and gain insights into industry practices.

Sr.No	Internship Rules
1	**1. Students shall prepare a project report with the following contents:** **a) Title Page** **b) Certificate** **c) Index Page detailing description of the following with their sub sections:-** i. Title: A suitable title giving the idea about what work is proposed. ii. Introduction: An introduction to the topic giving proper. iii. Background of the topic. iv. Requirement Specification. v. Specify Software/hardware/data requirements. vi. System Design details **2. Methodology/Architecture/UML/DFD/Algorithms/protocols used(whichever is applicable).** i. System Implementation: Code ii. Results: Test Cases/Tables/Figures/Graphs/Screen shots/Reports etc. iii. Conclusion and Future Scope: Specify the Final conclusion and future scope. iv. References: Books, web links, research articles etc.
2	**Only full-time graduate students who meet the required GPA and course prerequisites are eligible for internships.**
3	**Students opting for an internship should obtain prior approval from a faculty advisor before starting the internship.**
4	**Internships may vary in duration from a few weeks (summer internships) to several months. (Semester-long or part-time internships).**
5	**Students are expected to work with flexible hours based on the internship's structure and the organization's schedule. However, this should align with college guidelines and academic Credit requirements.**
6	**Students shall undertake application oriented/ web-based/ database-oriented/ research based work.**
7	**Students shall successfully implement the chosen work. Only a hypothetical /theoretical study shall not be accepted**
8	**Students having internships should attain college at least once a week.**
9	**Students should also submit college assignments on time.**
10	**Students must submit necessary documentation (e.g., learning contracts, reports) to receive academic credit, as required by their college or university.**
11	**The student's performance will be assessed by both the internship supervisor and the college.**
12	**Students must submit a detailed report summarizing their internship experience and learning outcomes.**
13	**Students must adhere to workplace norms and demonstrate ethical behaviour.**
14	**The internship work and report shall be certified by the concerned Internship In-Charge**
15	**Some internships may lead to full-time job offers upon graduation. Interns should stay in touch with employers and express interest in any available opportunities.**