



VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI
JNANASAGARA CAMPUS, BALLARI-583 105

Department of Studies in Computer Science

*SEP: Credits Structure under Choice based Credit System
[CBCS]*

Syllabus of V & VI Semester

Bachelor of Computer Applications



With effect from 2025-26 Onwards

Approved in the BOS dated 25.03.2026

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Curriculum Structure

| Semester | Course No. | Theory/Practical | Credits | Paper Title | Marks | |
|----------|---------------|-------------------|---------|---|-------|------|
| | | | | | S.A. | I.A. |
| V | 24MJBCA5T1 | Theory | 4 | Design and Analysis of Algorithms | 80 | 20 |
| | 24MJBCA5P1 | Practical | 2 | Design and Analysis of Algorithms Lab | 40 | 10 |
| | 24MJBCA5T2 | Theory | 4 | C# and .Net Framework | 80 | 20 |
| | 24MJBCA5P2 | Practical | 2 | C# and .Net Framework Lab | 40 | 10 |
| | 24MJBCA5P3 | Theory | 4 | PHP and MySQL | 80 | 20 |
| | 24MJBCA5T3 | Practical | 2 | PHP and MySQL Lab | 40 | 10 |
| | 24ELBCA5L1 | Theory | 4 | Software Engineering | 80 | 20 |
| | 24ELBCA5L2 | Theory | 4 | Cyber Security | 80 | 20 |
| | 24ELBCA5L3 | Theory | 4 | Mobile Application Development | 80 | 20 |
| | 24RMBCA5L1 | Theory/Practical | 2 | Internship/Elementary Research Methodology | 40 | 10 |
| VI | 24MJBCA6T1 | Theory | 4 | Data Warehousing and Data Mining | 80 | 20 |
| | 24MJBCA6P1 | Practical | 2 | Data Warehousing and Data Mining Lab | 40 | 10 |
| | 24MJBCA6T2 | Theory | 4 | R Programming | 80 | 20 |
| | 24MJBCA6P2 | Practical | 2 | R Programming Lab | 40 | 10 |
| | 24MJBCA6T3 | Theory | 4 | Object Oriented Analysis and Design using UML | 80 | 20 |
| | 24MJBCA6P3 | Practical | 2 | Object Oriented Analysis and Design using UML Lab | 40 | 10 |
| | 24PROJBCA6P | Project | 4 | Project | 80 | 20 |
| | 24SECBCA6T(A) | Theory/ Practical | 2 | SEC-II(A): ETL Tool | 40 | 10 |
| | 24SECBCA6T(B) | Theory/ Practical | 2 | SEC-II(B): Data Visualization using R | 40 | 10 |
| | 24SECBCA6T(C) | Theory/ Practical | 2 | SEC-II(C): Software Testing (2) | 40 | 10 |

Syllabus for BCA

Semester: V

| | |
|--|------------------------------------|
| Title of the Subject: DESIGN & ANALYSIS of ALGORITHMS | |
| Course Code: 24MJBCA5T1 | CIA Marks: 20 Marks |
| Semester: V Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Analyze the asymptotic performance of algorithms.
- Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- Find optimal solution by applying various methods.
- Understand the applications of greedy algorithm.
- Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.

Design and Analysis of Algorithm

| Unit | Description | Hours |
|------|--|-------|
| 1 | Introduction to Algorithms & Performance Analysis: Definition and Characteristics of Algorithms, Role of Algorithms in Computer Science, Algorithm Design Techniques Overview, Performance Analysis- Time Complexity, Space Complexity; Asymptotic Notations- Big-O Notation, Omega (Ω) Notation, Theta (Θ) Notation; Best Case, Worst Case & Average Case Analysis, Growth of Functions, Recurrence Relations- Substitution Method, Recursion Tree Method, Master Theorem. | 12 |
| 2 | Divide and Conquer Strategy: General Method of Divide and Conquer, Linear search Binary Search, Merge Sort, Quick Sort, Strassen' s Matrix Multiplication, Solving Recurrence Relations, Analysis of Divide & Conquer Algorithms. | 10 |
| 3 | Greedy Method: Concept of Greedy Strategy, Characteristics of Greedy Algorithms, Fractional Knapsack Problem, Job Sequencing with Deadlines, Minimum Spanning Trees-Prim' s Algorithm, Kruskal' s Algorithm; Dijkstra' s Shortest Path Algorithm, HuffmanCoding. | 12 |
| 4 | Dynamic Programming: Concept of Dynamic Programming, Difference between Greedy and Dynamic Programming, Principle of Optimality, Multistage Graph, 0/1 Knapsack Problem, Longest Common Subsequence, Matrix Chain Multiplication, Optimal Binary Search Tree. | 12 |
| 5 | Chapter 5: Backtracking & Branch and Bound: Backtracking- General Method, Nqueen Problem, Sum of Subsets, Graph Coloring, Hamiltonian Cycle; Branch and Bound- Concept & State Space Trees, FIFO Branch & Bound, LC Branch & Bound, Travelling Salesman Problem (TSP). | 10 |

References:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, PHI.
2. Fundamental of Algorithms by Gills Brassard, Paul Bratley, PHI.
3. Introduction to Design and Analysis of Algorithms, Anany Levitin, Pearson.
4. Foundations of Algorithms, Shailesh R Sathe, Penram
5. Design and Analysis of Algorithms, Dave and Dave, Pearson.

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|--|------------------------------------|
| Title of the Subject: DESIGN & ANALYSIS of ALGORITHMS LAB | |
| Course Code: 24MJBCA5P1 | CIA Marks: 10 Marks |
| Semester: V Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 0-0-4 | Credits: 02 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Implement algorithm design techniques
- Compare efficiency of algorithms
- Solve optimization problems
- Understand real-time applications of DAA concepts
- Improve coding & problem solving skills

Practicals:

1. Implementation and Time analysis of Bubble sort algorithm.
2. Implementation and Time analysis of Insertion sort algorithm.
3. Implementation and Time analysis of Selection sort algorithm.
4. Implementation and Time analysis of Merge sort algorithm.
5. Implementation and Time analysis of Quick sort algorithm.
6. Implementation and Time analysis of Linear and Binary search algorithm.
7. Implementation of max-heap sort algorithm.
8. Implementation and Time analysis of factorial program using iterative and recursive method
9. Implementation of a knapsack problem using dynamic programming.
10. Implementation of chain matrix multiplication using dynamic programming.
11. Implementation of a knapsack problem using greedy algorithm
12. Implementation of DFS and BFS algorithm.
13. Implementation of prim's algorithm
14. Implementation of kruskal's algorithm.
15. Implementation of N-Queen problem.

NOTE: Languages suggested

- a) C / C++ b) Python (Optional)

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|--|------------------------------------|
| Title of the Subject: C# and .Net Framework | |
| Course Code: 24MJBCA5T2 | CIA Marks: 20 Marks |
| Semester: V Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- The student will gain knowledge in the concepts of the .NET framework as a whole and the technologies that constitute the Framework.
- The student will gain programming skills in C# both in basic and advanced levels.
- By building sample applications, the student will get experience and be ready for large-scale projects.

C# and .Net Framework

| Unit | Description | Hours |
|------|--|-------|
| 1 | INTRODUCTION to C#: Introducing C#, Understanding .NET, Overview of C#, Literals, Variables, Data Types, Operators, Expressions, Branching, Looping, Methods, Arrays, Strings, Structures, Enumerations. | 11 |
| 2 | OBJECT ORIENTED ASPECTS OF C#: Classes, Objects, Inheritance, Polymorphism, Interfaces, Operator Overloading, Delegates, Errors and Exception Handling. | 11 |
| 3 | WINDOWS APPLICATIONS: Drawbacks of Console Applications, Container Controls, Non Container Controls, Developing Windows Application from Notepad and Visual Studio, Events, Types of Events – Mouse, Focus, Drag, Key and Other Related Events, Building Windows Applications. | 12 |
| 4 | ADO.NET: Problems with File Handling, Data Source Communication, Drivers and Providers, Introduction of ADO.NET, ADO.NET Namespaces, ADO.NET Objects, Accessing Data with ADO.NET. | 11 |
| 5 | BUILDING ASP.NET WEB PAGES: HTML form Development, Client side Scripting, Server side Scripting, Web applications and Web servers, HTTP, Advantages Using ASP.NET, ASP.NET Application, ASP.NET Namespaces, ASP.NET Web Page Structure, Creating Sample C# Web Applications, ASP.NET Web Page Execution Architecture, Debugging and Tracing of ASP.NET. | 11 |

References:

1. C# for Programmers, Harvey M. Deitel and Paul J. Deitel, Pearson Education.
2. ASP.NET with C#, Kogent Learning Solutions Inc., Wiley India.
3. .NET 4.5 Programming 6-in-1 Black Book, Kogent Learning Solutions Inc., Wiley India.
4. The Complete Reference: C# 4.0, Herbert Schildt, Tata McGraw-Hill.
5. Professional C# and .NET, Christian Nagel et al., Wiley India.

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|--|------------------------------------|
| Title of the Subject: C# and .Net Framework Lab | |
| Course Code: 24MJBCA5P2 | CIA Marks: 10 Marks |
| Semester: V Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 0-0-4 | Credits: 02 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Develop console-based applications using C#
- Apply object-oriented programming (OOP) principles effectively
- Create and design graphical user interface (GUI) applications
- Manage and respond to events within applications
- Establish connections with databases
- Execute CRUD (Create, Read, update, Delete) operations on data

Practicals:

1. Write a C# program to demonstrate basic data types, variables, and operators.
2. Write a C# program to demonstrate branching and looping statements.
3. Write a C# program to demonstrate arrays, strings, and methods.
4. Write a C# program to demonstrate classes and objects.
5. Write a C# program to demonstrate inheritance and polymorphism.
6. Write a C# program to demonstrate interfaces, delegates, and exception handling.
7. Develop a Windows application to perform basic arithmetic operations.
8. Develop a Windows application to demonstrate mouse and keyboard events.
9. Write a C# program to connect to a database using ADO.NET.
10. Write a C# program to perform CRUD operations using ADO.NET.
11. Develop an ASP.NET web page to collect and display user input.
12. Develop an ASP.NET web application to perform database operations.
13. Develop a simple Student Information System using C# & ADO.NET
14. Design a form with Label, TextBox, Button, Radio Button & Checkbox.
15. Implement a login form.

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|--|------------------------------------|
| Title of the Subject: PHP and MySQL | |
| Course Code: 24MJBCAST3 | CIA Marks: 20 Marks |
| Semester: V Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Write and execute PHP scripts that demonstrate variable handling, operators, and constants effectively.
- Apply control structures such as loops and conditional statements to solve programming problems.
- Manipulate arrays and process date/time data using built-in PHP functions.
- Create user-defined functions, classes, and perform advanced OOP and file-handling operations for real-world applications.
- Build dynamic database-driven applications by integrating PHP with SQL using MySQLi, PDO, or SQLite extensions.

PHP and MySQL

| Unit | Description | Hours |
|------|---|-------|
| 1 | Introducing PHP: Basic development Concepts, Creating first PHP Scripts, Using Variable and Operators, Storing Data in variable, Understanding Data type, Setting and Checking variables, Data types, Using Constant, Manipulating Variables with Operators, Handling Form Input. | 11 |
| 2 | Controlling Program Flow: Writing Simple Conditional Statements, Writing More Complex Conditional Statements, Repeating Action with Loops, Working with String and Numeric Functions. | 11 |
| 3 | Working with Arrays: Storing Data in Arrays, Processing Arrays with Loops and Iterations, Using Arrays with Forms, Working with Array Functions, Working with Dates and Times. | 11 |
| 4 | Functions and Classes: Creating User-Defined Functions, Creating Classes, Using Advanced OOP Concepts. Working with Files and Directories: Reading Files, Reading Local Files, Reading Remote Files, Reading Specific Segments of a File, Writing Files, Reading and Writing Configuration Files, Processing Directories, Performing Other File and Directory Operations, Creating a Photo Gallery | 11 |
| 5 | Working with Databases and SQL: Introducing Databases and SQL, Understanding Databases, Records, and Primary Keys, Understanding Relationships and Foreign Keys, Understanding SQL Statements, Using PHP's MySQLi Extension, Retrieving Data, Adding or Modifying Data, Handling Errors, Using PHP's SQLite Extension, Introducing SQLite, Retrieving Data, Adding or Modifying Data, Handling Errors, Using PHP's PDO Extension, Retrieving Data, Adding and Modifying Data, Handling Errors, Using a MySQL Database. | 12 |

References:

1. PHP A Beginner's Guide, VIKRAM VASWANI, Tata McGraw-Hill, 2008.
2. The PHP Complete Reference, Steven Holzner –Tata McGraw-Hill Edition, 2010.
3. Spring into PHP5, Steven Holzer, Tata McCraw Hill Edition, 2005.

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|--|------------------------------------|
| Title of the Subject: PHP and MySQL LAB | |
| Course Code: 24MJBCA5P3 | CIA Marks: 10 Marks |
| Semester: V Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 0-0-4 | Credits: 02 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Design and develop dynamic web pages using server-side scripting
- Utilize forms to capture and process user input efficiently
- Implement session and cookie management for stateful web applications
- Perform database operations for data storage and retrieval
- Build and deploy small-scale web applications
- Apply development tools such as PHP Intelephense to enhance coding efficiency and debugging

Practicals:

1. Develop a PHP program to convert Dollar into Rupee.
2. Develop a PHP program to test odd and even number.
3. Develop a PHP program to assign the the scouts to tents based on their age.
4. Develop a PHP program to calculate factorial of a number.
5. Develop a PHP program to display count of distinction and failed students in a subject.
6. Develop a PHP program to enter your date of birth and calculate how old you are today, in years and months.
7. Develop a PHP program to calculate GCF and LCM.
8. Develop a PHP program to demonstrate constructors and destructors.
9. Develop a PHP program to copy a file without using built-in function.
10. Develop a PHP code to read the values entered into the form using the MySQL database.
11. Develop a PHP program to create & write to a file.
12. Develop a simple student registration form with Database connectivity.
13. Develop a login authentication system.
14. Develop a PHP program to insert records into database & display records from database.
15. Create a form to accept username & display it using GET method.

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|---|------------------------------------|
| Title of the Subject: SOFTWARE ENGINEERING | |
| Course Code: 24ELBCA5L1 | CIA Marks: 20 Marks |
| Semester: V Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Explain various Software Development Life Cycle (SDLC) models and their applications
- Analyze and interpret software requirements effectively
- Design structured and scalable software systems
- Apply appropriate software testing techniques to ensure quality
- Plan and manage software development projects efficiently

Software Engineering

| Unit | Description | Hours |
|------|--|-------|
| 1 | Introduction to Software Engineering: Definition of Software Engineering, Characteristics of Software, Software Crisis, Software Engineering Principles, Software Development Life Cycle (SDLC), Types of Software, Role of Software Engineer, Software Process Models- Waterfall Model, Incremental Model, Spiral Model. | 10 |
| 2 | Software Requirements & Analysis: Requirement Engineering, Types of Requirements- Functional, Non-functional; Requirement Gathering Techniques, Software Requirement Specification (SRS), Feasibility Study- Technical, Economic, Operational; Data Flow Diagrams (DFD), Entity Relationship Diagrams (ERD). | 12 |
| 3 | Software Design: Design Concepts, Architectural Design, Modular Design, Cohesion and Coupling, Structured Design, UML Diagrams- Use Case Diagram, Class Diagram, Sequence Diagram. | 12 |
| 4 | Software Testing: Importance of Testing, Types of Testing- Unit Testing, Integration Testing, System Testing; Black Box Testing, White Box Testing, Test Case Design, Debugging. | 10 |
| 5 | Software Maintenance & Project Management: Software Maintenance Types, Re-engineering, Software Configuration Management, Risk Management, Project Scheduling, Cost Estimation, Introduction to Agile Development. | 12 |

Reference Books:

1. Software Engineering by Ian Sommerville, 10th Edition, Pearson.
2. Software Engineering: A Practitioner's Approach by Roger S. Pressman, Bruce R. Maxim, 8th Edition, 8th Edition
3. Fundamentals of Software Engineering by Rajib Mall, 5th Edition, PHI Learning.
4. Software Engineering by K.K. Aggarwal, Yogesh Singh, 3rd Edition, New Age International.
5. Software Engineering by Pankaj Jalote, 3rd Edition, Narosa Publishing.
6. An Integrated Approach to Software Engineering by Pankaj Jalote, 3rd Edition, Narosa Publishing.

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|---|------------------------------------|
| Title of the Subject: CYBER SECURITY | |
| Course Code: 24ELBCA5L2 | CIA Marks: 20 Marks |
| Semester: V Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Understand the fundamentals of cyber security, types of attackers, and common cyber threats.
- Explain the concepts of cyber law, Indian IT Act, digital signatures, and legal aspects of cybercrime.
- Identify and analyze various cyber attack techniques such as phishing, SQL injection, DoS/DDoS, and password cracking.
- Apply data security principles, authentication methods, and access control mechanisms to protect systems and networks.
- Evaluate cybercrime investigation techniques including digital evidence handling, data recovery, and basic forensic tools.

Cyber Security

| Unit | Description | Hours |
|------|--|-------|
| 1 | Cyber Security: Introduction in Cyber Security -Hackers - Attackers -Types of Attackers Examples –Data Recovery. Cyber law: Features of Cyber Law - Significance of Cyber Law - Advantages. Data Security - Meaning - Fundamentals of Data Security - Requirements of Data Security - Precautionary Measures. | 12 |
| 2 | Tools and Methods Used in Cyber crime: Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft). | 12 |
| 3 | Cybercrimes and Cyber security: The Legal Perspectives Why do we need Cyber law: The Indian Context, The Indian IT Act, Digital Signature and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario. | 10 |
| 4 | Authentication and Firewalls - Authentication & Access Control: Identification - Authentication - Authentication by Passwords - Protecting Passwords - Access Control Structure - Evidences - Law of Evidence on Electronic Records. | 11 |
| 5 | Data/Files Recovery - Cracking - Pornography - Software privacy - Data Recovery - File Modification & File access, Recover Internet Usage Data, Recover Swap Files/Temporary/Cache Files, and Introduction to Encase Forensic. | 11 |

References:

1. Sunit Belapure and Nina Godbole. Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives. Wiley India Pvt Ltd. 2013.
2. Surya PrakashTripathi, Ritendra Goyal, Praveen Kumar Shukla. Introduction to information security and cyber laws. Dreamtech Press. 2015.
3. Charles J. Brooks, Christopher Grow, Philip A. Craig Jr., Donald Short, ISBN: 978-1-119-36239-5 October 2018.

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|---|------------------------------------|
| Title of the Subject: MOBILE APPLICATION DEVELOPMENT | |
| Course Code: 24ELBCA5L3 | CIA Marks: 20 Marks |
| Semester: V Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Create Servlets for server side programming Create, test and debug Android application by setting up Android development environment.
- Critique mobile applications on their design pros and cons.
- Program mobile applications for the Android operating system and understand techniques for designing and developing sophisticated mobile interfaces.
- Deploy applications to the Android marketplace for distribution.

Mobile Application Development

| Unit | Description | Hours |
|------|---|-------|
| 1 | Android OS design and Features: Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools, Building your First Android application. | 12 |
| 2 | Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions. | 12 |
| 3 | Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. | 10 |
| 4 | Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. | 11 |
| 5 | Using Common Android APIs: Using Android Data and Storage APIs, Managing data using SQLite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Deploying Android Application to the World. | 11 |

References:

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011).
2. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt. Ltd
3. Mark L Murphy, "Beginning Android", Wiley India Pvt. Ltd
4. Android Application Development All in one for Dummies by Barry Burd, Edition: I
5. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.
6. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012.

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|--|------------------------------------|
| Title of the Subject: ELEMENTARY RESEARCH METHODOLOGY | |
| Course Code: 24RMBCA5L1 | CIA Marks: 10 Marks |
| Semester: V Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 2-0-0 | Credits: 02 Credits |
| Duration of Exam: 01½ Hrs | Total Contact Hours: 28 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Identify research problems
- Collect and analyze data
- Use basic statistical tools
- Write research reports
- Follow research ethics

Elementary Research Methodology

| Unit | Description | Hours |
|------|---|-------|
| 1 | Introduction to Research: Meaning of Research, Importance of Research in Science , Types of Research- Basic Research, Applied Research; Research Process, Characteristics of Good Research. | 05 |
| 2 | Research Problem & Objectives: Identification of Research Problem, Selection of Research Topic, Formulation of Objectives, Research Questions, Hypothesis, Literature Review Basics. | 06 |
| 3 | Data Collection Methods: Types of Data- Primary Data, Secondary Data; Methods of Data Collection- Observation, Survey, Questionnaire, Interview; Sampling Techniques. | 06 |
| 4 | Data Analysis & Presentation: Data Classification, Tabulation, Graphical Representation, Basic Statistical Tools- Mean, Median, Mode. | 05 |
| 5 | Research Report Writing: Structure of Research Report, Referencing & Citation, Writing Abstract, Conclusion & Recommendations, Ethical Issues in Research. | 06 |

Reference Books:

1. Research Methodology: Methods and Techniques by C.R. Kothari, Gaurav Garg, 4th Edition, New Age International.
2. Research Methodology by R. Panneerselvam, 2nd Edition, PHI Learning.
3. Research Methodology: A Step-by-Step Guide for Beginners by Ranjit Kumar, 4th Edition, SAGE Publications.
4. Research Methods for Science by Michael P. Marder, Cambridge University Press.

*****END of V Sem*****

**BCA/B.Sc Degree Examination,
SEP – QP - Pattern**

Time: 3 Hours

Max. Marks: 80

Section – A

Note: Answer all sub questions

Each question carries TWO mark.

(10 x 2 = 20)

1.

- a)
- b)
- c)
- d)
- e)
- f)
- g)
- h)
- i)
- j)

Section – B

Note : Answer any Four questions

Each question carries FIVE marks.

(4 x 5 =20)

- 2.**
- 3.**
- 4.**
- 5.**
- 6.**
- 7.**

Section – C

Note : Answer any Four questions

Each question carries TEN marks.

(4 x 10 =40)

- 8.**
- 9.**
- 10.**
- 11.**
- 12.**
- 13.**

Note : 1. For Section –A , Two questions from each Unit.

2. For Section – B , One question from each Unit, and Q-7 must be from Unit 2 to 5.

3. For Section – C , One question from each Unit, and Q-13 must be from Unit 2 to 5.

**BCA/B.Sc Degree Examination,
SEP – Scheme for Practical Examination**

1. Writing Two Programs : **14 Marks (for each 7 marks)**
 2. Execution of Two programs : **16 Marks (for each 8 marks)**
 3. Practical record : **05 Marks**
 4. Viva Voce : **05 Marks**
- Total : 40 Marks**

BCA/B.Sc. Degree Examination,

Skill Enhancement Courses (SECs) Question paper pattern

Paper Code:

Paper Title:

Time: 1.5 Hours

Max. Marks: 40

There shall be Theory examinations of Multiple Choice Based Questions [MCQs] with Question Paper set of A, B, C and D Series at the end of each semester for SECs for the duration of 90 minutes. The Answer Paper is of OMR (Optical Mark Reader) Sheet.

BCA VI Semester

| | |
|---|------------------------------------|
| Title of the Subject: DATA WAREHOUSING AND DATA MINING | |
| Course Code: 24MJBCA6T1 | CIA Marks: 20 Marks |
| Semester: VI Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Explain the concepts, architecture, and components of Data Warehousing and OLAP systems.
- Apply data preprocessing techniques and association rule mining methods to extract meaningful patterns from data.
- Analyze and implement classification and prediction techniques for knowledge discovery.
- Evaluate clustering techniques and outlier detection methods for different types of data.
- Demonstrate the ability to mine complex data types such as spatial, multimedia, text, and web data.

Data Warehousing and Data Mining

| Unit | Description | Hours |
|------|--|-------|
| 1 | Introduction to Data Warehousing: Introduction to Data Warehousing, Characteristics of Data Warehouse, Operational Database vs Data Warehouse, Data Warehouse Architecture, Components of Data Warehouse, Data Marts, Metadata. | 11 |
| 2 | Data Warehouse Design & OLAP: Data Warehouse Design Process, Star Schema, Snowflake Schema, Fact Tables and Dimension Tables, Introduction to OLAP, OLAP Operations - Roll-up, Drill-down, Slice, Dice; MOLAP, ROLAP, HOLAP. | 11 |
| 3 | Introduction to Data Mining: Introduction to Data Mining, Knowledge Discovery in Databases (KDD) Process, Data Mining Tasks, Data Mining Applications, Data Preprocessing - Data Cleaning, Data Integration, Data Transformation, Data Reduction. | 12 |
| 4 | Data Mining Techniques: Classification, Clustering, Association Rule Mining, Decision Trees, k-Means Clustering, Market Basket Analysis. | 11 |
| 5 | Data Mining Tools & Applications: Data Mining Tools Overview, Data Visualization, Web Data Mining, Text Data Mining, Applications of Data Mining - Banking, Healthcare, Marketing, E-commerce; Ethical Issues in Data Mining. | 11 |

References:

1. Jiawei Han, Micheline Kamber and Jian Pei: Data Mining Concepts and Techniques, 3rd Edition, Elsevier, 2011.
2. Alex Berson and Stephen J. Smith: Data Warehousing, Data Mining and OLAP, Tata McGraw-Hill, 2007.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar: Introduction to Data Mining, Pearson Education, 2007.
4. Ralph Kimball and Margy Ross: The Data Warehouse Toolkit – The Definitive Guide to Dimensional Modeling, 2nd Edition, Wiley India, 2002.
5. G. K. Gupta: Introduction to Data Mining with Case Studies, Prentice Hall of India, 2006.

| | |
|---|------------------------------------|
| Title of the Subject: DATA WAREHOUSING AND DATA MINING LAB | |
| Course Code: 24MJBCA6P1 | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 0-0-4 | Credits: 02 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Perform data preprocessing
- Implement classification and clustering algorithms
- Discover patterns from datasets
- Use data mining tools
- Apply data mining to real-world problems

Practicals:

1. Write a Python program to load a CSV file and display the first 5 rows of the dataset.
2. Write a Python program to identify and count missing values in a dataset.
3. Write a Python program to replace missing values with mean or median.
4. Write a Python program to normalize numerical data using simple scaling.
5. Write a Python program to group data using the groupby() function and calculate total sales.
6. Write a Python program to find frequent items from a small transaction dataset.
7. Write a Python program to calculate support and confidence for given association rules.
8. Write a Python program to implement a simple Decision Tree classifier using a sample dataset.
9. Write a Python program to implement a simple Naïve Bayes classifier.
10. Write a Python program to perform K-Means clustering on a small dataset.
11. Write a Python program to draw a simple dendrogram for hierarchical clustering.
12. Write a Python program to count the frequency of words in a given text file.
13. Use Weka tool to perform classification on a dataset.
14. Use Weka tool to perform clustering.
15. Implement Market Basket analysis.

NOTE: The programs can be implemented using **Python / Weka**

Web:

1. <https://www.futurelearn.com/courses/data-mining-with-weka>
2. <https://archive.ics.uci.edu/ml/index.php>

| | |
|--|------------------------------------|
| Title of the Subject: R PROGRAMMING | |
| Course Code: 24MJBCA6T2 | CIA Marks: 20 Marks |
| Semester: VI Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Explain the fundamentals of R programming, including its environment, data types, operators, and control structures.
- Apply built-in and user-defined functions to perform computations and manipulate data structures in R.
- Analyze and manage different data structures such as vectors, matrices, lists, arrays, and data frames.
- Perform data importing, preprocessing, transformation, and statistical analysis using R.
- Create meaningful visualizations and interpret results using graphical functions in R.

R Programming

| Unit | Description | Hours |
|------|--|-------|
| 1 | Introduction to R: What is R, Why R, Advantages of R over Other Programming Languages, R Studio, R Command Prompt, R Script File, Comments in R, Handling Packages in R, Installing R Packages, Basic Package Functions (installed.packages(), library(), help(), find.package()), Special Values in R (NA, Inf, -Inf). | 11 |
| 2 | R Data Types and Control Structures: Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Variable Assignment, Data Types of Variables, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Decision Making Statements (if, if-else, switch), Looping Statements (repeat, while, for), Loop Control Statements (break, next). | 12 |
| 3 | Functions and Data Structures in R: Built-in Functions (mean(), sum(), min(), max(), seq()), User-defined Functions, Calling Functions with and without Arguments, String Manipulation Functions (substr(), strsplit(), paste(), grep(), tolower()), Vector Operations, Vector Sorting and Recycling, List Creation and Manipulation, Matrix Operations (Addition, Subtraction, Multiplication, Division), Array Manipulation, Factor Creation and Levels. | 11 |
| 4 | Data Frames and Data Handling in R: Creating Data Frames, Accessing and Modifying Data Frames, Data Frame Functions (dim(), nrow(), ncol(), str(), summary(), head(), tail()), Extracting and Expanding Data Frames, Adding and Deleting Rows and Columns, Joining and Merging Data Frames (rbind(), cbind(), merge()), Reshaping Data (melt(), cast()), Working Directory Functions (getwd(), setwd(), dir()), Reading and Writing CSV Files, Reading Excel Files. | 12 |
| 5 | Descriptive Statistics and Data Visualization in R: Data Range, Frequencies, Mean, Median, Mode, Correlation Analysis, Data Visualization Techniques, Pie Charts (Titles, Colors, Legends), Histograms and Density Plots, Bar Charts (Labels, Titles, Colors). | 10 |

References:

1. Sandip Rakshit: R Programming for Beginners, McGraw Hill Education (India), 2017.
2. Seema Acharya: Data Analytics using R, McGraw Hill Education (India), 2018.
3. Andrie de Vries and Joris Meys: R for Dummies, 2nd Edition, John Wiley and Sons, 2015.
4. Norman Matloff: The Art of R Programming – A Tour of Statistical Software Design, No Starch Press, 2011.
5. Hadley Wickham and Garrett Grolemund: R for Data Science, O'Reilly Media, 2017.

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|--|------------------------------------|
| Title of the Subject: R PROGRAMMING LAB | |
| Course Code: 24MJBCA6P2 | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 0-0-4 | Credits: 02 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Students learn **basic programming in R**
- Students perform **data analysis and visualization**
- Helps prepare for **Data Mining, Machine Learning.**
- Helps prepare for **Statistical Computing courses**

Practicals:

1. Write a program to explore the R environment and perform basic arithmetic operations.
2. Write a program to install, load, and use R packages and demonstrate basic package functions.
3. Write a program to demonstrate the use of special values (NA, Inf, -Inf) and built-in functions in R.
4. Write a program to create and perform operations on vectors in R.
5. Write a program to create and manipulate lists, matrices, and arrays in R.
6. Write a program to define and call user-defined functions in R.
7. Write a program to perform string manipulation using built-in string functions in R.
8. Write a program to create and work with factors and display their levels.
9. Write a program to create, access, and modify data frames in R.
10. Write a program to perform data frame operations such as adding, deleting, and merging rows and columns.
11. Write a program to read and write CSV and Excel files in R.
12. Write a program to calculate descriptive statistics such as mean, median, mode, and correlation.
13. Write a program to generate data visualizations such as pie charts, bar charts, histograms, and density plots.
14. Write a program to perform correlation analysis.
15. Write a R program to read & write data from a CSV file.

| | |
|--|------------------------------------|
| Title of the Subject: OBJECT ORIENTED ANALYSIS AND DESIGN USING UML | |
| Course Code: 24MJBCA6T3 | CIA Marks: 20 Marks |
| Semester: VI Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 4-0-0 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Explain the importance of modeling and apply UML concepts in object-oriented system development.
- Analyze system requirements and develop domain models, sequence diagrams, and operation contracts.
- Design software systems using design principles, architectural patterns, and GRASP patterns.
- Map UML designs into code using test-driven development and refactoring techniques.
- Apply design patterns and architectural refinement techniques in real-world case studies.

Object Oriented Analysis and Design using UML

| Unit | Description | Hours |
|------|---|-------|
| 1 | Introduction to Object-Oriented Concepts and UML: Introduction to Software Development and System Analysis, Procedural vs Object-Oriented Approach, Basic Object- Oriented Concepts - Object, Class, Abstraction, Encapsulation, Inheritance, Polymorphism; Introduction to Object-Oriented Analysis and Design (OOAD), Overview of UML (Unified Modeling Language), Importance and Advantages of UML in Software Development, UML Architecture and Basic Building Blocks - Things, Relationships, Diagrams. | 12 |
| 2 | Object-Oriented Analysis (OOA): Introduction to Object-Oriented Analysis, Identifying Classes and Objects, Use Case Modeling, Actors and Use Case Diagrams, Relationships in Use Case Diagrams- Include, Extend, Generalization; Writing Use Case Scenarios, Activity Diagrams for Business Processes, Identifying Functional Requirements. | 11 |
| 3 | Structural Modeling using UML: Introduction to Structural Modeling, Class Diagrams - Attributes, Methods, Relationships (Association, Aggregation, Composition, Inheritance); Object Diagrams, Package Diagrams, Component Diagrams, Deployment Diagrams. | 11 |
| 4 | Behavioral Modeling using UML: Introduction to Behavioral Modeling, Interaction Diagrams - Sequence Diagrams, Collaboration (Communication) Diagrams; State Chart Diagrams, Activity Diagrams, Modeling Dynamic Behavior of Systems. | 11 |
| 5 | Object-Oriented Design and Case Studies: Object-Oriented Design Concepts, Design Principles in OOAD, Introduction to Design Patterns (Basic Concepts), System Architecture Design, Case Study Development | 11 |

| | | |
|--|---|--|
| | using UML Diagrams - Library Management System, Online Shopping System, Student Management System; Documentation of UML Models. | |
|--|---|--|

References:

1. Grady Booch, James Rumbaugh and Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education, 2005.
2. Hans-Erik Eriksson, Magnus Penker, Brian Lyons and David Fado: UML 2 Toolkit, Wiley-Dreamtech India Pvt. Ltd., 2004.
3. Michael Blaha and James Rumbaugh: Object-Oriented Modeling and Design with UML, Prentice Hall of India, 2005.
4. Craig Larman: Applying UML and Patterns – An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3rd Edition, Pearson Education, 2005.
5. Martin Fowler: UML Distilled – A Brief Guide to the Standard Object Modeling Language, 3rd Edition, Pearson Education, 2004.

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|--|------------------------------------|
| Title of the Subject: OBJECT ORIENTED ANALYSIS AND DESIGN USING UML LAB | |
| Course Code: 24MJBCA6P3 | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 0-0-4 | Credits: 02 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Use UML tools to design system models
- Identify system actors, objects, and interactions
- Develop structural and behavioral UML diagrams
- Apply OOAD concepts to real-world software systems
- Document software designs using UML diagrams

Practicals:

1. Design a UML Class Diagram for a Library Management System.
2. Draw a Use Case Diagram for an Online Shopping System.
3. Develop a System Sequence Diagram for an ATM cash withdrawal process.
4. Draw an Activity Diagram for a Student Registration process.
5. Design a Package Diagram for a Hospital Management System.
6. Develop a Domain Model for an Online Bookshop system.
7. Identify class responsibilities and redesign a system using GRASP principles.
8. Design and illustrate the Model-View-Controller (MVC) design pattern for a simple application.
9. Draw a UML component for online shopping system.
10. Demonstrate Test Driven Development (TDD) and refactoring for a simple program.
11. Model the Next Gen POS system or Multi-Threaded Airport Simulation using appropriate UML diagrams.
12. Draw State Chart diagram for online food ordering system.
13. Draw Activity diagram for online ticket reservation system.
14. Draw a class diagram & object diagram for Library Management System.
15. Draw a class diagram & object diagram for Banking System.

NOTE: Install and explore UML tools such as **StarUML / Visual Paradigm / Draw.io**.

| | |
|--------------------------------------|------------------------------------|
| Title of the Subject: PROJECT | |
| Course Code: 24PROJBCA6P | CIA Marks: 20 Marks |
| Semester: VI Sem | SEE Marks: 80 Marks |
| Contact Hours(L:T:P): 0-0-8 | Credits: 04 Credits |
| Duration of Exam: 03 Hrs | Total Contact Hours: 56 Hrs |

PROJECT

Group Project Rules and Guidelines

1. Group Formation

1. Each project group must consist of **maximum 4 students**.
2. Students must form their groups at the **beginning of the semester**.
3. No student is allowed to be part of **more than one group**.
4. The group must select **one team leader** to coordinate the project activities.

2. Project Selection

1. The project topic must be related to **Computer Science / IT / Software Development**.
2. The project topic must be **approved by the project guide or department** before starting the work.
3. Students are encouraged to develop **real-world applications** such as:
 - Web applications
 - Mobile applications
 - Data analysis projects
 - Software tools

3. Project Work Distribution

1. All members must **actively participate in the project development**.
2. Work should be **distributed equally among the group members**.
3. Each member must clearly explain **their contribution** during the project evaluation.

4. Project Documentation

1. Each group must submit a **project report/documentation**.
2. The report should include:
 - Title page
 - Abstract
 - Introduction
 - System design
 - Implementation details
 - Screenshots / Results
 - Conclusion
 - Bibliography
3. The report must be **signed by the project guide** before submission.

5. Project Demonstration

1. Each group must **demonstrate the working project** during the final evaluation.
2. All group members must be present during the **project presentation and viva**.
3. Each member should be able to **explain the project design and functionality**.

6. Evaluation Criteria

The project evaluation may include:

- Project idea and innovation
- Implementation and functionality
- Documentation quality
- Presentation and demonstration
- Individual contribution

7. General Rules

1. **Plagiarism or copied projects are strictly prohibited.**
2. Projects must be **developed by the students themselves.**
3. Late submission of the project report may lead to **marks deduction.**
4. The decision of the **project guide / department will be final** in all matters related to project evaluation.

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|--|--|
| Title of the Subject: ETL (Extract, Transform, Load) TOOL | |
| Course Code: 24SECBCA6T(A) | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 1-0-2 | Credits: 02 Credits |
| Duration of Exam: 01½ Hrs | Total Contact Hours: 14 Hrs (Theory) and 28 Hrs (Practical's) |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Understand the concepts of data warehousing and ETL processes.
- Design and implement ETL workflows using ETL tools.
- Apply data transformation and cleansing techniques.
- Manage ETL workflows including scheduling and error handling.
- Optimize ETL processes for better performance and data quality.

ETL (Extract, Transform, Load) TOOL

| Unit | Description | Hours |
|------|--|-------|
| 1 | Introduction to ETL and Data Warehousing Concepts: Introduction to Data Warehousing, ETL Process Overview, Data Extraction, Data Transformation, Data Loading, Types of Data Sources, ETL Architecture, Data Staging Area, Data Cleansing Techniques, Data Integration Concepts. | 4 |
| 2 | ETL Tool Components and Transformations: Overview of ETL Tools (Informatica / Talend / Pentaho), Source Analyzer, Target Designer, Mapping Designer, Workflow Manager, Repository Manager, Types of Transformations (Expression, Filter, Aggregator, Joiner, Lookup, Router, Sorter), Debugging and Testing Mappings. | 5 |
| 3 | Advanced ETL Concepts and Performance Tuning: Workflow Scheduling, Error Handling and Logging, Incremental Loading, Slowly Changing Dimensions (SCD), Performance Optimization Techniques, Data Validation, Metadata Management, ETL Best Practices. | 5 |

References:

1. Ralph Kimball and Joe Caserta: *The Data Warehouse ETL Toolkit*, Wiley India, 2004.
2. Vinay K. Singh and Nitin Gupta: *Data Warehousing and Data Mining*, S. K. Kataria & Sons, 2012.
3. Paulraj Ponniah: *Data Warehousing Fundamentals*, Wiley India, 2010.
4. Tom Haughey: *Successful Data Warehousing*, Pearson Education, 2002.
5. Ivan Pepelnjak: *ETL Data Integration Patterns and Best Practices*, Technics Publications, 2010.

| | |
|--|--|
| Title of the Subject: ETL (Extract, Transform, Load) TOOL LAB | |
| Course Code: 24SECBCA6P(A) | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 1-0-2 | Credits: 02 Credits |
| Duration of Exam: 01½ Hrs | Total Contact Hours: 14 Hrs (Theory) and 28 Hrs (Practical's) |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Understand the **working of ETL tools**
- Extract data from different sources
- Perform **data cleaning and transformation**
- Load processed data into databases
- Design a **complete ETL workflow**

ETL (Extract, Transform, Load) TOOL LAB

1. Install and explore **Talend Open Studio / Pentaho Data Integration.**
2. Create a simple project and connect to a sample dataset (CSV file).
3. Extract data from a **CSV file.**
4. Extract data from a **Excel file.**
5. Extract data from a **MySQL database table.**
6. Perform **data filtering** on dataset.
7. Perform **sorting of data records.**
8. Apply **data type conversion.**
9. Remove **duplicate records** from dataset.
10. Handle **missing values in dataset.**
11. Perform **data aggregation operations** (sum, count, average).
12. Merge data from **two different data sources.**
13. Load processed data into **MySQL database table.**
14. Export transformed data to **CSV or Excel file.**
15. Design a **complete ETL workflow:**
 - a) Extract data from file
 - b) Apply transformation
 - c) Load into database.

NOTE: Install the following software's **Talend Open Studio / Pentaho Data Integration** to perform the above operations/program outputs. Most students use **Pentaho Data Integration** because it is **free and easy** for ETL practical's.

WEB:

1. Pentaho Data Integration **Official Download Page:** [Download Pentaho Data Integration / Developer Edition](#)
2. Talend Studio **Official Portal:** <https://www.talend.com/products/data-integration/>

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|---|--|
| Title of the Subject: DATA VISUALIZATION using R | |
| Course Code: 24SECBCA6T(B) | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 1-0-2 | Credits: 02 Credits |
| Duration of Exam: 1½ Hrs | Total Contact Hours: 14 Hrs (Theory) and 28 Hrs (Practical's) |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Understand the fundamental principles and importance of data visualization in data analysis.
- Apply basic and advanced plotting techniques in R to represent different types of data.
- Design customized and aesthetically appealing visualizations using R libraries such as ggplot2.
- Analyze statistical data using appropriate graphical representations.
- Develop interactive and dynamic visualizations using advanced R tools.

Data Visualization using R

| Unit | Description | Hours |
|------|--|-------|
| 1 | Introduction to Data Visualization in R: Overview of Data Visualization, Importance of Data Visualization in Data Analysis, Types of Data, Basic Plotting in R, Graphical Parameters, Base R Plot Functions (plot(), barplot(), pie(), hist()), Customizing Graphs (titles, labels, colors, legends), Saving Graphs to Files. | 4 |
| 2 | Advanced Visualization using R Libraries: Introduction to ggplot2, Grammar of Graphics Concept, Creating Scatter Plots, Line Charts, Bar Charts, Histograms using ggplot2, Aesthetic Mapping, Themes and Customization, Faceting, Multiple Plots, Introduction to Data Visualization Packages (lattice, plotly). | 5 |
| 3 | Statistical and Interactive Visualizations: Box Plots and Violin Plots, Density Plots, Correlation Visualization, Heatmaps, Time Series Visualization, Interactive Visualizations using Plotly, Dashboard Creation using Shiny (Introduction), Data Visualization Best Practices and Ethics. | 5 |

References:

1. Hadley Wickham: *ggplot2 – Elegant Graphics for Data Analysis*, Springer, 2016.
2. Hadley Wickham and Garrett Grolemund: *R for Data Science*, O'Reilly Media, 2017.
3. Kieran Healy: *Data Visualization – A Practical Introduction*, Princeton University Press, 2018.
4. Paul Murrell: *R Graphics*, Chapman & Hall/CRC Press, 2011.
5. Winston Chang: *R Graphics Cookbook*, O'Reilly Media, 2018.

| | |
|---|--|
| Title of the Subject: DATA VISUALIZATION using R LAB | |
| Course Code: 24SECBCA6P(B) | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 1-0-2 | Credits: 02 Credits |
| Duration of Exam: 1 Hrs | Total Contact Hours: 14 Hrs (Theory) and 28 Hrs (Practical's) |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Install and work with **R and RStudio**
- Create **basic graphs and charts in R**
- Use **ggplot2 for advanced data visualization**
- Import datasets and visualize them effectively
- Export visualizations for reports and presentations

Practicals:

1. Write an R program to create basic plots using the plot() function.
2. Write an R program to generate bar charts and pie charts with proper labels and legends.
3. Write an R program to create histograms and density plots for a dataset.
4. Write an R program to customize graphs using titles, axis labels, colors, and legends.
5. Write an R program to create scatter plots and line charts using ggplot2.
6. Write an R program to create grouped and stacked bar charts using ggplot2.
7. Write an R program to create box plots and violin plots for statistical analysis.
8. Write an R program to visualize correlation using heatmaps.
9. Write an R program to create time series visualizations.
10. Write an R program to generate faceted plots using ggplot2.
11. Write an R program to create interactive visualizations using plotly.
12. Write an R program to design a simple dashboard using Shiny.

WEB:

1. <https://www.kaggle.com/datasets>
2. <https://archive.ics.uci.edu/ml/index.php>
3. <https://stat.ethz.ch/R-manual/R-devel/library/datasets/html/00Index.html>

| | |
|---|--|
| Title of the Subject: SOFTWARE TESTING | |
| Course Code: 24SECBCA6T(C) | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 1-0-2 | Credits: 02 Credits |
| Duration of Exam: 01½ Hrs | Total Contact Hours: 14 Hrs (Theory) and 28 Hrs (Practical's) |

Course Outcomes (COs):

At the end of the course, students will be able to:

- Understand the fundamentals, principles, and life cycle of software testing.
- Apply various black-box and white-box testing techniques to software systems.
- Design and develop effective test cases and test plans for software applications.
- Analyze defects and perform different levels of testing including integration and system testing.
- Use automated testing tools and frameworks to improve software quality.

Software Testing

| Unit | Description | Hours |
|------|--|-------|
| 1 | Introduction to Software Testing: Software Testing Fundamentals, Need for Testing, Errors, Faults and Failures, Verification and Validation, Software Testing Life Cycle (STLC), Levels of Testing (Unit Testing, Integration Testing, System Testing, Acceptance Testing), Testing Principles. Test Case Design Techniques (Black Box Testing): Equivalence Partitioning, Boundary Value Analysis, Decision Table Testing, State Transition Testing. | 4 |
| 2 | White Box Testing Techniques: Control Flow Testing, Flow Graph Notation, Cyclomatic Complexity, Path Testing, Data Flow Testing, Loop Testing. Integration and System Testing: Top-Down and Bottom-Up Integration Testing, Regression Testing, Smoke Testing, Performance Testing, Security Testing. | 5 |
| 3 | Test Management and Automation: Test Planning, Test Case Design and Documentation, Defect Life Cycle, Bug Tracking, Test Reports. Automated Testing Tools: Introduction to Automated Testing, Selenium Overview, JUnit Testing, Test Driven Development (TDD), Continuous Integration Concepts. | 5 |

References:

1. Roger S. Pressman: *Software Engineering – A Practitioner’s Approach*, McGraw-Hill Education, 2010.
2. K. K. Aggarwal and Yogesh Singh: *Software Engineering*, New Age International Publishers, 2005.
3. Boris Beizer: *Software Testing Techniques*, Dreamtech Press, 2003.
4. Glenford J. Myers, Corey Sandler and Tom Badgett: *The Art of Software Testing*, 3rd Edition, Wiley India, 2012.
5. Srinivasan Desikan and Gopalaswamy Ramesh: *Software Testing – Principles and Practices*, Pearson Education, 2006.

| | |
|---|--|
| Title of the Subject: SOFTWARE TESTING LAB | |
| Course Code: 24SECBCA6P(C) | CIA Marks: 10 Marks |
| Semester: VI Sem | SEE Marks: 40 Marks |
| Contact Hours(L:T:P): 1-0-2 | Credits: 02 Credits |
| Duration of Exam: 01½ Hrs | Total Contact Hours: 28 Hrs (Practical's) |

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:

- Understand **software testing process and techniques**
- Perform **unit testing using JUnit**
- Apply **black box and white box testing methods**
- Automate web testing using **Selenium**
- Prepare **test cases, bug reports, and test documentation**

Practicals:

1. Install Eclipse IDE / IntelliJ IDEA for Java testing.
2. Install JUnit testing framework and configure it with Java.
3. Write a simple unit test case using JUnit for a basic Java program.
4. Write JUnit test cases for a program that performs arithmetic operations.
5. Perform unit testing for a string manipulation program.
6. Generate test reports using JUnit.
7. Design test cases for student grade calculation program.
8. Perform statement coverage testing for a program.
9. Perform branch coverage testing for a conditional program.
10. Install Selenium WebDriver and configure it with Java.
11. Write a Selenium script to open a web page.
12. Automate login testing for a sample website.
13. Perform form testing using Selenium automation.
14. Prepare a test plan for a simple application.
15. Perform manual testing for a small application.
16. Prepare a bug report and test summary report.

WEB:

1. Java JDK (for JUnit and Selenium): <https://www.oracle.com/java/technologies/downloads/>
2. **Eclipse IDE (Free Java Development Environment):** <https://www.eclipse.org/downloads/>
3. **IntelliJ IDEA Community Edition:** <https://www.jetbrains.com/idea/download>
4. JUnit Testing Framework : <https://junit.org/junit5/>
5. Selenium Web Driver: <https://www.selenium.dev/downloads/>
6. **Chrome Driver (for Selenium with chrome):** <https://chromedriver.chromium.org/downloads>

**BCA/B.Sc Degree Examination,
SEP – QP - Pattern**

Time: 3 Hours

Max. Marks: 80

Section – A

Note: Answer all sub questions

Each question carries TWO mark.

(10 x 2 = 20)

1.

- a)
- b)
- c)
- d)
- e)
- f)
- g)
- h)
- i)
- j)

Section – B

Note : Answer any Four questions

Each question carries FIVE marks.

(4 x 5 =20)

- 2.**
- 3.**
- 4.**
- 5.**
- 6.**
- 7.**

Section – C

Note : Answer any Four questions

Each question carries TEN marks.

(4 x 10 =40)

- 8.**
- 9.**
- 10.**
- 11.**
- 12.**
- 13.**

Note : 1. For Section –A , Two questions from each Unit.

2. For Section – B , One question from each Unit, and Q-7 must be from Unit 2 to 5.

3. For Section – C , One question from each Unit, and Q-13 must be from Unit 2 to 5.

**BCA/B.Sc Degree Examination,
SEP – Scheme for Practical Examination**

1. Writing Two Programs : **14 Marks (for each 7 marks)**
 2. Execution of Two programs : **16 Marks (for each 8 marks)**
 3. Practical record : **05 Marks**
 4. Viva Voce : **05 Marks**
- Total : 40 Marks**

BCA/B.Sc. Degree Examination,

Skill Enhancement Courses (SECs) Question paper pattern

Paper Code:

Paper Title:

Time: 1.5 Hours

Max. Marks: 40

There shall be Theory examinations of Multiple Choice Based Questions [MCQs] with Question Paper set of A, B, C and D Series at the end of each semester for SECs for the duration of 90 minutes. The Answer Paper is of OMR (Optical Mark Reader) Sheet.

*******THE END*******