# B.Sc. Computer Science with Data Analytics

## Syllabus

## AFFILIATED COLLEGES

## Programme Code: 28B

**2025 – 2026 onwards**

# BHARATHIAR UNIVERSITY

**(A State University, Accredited with "A++" Grade by NAAC, Ranked 21st among Indian Universities by MHRD-NIRF)**

**Coimbatore - 641 046, Tamil Nadu, India**

| **Programme Educational Objectives (PEOs)** | |
|---|---|
| **The B.Sc. Computer Science with Data Analytics** program describe accomplishments that graduates are expected to attain within five to seven years after graduation. | |
| **PEO1** | Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics |
| **PEO2** | Apply principles of Data Science to the analysis of business problem |
| **PEO3** | Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.. |

| **Programme Specific Outcomes (PSOs)** | |
|---|---|
| **After the successful completion of B.Sc. Computer Science with Data Analytics** programme the students are expected to | |
| **PSO1** | Impart education with domain knowledge effectively and efficiently in par with the expected quality standards for Data analyst professional. |
| **PSO2** | Ability to apply the mathematical, technical and critical thinking skills in the discipline of Data analytics to find solutions for complex problems. |
| **PSO3** | Ability to engage in life-long learning and adopt fast changing technology to prepare for professional development. |
| **PSO4** | Expose the students to key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics. |
| **PSO5** | Inculcate effective communication skills combined with professional & ethical attitude. |

| **Programme Outcomes (POs)** | |
|---|---|
| **On successful completion of the B.Sc. Computer Science with Data Analytics** | |
| **PO1** | Exhibit good **domain knowledge** and completes the assigned responsibilities effectively and efficiently in par with the expected quality standards. |
| **PO2** | Apply **analytical and critical thinking** to identify, formulate, analyze, and solve complex problems in order to reach authenticated conclusions |
| **PO3** | **Design and develop research based solutions** for complex problems with specified needs through appropriate consideration for the public health, safety, cultural, societal, and environmental concerns. |
| **PO4** | Establish the ability to **Listen, read, proficiently communicate and articulate complex ideas** with respect to the needs and abilities of diverse audiences. |
| **PO5** | **Deliver innovative ideas to instigate new business ventures** and possess the qualities of a good entrepreneur |
| **PO6** | Acquire the qualities of a **good leader and engage in efficient decision making.** |
| **PO7** | Graduates will be able to undertake any responsibility as an **individual/member of multidisciplinary teams and have an understanding of team leadership** |
| **PO8** | Function as s**ocially responsible individual** with ethical values and accountable to ethically validate any actions or decisions before proceeding and actively contribute to the societal concerns. |
| **PO9** | Identify and **address own educational needs i**n a changing world in ways sufficient to maintain the competence and to allow them to contribute to the advancement of knowledge |
| **PO10** | **Demonstrate knowledge and understanding of management principles a**nd apply these to one own work to manage projects and in multidisciplinary environment. |

# BHARATHIAR UNIVERSITY::COIMBATORE 641 046

## B. Sc. Computer Science with Data Analytics

## (CBCS PATTERN)

(*For the students admitted from the academic year **2025-2026** and onwards*)

## Scheme of Examination

| Part | Title of the Course | Hours/ Week | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|
| | | | Duration in Hours | Maximum Marks | | | |
| | | | | CIA | CEE | Total | |
| | **Semester I** | | | | | | |
| I | Language - I | 6 | 3 | 25 | 75 | 100 | 4 |
| II | English - I | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Core 1: Programming in C | 5 | 3 | 25 | 75 | 100 | 4 |
| III | Core 2: Data structures | 5 | 3 | 25 | 75 | 100 | 4 |
| III | Core Lab 1: Programming Lab - C | 4 | 3 | 20 | 30 | 50 | 2 |
| III | Allied 1: Introduction to Linear algebra | 4 | 3 | 25 | 75 | 100 | 4 |
| IV | Environmental Studies* | 2 | 3 | - | 50 | 50 | 2 |
| | **Total** | **30** | | **145** | **455** | **600** | **24** |
| | **Semester II** | | | | | | |
| I | Language – II | 6 | 3 | 25 | 75 | 100 | 4 |
| II | English – II | 4 | 3 | 25 | 25 | 50 | 2 |
| III | Core 3: Programming in C++ | 6 | 3 | 25 | 75 | 100 | 4 |
| III | Core Lab 2: Programming Lab - C++ | 4 | 3 | 20 | 30 | 50 | 2 |
| III | Core Lab 3: Internet Basics Lab | 4 | 3 | 20 | 30 | 50 | 2 |
| III | Allied 2: Discrete Mathematics | 4 | 3 | 25 | 75 | 100 | 4 |
| IV | Value Education – Human Rights* | 2 | 3 | - | 50 | 50 | 2 |
| IV | Naan Muthalvan - Skill Course Effective English http://kb. Naan mudhalvan. in/ images / c/ c7 /Cambridge Course_Details.pdf | - | - | 25 | 25 | 50 | 2 |
| | **Total** | **30** | | **165** | **385** | **550** | **22** |
| | **Semester III** | | | | | | |
| I | Language-III | 6 | 3 | 25 | 75 | 100 | 4 |
| II | English-III | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Core 4 : JAVA Programming | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Core 5: Database Management Systems | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Core Lab 4: JAVA Programming Lab | 4 | 3 | 20 | 30 | 50 | 2 |
| III | Allied 3: Data Communication and Networks | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Skill based Subject 1: Data Visualization | 3 | 3 | 25 | 25 | 50 | 2 |
| IV | Tamil** / Advanced Tamil* (OR) Non- major elective - I (Yoga for Human Excellence)* / Women's Rights* | 1 | 3 | - | 50 | 50 | 1 |
| IV | Health and Wellness***** | - | | 100 | - | 100 | 1 |
| IV | Naan Muthalvan | - | - | 25 | 25 | 50 | 2 |
| | **Total** | **30** | | **295** | **505** | **800** | **28** |
| | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Semester IV** | | | | | | |
| I | Language-IV | 6 | 3 | 25 | 75 | 100 | 4 |
| II | English-IV | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Core 6: Python Programming | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Core 7: Data Warehousing and Data Mining | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Core Lab 5: Python Programming Lab | 3 | 3 | 20 | 30 | 50 | 2 |
| III | Allied 4: Deep Learning | 4 | 3 | 25 | 75 | 100 | 4 |
| III | Skill based Subject 2 Lab: Capstone Project Work Phase I | 3 | 3 | 20 | 30 | 50 | 2 |
| IV | Tamil**/Advanced Tamil* (OR) Non- major elective -II (General Awareness*) | 2 | 3 | - | 50 | 50 | 2 |
| IV | Naan Muthalvan – Skill Course Office Fundamentals - Lab http://kb.naanmudhalvan.in/Bharathiar_University_(BU) | - | - | 25 | 25 | 50 | 2 |
| | **Total** | **30** | | **190** | **510** | **700** | **28** |
| | **Semester V** | | | | | | |
| III | Core 8: R Programming | 6 | 3 | 25 | 75 | 100 | 4 |
| III | Core 9: Big Data Analytics | 6 | 3 | 25 | 75 | 100 | 4 |
| III | Core Lab 6: R Programming Lab | 6 | 3 | 20 | 30 | 50 | 2 |
| III | Elective – I Business Data Analytics/ Social Network Analysis/t/Artificial Neural Network and Fuzzy Systems | 6 | 3 | 25 | 75 | 100 | 4 |
| III | Skill based Subject 3: Capstone Project Work Phase II | 6 | 3 | 20 | 30 | 50 | 2 |
| IV | Naan Muthalvan | - | - | 25 | 25 | 50 | 2 |
| | **Total** | **30** | | **140** | **310** | **450** | **18** |
| | **Semester VI** | | | | | | |
| III | Core 10: Linux and Shell Programming | 5 | 3 | 25 | 75 | 100 | 4 |
| III | Core 11: Project Work Lab %% | 5 | 3 | 25 | 75 | 100 | 4 |
| III | Core Lab 7: Linux and Shell Programming Lab | 5 | 3 | 20 | 30 | 50 | 2 |
| III | Elective – II: Web Application Security/ Software Agents/Embedded systems | 6 | 3 | 25 | 75 | 100 | 4 |
| III | Elective III Client Server Computing/ Open source Software/ Principles of Secure Coding | 6 | 3 | 25 | 75 | 100 | 4 |
| III | Skill Based Subject 4: Machine Learning | 3 | 3 | 25 | 25 | 50 | 2 |
| V | Extension Activities** | - | - | 50 | - | 50 | 2 |
| IV | Naan Muthalvan - Skill Course Cyber Security -S @http://kb.naanmudhalvan.in/images/7/71/Cybersecurity.pdf (or) Machine Learning # http://kb.naanmudhalvan.in/images/1/19/PBL_Google.pdf (or) Android APP Development $ http://kb.naanmudhalvan.in/images/0/08/Android_App_Dev.pdf | | | 25 | 25 | 50 | 2 |
| | **Total** | **30** | | **220** | **380** | **600** | **24** |
| | **Grand Total** | | | **1155** | **2545** | **3700** | **144** |

* No Continuous Internal Assessment (CIA). Only University Examinations.
** No University Examinations. Only Continuous Internal Assessment (CIA).


First
Semester

| Course Code | | Programming in C | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core: 1 | 5 | 0 | 0 | 4 |
| Pre - requisite | | Basic knowledge in computers | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

To introduce the concepts of Procedure Oriented Programming and the various programming constructs of C programming

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Describe about the about the fundamentals of computers, history and various types of software and hardware devices. | K1 |
| 2 | Interpret the concepts of Variables, Constant, Operators and various types of Expressions | K2 |
| 3 | Apply the concept of Decision making statements and looping constructs for solving basic programs | K3 |
| 4 | Use the concepts of files and pointers inside a C program | K3 |
| 5 | Develop programs incorporating all the C language constructs | K4 |
| 6 | Test the correctness of the programs and identify logical and syntax errors | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Fundamentals of Computers | 12 |
|---|---|---|

Fundamentals of Computers : Introduction – History of Computers-Generations of Computers-Classification of Computers-Basic Anatomy of a Computer System-Input Devices-Processor-Output
Devices-Memory Management – Types of Software- Overview of Operating System-Programming Languages-Translator Programs-Problem Solving Techniques - Overview of C.

| UNIT II | Overview of C | 11 |
|---|---|---|

Overview of C - Introduction - Character set - C tokens - keyword & Identifiers - Constants - Variables
- Data types - Declaration of variables - Assigning values to variables - Defining Symbolic Constants
- Arithmetic, Relational, Logical, Assignment, Conditional, Bitwise, Special, Increment and Decrement operators - Arithmetic Expressions - Evaluation of expression - precedence of arithmetic operators - Type conversion in expression – operator precedence &associativity - Mathematical functions - Reading & Writing a character - Formatted input and output.

| UNIT III | Decision Making and Branching | 12 |
|---|---|---|

Decision Making and Branching: Introduction – if, if….else, nesting of if …else statements- else if ladder – The switch statement, The?: Operator – The goto Statement. Decision Making and Looping:
Introduction- The while statement- the do statement – the for statement-jumps in loops. Arrays – Character Arrays and Strings

| UNIT IV | Functions | 12 |
|---|---|---|

User-Defined Functions: Introduction – Need and Elements of User-Defined Functions- Definition-Return Values and their types - Function Calls – Declarations – Category of Functions- Nesting of
Functions - Recursion – Passing Arrays and Strings to Functions - The Scope, Visibility and Lifetime of Variables- Multi file Programs- Structures and Unions.

| UNIT V | POINTERS | 13 Hours |
|---|---|---|
| Pointers: Introduction-Understanding pointers-Accessing the address of a variable-Declaration and Initialization of pointer Variable – Accessing a variable through its pointer-Chain of pointers- Pointer Expressions – Pointer Increments and Scale factor- Pointers and Arrays- Pointers and Strings – Array of pointers – Pointers as Function Arguments- Functions returning pointers – Pointers to Functions – Pointers and Structures. File Management in C. | | |
| **Total Lecture Hours** | | **60 Hours** |
| **Text Book(S)** | | |
| **1** | E Balagurusamy: Computing Fundamentals & C Programming – Tata McGraw-Hill, Second Reprint 2008. | |
| **Reference Book(s):** | | |
| **1** | Ashok N Kamthane: Programming with ANSI and Turbo C, Pearson, 2002. 2. Henry Mullish& Hubert L.Cooper: The Sprit of C, Jaico, 1996. | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | L | L | L | L | L |
| CO2 | M | L | L | L | L | L | L | L | L | L |
| CO3 | S | M | L | L | L | L | L | L | L | L |
| CO4 | S | M | L | L | L | L | L | L | L | L |
| CO5 | S | M | M | L | L | L | L | L | L | L |
| CO6 | S | S | S | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Programming Lab - C | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core Lab : 1 | 0 | 0 | 4 | 2 |
| Pre - requisite | | Basic knowledge in computers | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

To introduce the concepts of Procedure Oriented Programming and the various programming constructs of C programming.

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Apply the various basic programming constructs like decision making statements. Looping statements, functions, structures, pointers and files | K3 |
| 2 | Design programs using the concept of files in C and be able to simulate operations | K4 |
| 3 | Determine the efficient techniques in programming to solve various scientific Problems | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **EXERCISE 1** | **Implementation of Control structures** | **6** |
| Develop various C Programs using Control Structures | | |
| Develop various C programs using Switch case. | | |
| **EXERCISE 2** | **Implementation of Loopings** | **6** |
| Develop various C program for the implementation of looping | | |
| Develop various C program for the implementation of looping &Conrtol Structures | | |
| **EXERCISE 3** | **Implementation of Functions** | **9** |
| Develop a C program to illustrate recursive function. | | |
| Develop a C program to find the palindrome in a given sentence | | |
| Develop a C program to manipulate strings using string functions. | | |
| Develop a C Program using Functions | | |
| **EXERCISE 4** | **Implementation of Pointers** | **6** |
| Develop a C program to swap two integers using pointers. | | |
| Develop a C program using Array of Pointers. | | |
| **EXERCISE 5** | **Implementation of Structures** | **6** |
| Develop a C program using the structures. | | |
| Develop a C program using Array of Structures. | | |
| **EXERCISE 6** | **Implementation of Files** | **6** |
| Develop a C program to calculate electricity bill using files | | |
| **EXERCISE 7** | **Implementation of Security** | **6** |
| Develop a C program to encrypt and decrypt a string | | |
| Develop a G program to encrypt and decrypt Files | | |
| **Total Lecture Hours** | | **45 Hours** |

| | |
|---|---|
| **Text Book(S)** | |
| **1** | E Balagurusamy: Computing Fundamentals & C Programming – Tata McGraw-Hill, Second Reprint 2008. |
| **Reference Book(s)** | |
| **1** | Ashok N Kamthane: Programming with ANSI and Turbo C, Pearson, 2002. 2. Henry Mullish& Hubert L.Cooper: The Sprit of C, Jaico, 1996. |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Data Structures | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core : 2 | 5 | 0 | 0 | 4 |
| Pre - requisite | | Basic knowledge of Programming Constructs | Syllabus version | | 2025-26 Onward | |

**Course Objectives**

- To introduce the concept of data structures and the types of data structures
- To demonstrate how various data structures can be implemented and used in various applications

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Define the concept of Data structure and list the various classifications of data structures. | K1 |
| 2 | Demonstrate how arrays, stacks, queues, linked lists, trees, heaps, Graphs and Hash Tables are represented in the main memory and various operations are performed on those data structures. | K2 |
| 3 | Illustrate the various file organizations like Sequential, Random and Linked organizations. | K2 |
| 4 | Discover the real time applications of the various data structures | K3 |
| 5 | Design algorithms for various sorting and searching techniques | K4 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **INTRODUCTION** | **12 Hours** |

Introduction: Introduction of Algorithms, Analyzing Algorithms. Arrays: Sparse Matrices - Representation of Arrays. Stacks and Queues. Fundamentals - Evaluation of Expression Infix to Postfix Conversion - Multiple Stacks and Queues

| | | |
|---|---|---|
| **UNIT II** | **LINKED LIST** | **12** |

Linked List: Singly Linked List - Linked Stacks and Queues - Polynomial Addition - More on Linked Lists - Sparse Matrices - Doubly Linked List and Dynamic - Storage Management - Garbage Collection and Compaction.

| | | |
|---|---|---|
| **UNIT III** | **NON LINEAR DATA STRUCTURES** | **12 Hours** |

Trees: Basic Terminology - Binary Trees - Binary Tree Representations - Binary Trees -Traversal - More on Binary Trees - Threaded Binary Trees - Binary Tree Representation of Trees - Counting Binary Trees. Graphs: Terminology and Representations - Traversals, Connected Components and Spanning Trees, Shortest Paths and Transitive Closure

| | | |
|---|---|---|
| **UNIT IV** | **EXTERNAL – SORTING** | **12 Hours** |

External Sorting: Storage Devices -Sorting with Disks: K-Way Merging - Sorting with Tapes Symbol Tables: Static Tree Tables - Dynamic Tree Tables - Hash Tables: Hashing Functions - Overflow Handling.

| | | |
|---|---|---|
| **UNIT V** | **INTERNAL – SORTING** | **12 Hours** |

Internal Sorting: Insertion Sort - Quick Sort - 2 Way Merge Sort - Heap Sort - Shell Sort - Sorting on Several Keys. Files: Files, Queries and Sequential organizations - Index Techniques -FileOrganizations.

**Total Hours 60 Hours**

| | | |
|---|---|---|
| **Text Book(s)** | | |
| | | |
| **1** | Ellis Horowitz, Sartaj Shani, Data Structures, Galgotia Publication. | |
| | | |
| **Reference Book(s)** | | |
| **1** | Ellis Horowitz, Sartaj Shani, Sanguthevar Rajasekaran, Computer Algorithms, Galgotia Publication. | |
| | | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | Introduction to Linear Algebra | L | T | P | C |
|---|---|---|---|---|---|
| Core/elective/Supportive | Allied : 1 | 4 | 0 | 0 | 4 |
| Pre - requisite | Logical reasoning and problem-solving skills | Syllabus version | | 2025_26 Onwards | |

**Course Objectives**

To introduce the computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, and vector spaces

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Explain the concept/theory in linear algebra, to develop dynamic and graphical views to the related issues of the chosen topics as outlined in "course content," and to formally prove theorems | K2 |
| 2 | Recognize the basic applications of the chosen topics and their importance in the modern science | K3 |
| 3 | Develop simple mathematical models, and apply basic linear algebra techniques learned from the chosen topics to solve simple problems | K3 |
| 4 | Report and communicate effectively with others and present mathematical results in a logical and coherent fashion | K4 |
| 5 | Appraise the power and beauty of mathematics, and solve problems independently and collaboratively as part of a team | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

**UNIT I** — **15**

Introduction – Vectors and Matrices – Length and Dot Products – Solving Linear Equations – Linear Equations – The Idea of Elimination – Elimination Using Matrices – Rules for Matrix Operations – Inverse Matrices – Elimination = Factorization: A = LU – Transposes and Permutations

**UNIT II** — **15**

Vector Spaces and Subspaces – Spaces of Vectors – The Null space of A: Solving Ax = 0 – The Rank and the Row Reduced Form – The complete solution to Ax=b – Independence, Basis, and Dimensions – Dimensions of the four Subspaces – Orthogonality – Orthogonality of the Four Subspaces – Projections – Least Squares Approximations – Orthogonal Bases and Gram – Schmidt.

**UNIT III** — **15**

Determinants – The Properties of Determinants – Permutations and Cofactors – Cramer"s Rule, Inverse, and Volumes – Eigen values and Eigenvectors – Introduction to Eigen values – Diagonalizing a Matrix – Applications to Differential Equations – Symmetric Matrices – Positive Definite Matrices – Similar Matrices – The Singular Value Decomposition

**UNIT IV** — **15**

Singular value Decomposition – Linear Transformations – The Idea of a Linear Transformation – The Matrix of a Linear Transformation – Change of Basis – Diagonalization and the Pseudo inverse.

**UNIT V** — **15**

Complex Vectors and Complex Matrices – Complex Numbers – Hermitian and Unitary Matrices – The Fast Fourier Transform – Applications – Numerical Linear Algebra.

**Total Lecture Hours** — **75 Hours**

| | | |
|---|---|---|
| | **Text Book(s)** | |
| **1** | Gilbert Strang(2016). Introduction to Linear Algebra, 5th Edition. Wellesley – Cambridge Press | |
| | **Reference Books** | |
| **1** | S.Lang (1997). Introduction to Linear Algebra. Second Edition. Springer. | |
| **2** | Gilbert Strang (2006). Linear Algebra and Its Apllications. Fourth Edition. Cengage Learning. | |
| **3** | David C. Lay, Steven R. Lay, and Judi J. McDonald (2014). Linear Algebra and Its Applications. 5th Edition. Pearson. | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low


Second
Semester

| Course Code | Programming in C++ | L | T | P | C |
|---|---|---|---|---|---|
| Core/elective/Supportive | Core : 3 | 6 | 0 | 0 | 4 |
| Pre - requisite | • Basic knowledge of Procedure Oriented Programming concepts<br>• Basic knowledge in C Programming | Syllabus version | | 2025-26 Onward | |

**Course Objectives**

To introduce he concepts of Object Oriented Programming Paradigm and the programming constructs of C++

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects | **K1** |
| 2 | Demonstrate the various basic programming constructs like decision making statements. Looping statements and functions | **K2** |
| 3 | Explain the object oriented concepts like overloading, inheritance, polymorphism, virtual functions , constructors and destructors | **K3** |
| 4 | Explain the various file stream classes; file types, usage of templates and exception handling mechanisms. | **K3** |
| 5 | Compare the pros and cons of procedure oriented language with the concepts of object oriented language | **K5** |
| 6 | Develop programs incorporating the programming constructs of object oriented programming concepts | **K5** |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Introduction to C++ | 12 |
|---|---|---|

Introduction to C++ - key concepts of Object-Oriented Programming –Advantages – Object Oriented Languages – I/O in C++ - C++ Declarations. Control Structures : - Decision Making and Statements : If .. else ,jump, goto, break, continue, Switch case statements - Loops in C++ : for, while, do - functions in C++ - inline functions – Function Overloading.

| UNIT II | Classes and Objects | 14 |
|---|---|---|

Classes and Objects: Declaring Objects – Defining Member Functions – Static Member variables and functions – array of objects –friend functions – Overloading member functions – Bit fields and classes – Constructor and destructor with static members.

| UNIT III | Operator Overloading and Inheritance | 16 |
|---|---|---|

Operator Overloading: Overloading unary, binary operators – Overloading Friend functions – type conversion – Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance – Virtual base Classes – Abstract Classes.

| UNIT IV | Pointers and Polymorphism | 18 |
|---|---|---|

Pointers – Declaration – Pointer to Class , Object – this pointer – Pointers to derived classes and Base classes – Arrays – Characteristics – array of classes – Memory models – new and delete operators –

| UNIT V | File and Exception Handling | 15 |
|---|---|---|
| Files – File stream classes – file modes – Sequential Read / Write operations – Binary and ASCII Files – Random Access Operation – Templates – Exception Handling - String – Declaring and Initializing string objects – String Attributes – Miscellaneous functions . | | |
| | **Total Lecture Hours** | **75 Hours** |
| | **Text Book(s)** | |
| **1** | Ashok N Kamthane, Object-Oriented Programming with Ansi And Turbo C++, Pearson Education, 2003. | |
| | **Reference Books** | |
| **1** | E. Balagurusamy, Object-Oriented Programming with C++, TMH, 1998. | |
| **2** | Maria Litvin & Gray Litvin, C++ for you, Vikas publication, 2002. | |
| **3** | John R Hubbard, Programming with C, 2nd Edition, TMH publication, 2002 | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO6** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | Programming Lab – C++ | L | T | P | C |
|---|---|---|---|---|---|
| Core/elective/Supportive | Core Lab : 2 | 0 | 0 | 4 | 2 |
| Pre - requisite | • Basic knowledge of Procedure Oriented Programming concepts<br>• Basic knowledge in C Programming | Syllabus version | | 2025-26 Onward | |

**Course Objectives**

To introduce he concepts of Object Oriented Programming Paradigm and the programming constructs of C++

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Apply the various basic programming constructs like decision making statements. Looping statements, functions, concepts like overloading, inheritance, polymorphism, virtual functions , constructors and destructors | K3 |
| 2 | Illustrate the concept of Virtual Classes, inline functions and friend functions | K4 |
| 3 | Compare the various file stream classes; file types, usage of templates and exception handling mechanisms. | K5 |
| 4 | Compare the pros and cons of procedure oriented language with the concepts of object oriented language | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **PROGRAM - 1** | | **5** |

Write a C++ Program to create a class to implement the data structure STACK. Write a constructor to initialize the TOP of the STACK. Write a member function PUSH () to insert an element and member function POP () to delete an element check for overflow and underflow conditions.

| | | |
|---|---|---|
| **PROGRAM - 2** | | **5** |

Write a C++ Program to create a class ARITHMETIC which consists of a FLOAT and an INTEGER variable. Write member functions ADD (), SUB (), MUL (), DIV () to perform addition, subtraction, multiplication, division respectively. Write a member function to get and display values.

| | | |
|---|---|---|
| **PROGRAM - 3** | | **5** |

Write a C++ Program to read an integer number and find the sum of all the digits until it reduces to a single digit using constructors, destructors and inline member functions.

| | | |
|---|---|---|
| **PROGRAM - 4** | | **5** |

Write a C++ Program to create a class FLOAT that contains one float data member. Overload all the four Arithmetic operators so that they operate on the object FLOAT.

| | | |
|---|---|---|
| **PROGRAM - 5** | | **5** |

Write a C++ Program to create a class STRING. Write a Member Function to initialize, get and display stings. Overload the operators ++ and == to concatenate two Strings and to compare two strings respectively

| | | |
|---|---|---|
| **PROGRAM -6** | | **5** |
| Write a C++ Program to create class, which consists of EMPLOYEE Detail like E_Number, E_Name, Department, Basic, Salary, Grade. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending onthe grade. | | |
| **PROGRAM -7** | | **5** |
| Write a C++ Program to create a class SHAPE which consists of two VIRTUAL FUNCTIONS Calculate_Area() and Calculate_Perimeter() to calculate area and perimeter of various figures. Derive three classes SQUARE, RECTANGLE, TRIANGE from class Shape and Calculate Area andPerimeter of each class separately and display the result. | | |
| **PROGRAM -8** | | **5** |
| Write a C++ Program to create two classes each class consists of two private variables, a integer and a float variable. Write member functions to get and display them. Write a FRIEND Function common toboth classes, which takes the object of above two classes as arguments and the integer and float values of both objects separately and display the result. | | |
| **PROGRAM -9** | | **5** |
| Write a C++ Program using Function Overloading to read two Matrices of different Data Types such as integers and floating point numbers. Find out the sum of the above two matrices separately and display the sum of these arrays individually. | | |
| **PROGRAM -10** | | **5** |
| Write a C++ Program to check whether the given string is a palindrome or not using Pointers. | | |
| **PROGRAM -11** | | **5** |
| Write a C++ Program to create a File and to display the contents of that file with line numbers. | | |
| **PROGRAM - 12** | | **5** |
| Write a C++ Program to merge two files into a single file. | | |
| **Total Lecture Hours** | | **60 Hours** |

| | |
|---|---|
| | **Text Book(s)** |
| **1** | Ashok N Kamthane, Object-Oriented Programming with Ansi And Turbo C++, Pearson Education, 2003. |
| | **Reference Books** |
| **1** | E. Balagurusamy, Object-Oriented Programming with C++, TMH, 1998. |
| **2** | Maria Litvin & Gray Litvin, C++ for you, Vikas publication, 2002. |
| **3** | John R Hubbard, Programming with C, 2nd Edition, TMH publication, 2002 |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Internet Basics - Lab | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core Lab : 3 | 0 | 0 | 4 | 2 |
| Pre - requisite | | Basic knowledge in Computers | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

1. Introduce the fundamentals of Internet and the Web functions.
2. Impart knowledge and essential skills necessary to use the internet and its various components.
3. Find, evaluate, and use online information resources.
4. Use Google Apps for education effectively.

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Apply the predefined procedures to create Gmail account, check and receive messages | **K3** |
| 2 | Apply the predefined procedures to perform various basic operations on internet | **K3** |
| 3 | Utilize various google applications like docs, google classroom, google drive, google forms, google meet and slides | **K3** |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | |
|---|---|
| **PROGRAM – 1** | **2** |
| Create an email account in Gmail. Using the account created compose a mail to invite other college students for your college fest, enclose the invitation as attachment and send the mail to at least 50 recipients. Use CC and BCC options accordingly | |
| **PROGRAM – 2** | **2** |
| Open your inbox in the Gmail account created, check the mail received from your peer from other college inviting you for his college fest, and download the invitation. Reply to the mail with a thank you note for the invite and forward the mail to other friends | |
| **PROGRAM – 3** | **2** |
| Assume that you are studying in final year of your graduation and are eagerly looking for a job. Visit any job portal and upload your resume. | |
| **PROGRAM – 4** | **2** |
| Create a meeting using Google calendar and share meeting id to the attendees. Transfer the ownership to the Manager once the meeting id is generated. | |
| **PROGRAM – 5** | **2** |
| Create a label and upload bulk contacts using import option in Google Contacts | |
| **PROGRAM -6** | **4** |
| Create your own Google classroom and invite all your friends through email id. Post study material in Google classroom using Google drive. Create a separate folder for every subject and upload all unit wise E-Content Materials. | |
| **PROGRAM -7** | |
| Create and share a folder in Google Drive using „share a link" option and set the permission to access that folder by your friends only. | |
| **PROGRAM -8** | |
| Create one-page story in your mother tongue by using voice recognition facility of Google Docs | |

| | |
|---|---|
| **PROGRAM -9** | **2** |
| Create a registration form for your Department Seminar or Conference using Google Forms. | |
| **PROGRAM -10** | **2** |
| Create a question paper with multiple choice types of questions for a subject of your choice, using Google Forms. | |
| **PROGRAM -11** | **4** |
| Create a meet using Google Calendar and record the meet using Google Meet.<br>Create a Google slides for a topic and share the same with your friends. | |
| **PROGRAM -12** | **4** |
| Create template for a seminar certificate using Google Slides. | |
| **PROGRAM -13** | |
| Create a sheet to illustrate simple mathematical calculations using Google Sheets.<br>Create student‟s internal mark statement and share the Google sheets via link. | **4** |
| | |
| **Total Lecture Hours** | **30 Hours** |
| | |

| **Text Book(s)** | |
|---|---|
| 1 | Ian Lamont, Google Drive & Docs in 30 Minutes, 2nd Edition. |
| **Reference Book(s)** | |
| 1 | Sherry Kinkoph Gunter, My Google Apps, 2014. |

**Course Designed by :**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | L | L | L | L | L | L | L | L |
| CO2 | S | M | L | L | L | L | L | L | L | L |
| CO3 | S | S | S | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Discrete Mathematics | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Allied : 2 | 4 | 0 | 0 | 4 |
| Pre - requisite | | Basic knowledge in Mathematics | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- Introduce students to the techniques, algorithms, and reasoning processes involved in the study of discrete mathematical structures.
- Introduce students to set theory, inductive reasoning, elementary and advanced counting techniques, equivalence relations, recurrence relations, graphs, and trees.
- Introduce students to prove mathematical statements by means of inductive reasoning

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand discrete mathematical preliminaries and apply discrete mathematics in formal representation of various computing constructs | **K2** |
| 2 | Demonstrate an understanding of relations ,functions, Combinatorics and lattices | **K2** |
| 3 | Apply the techniques of discrete structures and logical reasoning to solve a variety of problems and write an argument using logical notation | **K3** |
| 4 | Analyze and construct mathematical arguments that relate to the study of discrete Structures | **K4** |
| 5 | Develop and model problems with the concepts and techniques of discrete mathematics. | **K4** |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | MATHEMATICAL LOGIC | 15 |
|---|---|---|

Proposition – Logical Operators – Truth Tables – Laws of Logic – Equivalances – Rules of interface – validity Arguments – Consistency of Specifications – Propositonal Calculus – Quantifiers and universe of discourse.

| UNIT II | PROOF TECHNIQUES & RELATIONS AND FUNCTIONS | 15 |
|---|---|---|

**PROOF TECHNIQUES**: Introduction – Methods of proving theorems – Direct Proofs, Proof by Contraposition, Vacuous and trivial proofs, Proofs by contradiction – Mistakes in Proofs – Mathematical induction – Strong Mathematical induction – Strong mathematical induction and well ordering – Program Correctness.

**RELATIONS AND FUNCTIONS:** Definition and properties of binary relations – Representing Relations – Closures of Relations – Composition of Relations – Equivalence Relations – Partitions and Covering of sets – Partial Orderings – n-array Relations and their applications. Functions – Injective, Surjective, Bijective functions, Composition, identity and inverse.

| UNIT III | COMBINATORICS | 15 |
|---|---|---|

Basics of Counting – The Pigeonhole principle – Permutations and Combinations with and without repetition, Permutations with indistinguishable elements – distributions of objects – Generating permutations and combinations in lexicographic order.

| UNIT IV | RECURRENCE RELATIONS | 15 |
|---|---|---|
| Some Recurrence Relation Models – Solution of linear homogeneous recurrence relations with constant coefficients – solution of linear non-homogeneous recurrence relations by the method of characteristic roots – Divide and conquer recurrence relations. | | |
| **UNIT V** | **LATTICES** | **15** |
| Lattices as partially ordered set – Properties of Lattices – Lattices as algebraic system – Sub lattices – Direct Product and Homomorphism – Some special lattices. | | |
| **Total Lecture Hours** | | **75** Hours |

| **Text Book(s)** | |
|---|---|
| **1** | Kenneth H. Rosen, "Discrete Mathematics and its applications", McGraw Hill, 2011. |
| **2** | Judith L.Gersting, "Mathematical Structures for Computer Science", W.H> Freeman and Company, 2014 |
| **3** | Tremblay J.P. and Manohar R., "Discrete and Combinatorial Mathamatics – An Introduction", Addison Wesley, 2009. |
| **Reference Books** | |
| **1** | Doerr Alan and Levasseur K., "Applied Discrete Structures for Computer Science", Galgotia Publications, 2002 |
| **2** | Benard Kolman, Robert C. Busby and Sharan Ross, " Discrete Mathematical Structures", Pearson Education, 2014 |
| **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low


Third
Semester

| Course Code | | Java Programming | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core : 4 | 4 | 0 | 0 | 4 |
| Pre - requisite | | • Basic knowledge of Programming Constructs.<br>• Knowledge on Object Oriented Programming Concepts. | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of Object Oriented Programming Paradigm and the programming constructs of JAVA

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Recite the history of JAVA and its evolution | **K1** |
| 2 | Explain the various programming language constructs, object oriented concepts like overloading, inheritance, polymorphism, Interfaces , threads, exception handling and Packages | **K2** |
| 3 | Illustrate the concepts of Applets, files and the concept of stream classes. | **K3** |
| 4 | Outline the benefits and applications of objects oriented programming concepts and defend how JAVA differs from other programming languages | **K3** |
| 5 | Judge the pros and cons of other object oriented language with the concepts of JAVA | **K4** |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| **UNIT I** | **18** |
|---|---|
| Fundamentals of Object-Oriented Programming: Object-Oriented Paradigm – Basic Concepts of Object-Oriented Programming – Benefits of Object-Oriented Programming – Application of Object-Oriented Programming. Java Evolution: History – Features – How Java differs from C and C++ – Java and Internet – Java and www –Web Browsers. Overview of Java: simple Java program – Structure – Java Tokens – Statements – Java Virtual Machine. | |
| **UNIT II** | **18** |
| Constants, Variables, Data Types - Operators and Expressions – Decision Making and Branching: if, if...else, nested if, switch? : Operator - Decision Making and Looping: while, do, for – Jumps in Loops - Labeled Loops – Classes, Objects and Methods. | |
| **UNIT III** | **18** |
| Arrays, Strings and Vectors – Interfaces: Multiple Inheritance – Packages: Putting Classes together – Multithreaded Programming. | |
| **UNIT IV** | **18** |
| Managing Errors and Exceptions – Applet Programming – Graphics Programming. | |
| **UNIT V** | **18** |
| Managing Input / Output Files in Java: Concepts of Streams- Stream Classes – Byte Stream classes – Character stream classes – Using streams – I/O Classes – File Class – I/O exceptions – Creation of files – Reading / Writing characters, Byte-Handling Primitive Data Types – Random Access Files. | |

| | | |
|---|---|---|
| **Total Lecture Hours** | | **90** |
| **Text Book(s)** | | |
| **1** | Programming with Java – A Primer - E. Balagurusamy, 3rd Edition, TMH. | |
| **ReferenceBook(s)** | | |
| **1** | The Complete Reference Java 2 - Patrick Naughton & Hebert Schildt, 3rd Edition, TMH | |
| **2** | Programming with Java – John R. Hubbard, 2nd Edition, TMH. | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **L** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO2** | **M** | **L** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO3** | **S** | **M** | **L** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO4** | **S** | **M** | **M** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO5** | **S** | **S** | **S** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

*S-Strong; M-Medium; L-Low

| Course Code | | JAVA Programming Lab | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core Lab :4 | 0 | 0 | 4 | 2 |
| Pre - requisite | | • Basic knowledge of Programming Constructs<br>• Knowledge on Object Oriented Programming Concepts | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of Object Oriented Programming Paradigm and the programming constructs of JAVA

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Apply the various basic programming constructs of JAVA like decision making statements. Looping statements, overloading, inheritance, polymorphism, constructors and destructors | K3 |
| 2 | Illustrate the concepts of threading and multi-threading | K4 |
| 3 | Design programs using various file stream classes; file types, and frames | K4 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | |
|---|---|
| **PROGRAM 1** | **3** |
| Write a Java Applications to extract a portion of a character string and print the extracted string. | |
| **PROGRAM 2** | **3** |
| Write a Java Program to implement the concept of multiple inheritance using Interfaces. | |
| **PROGRAM 3** | **3** |
| Write a Java Program to create an Exception called payout-of-bounds and throw the exception | |
| **PROGRAM 4** | **3** |
| Write a Java Program to implement the concept of multithreading with the use of any three multiplication tables and assign three different priorities to them. | |
| **PROGRAM 5** | **6** |
| Write a Java Program to draw several shapes in the created windows | |
| **PROGRAM 6** | **6** |
| Write a Java Program to create a frame with four text fields name, street, city and pin code with suitable tables. Also add a button called my details. When the button is clicked its corresponding values are to be appeared in the text fields. | |
| **PROGRAM 7** | **6** |
| Write a Java Program to demonstrate the Multiple Selection List-box. | |
| **PROGRAM 8** | **6** |
| Write a Java Program to create a frame with three text fields for name, age and qualification and a text field for multiple line for address | |
| **PROGRAM 9** | **6** |
| Write a Java Program to create Menu Bars and pull down menus. | |
| **PROGRAM 10** | **6** |
| Write a Java Program to create frames which respond to the mouse clicks. For each events with mouse | |

| | |
|---|---|
| **PROGRAM 11** | **6** |
| Write a Java Program to draw circle, square, ellipse and rectangle at the mouse click positions. | |
| **PROGRAM 12** | **6** |
| Write a Java Program which open an existing file and append text to that file. | |
| | |
| **Total Lecture Hours** | **60 Hours** |

| | |
|---|---|
| **Text Book(s)** | |
| **1** | Programming with Java – A Primer - E. Balagurusamy, 3rd Edition, TMH. |
| **Reference Book(s)** | |
| **1** | The Complete Reference Java 2 - Patrick Naughton & Hebert Schildt, 3rd Edition, TMH |

**Course Designed by :**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO2** | **S** | **S** | **S** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **CO3** | **S** | **S** | **S** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

*S-Strong; M-Medium; L-Low

| Course Code | | Database Management Systems | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core :5 | 4 | 0 | 0 | 4 |
| Pre - requisite | | Familiarity with data structures like arrays, lists, trees | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Describe the fundamental elements of relational database management systems | K2 |
| 2 | Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL. | K2 |
| 3 | Explain the concepts of transaction processing, basic database storage structures and access techniques | K2 |
| 3 | Construct ER-models to represent simple database application scenarios | K3 |
| 4 | Apply the normalization techniques to improvise the database design | K3 |
| 5 | Develop DDL and DML commands to perform basic operations on a database | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | INTRODUCTION TO DBMS | **18** |

File Systems Organization – Sequential, Pointer, Indexed, Direct – Purpose of Database System- Database System Terminologies-Database characteristics- Data models – Types of data models – Components of DBMS- Relational Algebra. LOGICAL DATABASE DESIGN: Relational DBMS – Codd‟s Rule – Entity- Relationship model – Extended ER Normalization – Functional Dependencies, Anomaly- 1NF to 5NF- Domain Key Normal Form – Denormalization

| | | |
|---|---|---|
| **UNIT II** | SQL & QUERY OPTIMIZATION | **18** |

I SQL Standards – Data types – Database Objects- DDL-DML-DCL-TCL-Embedded SQL-Static Vs Dynamic SQL – QUERY OPTIMIZATION: Query Processing and Optimization – Heuristics and Cost Estimates in Query Optimization.

| | | |
|---|---|---|
| **UNIT III** | TRANSACTION PROCESSING AND CONCURRENCY CONTROL | **18** |

Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Commit Protocol-Dead lock.

| | | |
|---|---|---|
| **UNIT IV** | TRENDS IN DATABASE TECHNOLOGY | **18** |

Overview of Physical Storage Media – Magnetic Disks – RAID – Tertiary storage – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Introduction to Distributed Databases- Client server technology- Multidimensional and Parallel databases- Spatial and multimedia databases- Mobile and web databases- Data Warehouse-Mining- Data marts.

| | | |
|---|---|---|
| **UNIT V** | ADVANCED TOPICS | **18** |

DATABASE SECURITY: Data Classification-Threats and risks – Database access Control – Types of Privileges –Cryptography- Statistical Databases.- Distributed Databases-Architecture-Transaction

| | |
|---|---|
| Processing-Data Warehousing and Mining-Classification-Association rules-Clustering-Information Retrieval- Relevance ranking-Crawling and Indexing the Web- Object Oriented Databases-XML Databases. | |
| **Total Lecture Hours** | **90** |
| **Text Book(s)** | |
| **1** | RamezElmasri and Shamkant B. Navathe, "Fundamentals of Database Systems",Fifth Edition, Pearson Education, 2008. |
| **ReferenceBook(s)** | |
| **1** | Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011. |
| **2** | C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006. |
| **3** | AtulKahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006. |
| **4** | Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing House Private Limited, New Delhi, 2003. |
| **5** | Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2010. |
| **6** | G.K.Gupta, "Database Management Systems", Tata McGraw Hill, 2011. |
| **7** | Rob Cornell, "Database Systems Design and Implementation", Cengage Learning, 2011. |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Data Communication and Networks | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Allied :3 | 4 | 0 | 0 | 4 |
| Pre - requisite | | Familiarity with binary number systems and logic gates | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of data communication networks
- To explain the various types topologies and transmission media

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Describe the basis and structure of computer networks | K2 |
| 2 | Understand the concept of analog/digital signals and transmissions | K2 |
| 3 | Describe the layers of the OSI model | K2 |
| 4 | Explain the concept of ISDN architecture and interfaces | K2 |
| 5 | Identify the different types of network topologies and protocols. | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Introduction to communications and Networking | 16 |
|---|---|---|

Introduction to communications and Networking : Introduction – Fundamental concepts - Data communications – Protocols- standards - Standards organizations - Signal propagations- Analog and Digital signals- Bandwidth of a signal and a medium - Fourier analysis and the concept of bandwidth of a signal - The data transmission rate and the bandwidth. Information encoding: Introduction – Representing different symbols- Minimizing errors- Multimedia – Multimedia and Data compression

| UNIT II | Analog and digital transmission methods | 17 |
|---|---|---|

Analog and digital transmission methods: Introduction - Analog signal, Analog transmission - Digital signal, Digital transmission - Digital signal , Analog transmission - Baud rate and bits per second - Analog signal, Digital (Storage and) transmission - Nyquist Theorem.

| UNIT III | Modes of data transmission and Multiplexing | 20 |
|---|---|---|

Modes of data transmission and Multiplexing: Introduction – Parallel and Serial communication - Asynchronous, Synchronous and Isochronous communication - Simplex, Half-duplex and Full-duplex communication – Multiplexing - Types of Multiplexing - FDM versus TDM. Transmission Errors: Detection and correction : Introduction – Error classification – Types of Errors – Error detection.

| UNIT IV | Transmission media | 18 |
|---|---|---|

Transmission media: Introduction - Guided media - Un Guided media - Shannon capacity. Network topologies, switching and routing algorithms: Introduction - Mesh topology - Star topology - Tree topology - Ring topology - Bus topology - Hybrid topology - Switching basics- Circuit switching – Packet switching - Message switching - Router and Routing – Factors affecting routing algorithms - Routing algorithm -Approaches to routing.

| UNIT V | Networking protocols and OSI model | 19 |
|---|---|---|

Networking protocols and OSI model: Introduction – Protocols in computer communications - The OSI model - OSI layer functions. Integrated services digital networking (ISDN): Introduction – Background of ISDN - ISDN architecture – ISDN interfaces - Functional grouping – Referencepoints - ISDN protocol architecture - Broadband ISDN (B-ISDN). of ATM – Packet size – Virtual circuits in ATM – ATM cells – Switching – ATM layers – Miscellaneous Topics.

| Total Lecture Hours | 90 |
|---|---|

| | |
|---|---|
| **Text Book(s)** | |
| **1** | Data Communications and Networks, Achyut. S. Godbole, Tata McGraw-Hill Publishing Company, 2007. |
| **Reference Book(s)** | |
| **1** | B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH |
| **2** | A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI |
| **3** | W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Data Visualization | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Skill Based Subject : 1 | 3 | 0 | 0 | 2 |
| Pre - requisite | | Exposure to programming (preferably Python or R) is helpful | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concept of Data Visualization
- To explain the various techniques in Data Visualization

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand the basics of data visualization | K2 |
| 2 | Understand the importance of data visualization and the design and use of many visual Components | K2 |
| 3 | Explain the process of data visualization | K2 |
| 4 | Explain the basics of interactive data visualization techniques visualization-based issues. | K2 |
| 5 | Understand the concept of various types of visulaization | K2 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **Introduction** | **15** |

Introduction- context of data visualization- definition methodology, visualization design objectives. Key factors-purpose, visualization function and tone, visualization design options- data representation, data presenation, seven stages of data visualization, widgets, data visualization tools.

| | | |
|---|---|---|
| **UNIT II** | **visualizing data methods** | **15** |

visualizing data methods- mapping, time series- connections and correlations-scatter plot maps- trees, hierachies and recursion- networks naad graphs, info graphics

| | | |
|---|---|---|
| **UNIT III** | **Visualizing data process** | **15** |

Visualizing data process- acquiring data, where to find data, tools of acquiring data from the internet, locating file for use with processing, loading text data, dealing with files and folders, lisiting files in a folder, asynchronous image downloads, advanced web techniques, using a database, dealing with large number of files, parsing data, level of effort, tools for gathering clues, text is best, textmark up languages, regular expressions(regexps), grammars and BNF notation, compressed data vectors and geometry, binary data formats, advances detect work

| | | |
|---|---|---|
| **UNIT IV** | **Interactive data visualization** | **15** |

Interactive data visualization-drawing with data, scales-axes-updates, transaction and mode-interactivity- layouts-geomapping- exporting frame work-T3 lstabio

| | | |
|---|---|---|
| **UNIT V** | **Security data visualization** | **15** |

Security data visualization-port scan visualization-vulnerability assessment and exploitation- firewall log visualization- instruction detection log visualization- attacking and defending visualization systems- creating security visualization system

| | |
|---|---|
| **Total Lecture Hours** | **75 Hours** |

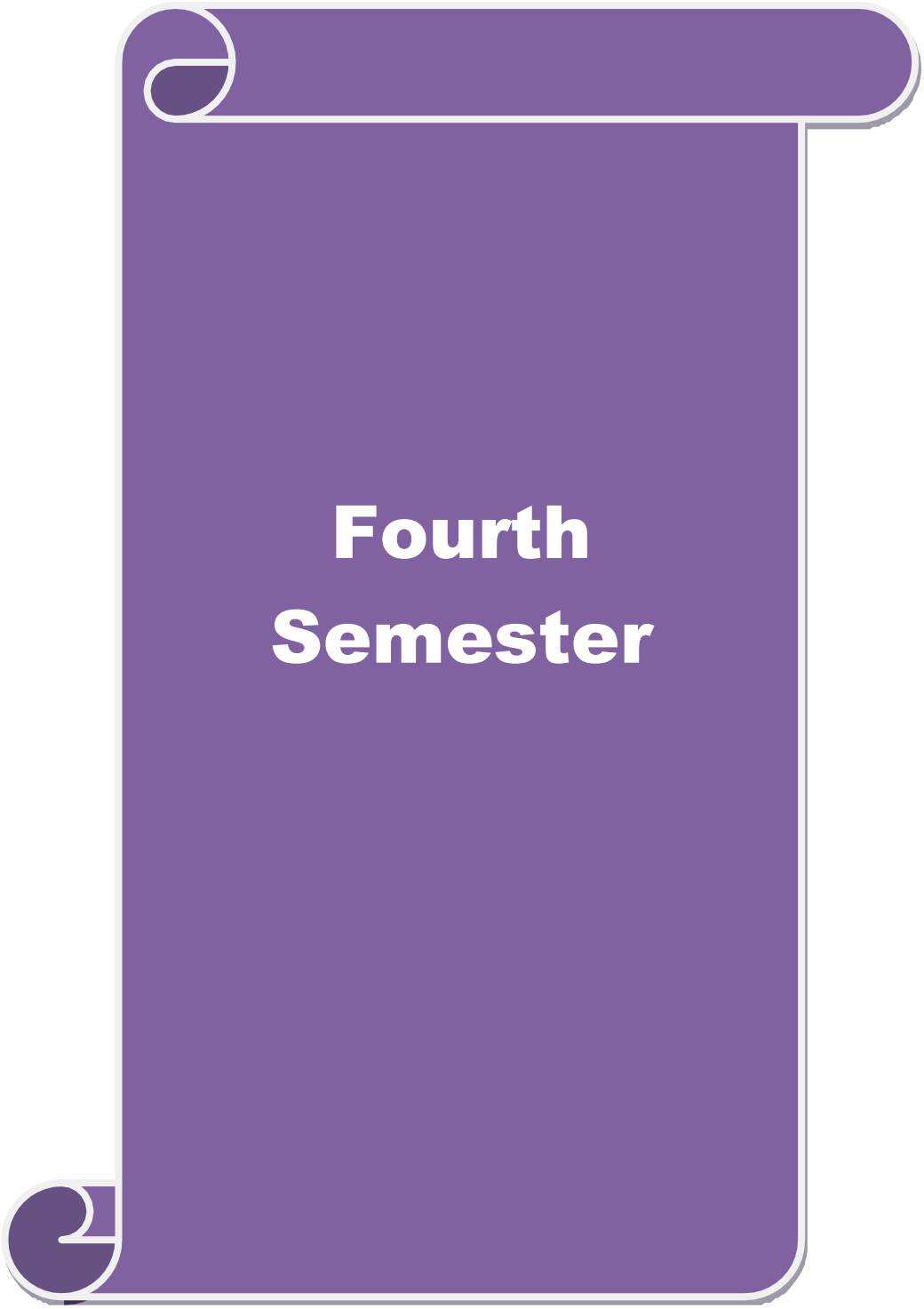
**Text Book(s)**

| | |
|---|---|
| **1** | Scott Murray, “interactive data visualization for the web “,O”Reilly media,inc,2013. |

| Reference Book(s) | |
|---|---|
| 1 | Ben fry,"visualizing data",O"Reilly media,inc,2007 |
| 2 | Greg conti,"security data visualization:","graphical techniques for network analysis",No starch press inc,2007 |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | L | L | L | L | L | L | L | L |
| CO2 | M | L | L | L | L | L | L | L | L | L |
| CO3 | S | M | L | L | L | L | L | L | L | L |
| CO4 | S | M | M | L | L | L | L | L | L | L |
| CO5 | S | S | S | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low


Fourth
Semester

| Course Code | | Python Programming | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core : 6 | 4 | 0 | 0 | 4 |
| Pre - requisite | | • Knowledge in Basics of Object Oriented Programming | Syllabus version | | 2025-26 Onward | |

**Course Objectives**

- To introduce the concepts of the various programming constructs of Python programming

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Apply the various basic programming constructs like operators, expressions, decision making statements and Looping statements | K2 |
| 2 | Summarize the concept of lists, tuples , functions and error handling | K2 |
| 3 | Apply the concept of Decision making statements, looping constructs , functions for solving basic programs | K3 |
| 4 | Analyze the concepts of Lists, tuples and error handling mechanisms | K4 |
| 5 | Evaluate a program incorporating all the python language constructs | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **BASICS** | **16** |

Python - Variables - Executing Python from the Command Line - Editing Python Files -Python Reserved Words - Basic Syntax-Comments - Standard Data Types – Relational Operators -Logical Operators - Bit Wise Operators - Simple Input and Output.

| | | |
|---|---|---|
| **UNIT II** | **CONTROL STATEMENTS, LISTS, TUPLES** | **17** |

**CONTROL STATEMENTS:** Control Flow and Syntax - Indenting - if Statement - statements and expressions- string operations- Boolean Expressions -while Loop - break and continue - for Loop.
**LISTS:** List-list slices - list methods - list loop–mutability–aliasing - cloning lists - list parameters**.**
**TUPLES:** Tuple assignment, tuple as return value -Sets–Dictionaries.

| | | |
|---|---|---|
| **UNIT III** | **FUNCTIONS:** | **20** |

Definition - Passing parameters to a Function – Built-in functions- Variable Number of Arguments - Scope – Type conversion-Type coercion-Passing Functions to a Function – Mapping Functions in a Dictionary – Lambda - Modules - Standard Modules – sys – math – time - dir – help Function.

| | | |
|---|---|---|
| **UNIT IV** | **ERROR HANDLING:** | **18** |

Run Time Errors - Exception Model - Exception Hierarchy - Handling Multiple Exceptions - Data Streams - Access Modes Writing - Data to a File Reading - Data From a File - Additional File Methods - Using Pipes as Data Streams - Handling IO Exceptions - Working with Directories.

| | | |
|---|---|---|
| **UNIT V** | **OBJECT ORIENTED FEATURES**: | **19** |

Classes Principles of Object Orientation - Creating Classes -Instance Methods - File Organization - Special Methods - Class Variables – Inheritance – Polymorphism - Type Identification - Simple Character Matches - Special Characters – Character Classes – Quantifiers - Dot Character - Greedy Matches – Grouping - Matching at Beginning or End - Match Objects – Substituting - Splitting a String - Compiling Regular Expressions.

| | |
|---|---|
| **Total Lecture Hours** | **90 Hours** |

**Text Book(s)**

| | |
|---|---|
| **1** | Mark Summerfield. —Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009. |

| | |
|---|---|
| **2** | Martin C. Brown, ―PYTHON: The Complete Reference‖, McGraw-Hill, 2001 |
| **Reference Book(s)** | |
| **1** | Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist,,,,, 2nd edition, Updated for Python 3, Shroff/O,,Reilly Publishers, 2016 |
| **2** | Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011. |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Data Warehousing and Data Mining | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core :7 | 4 | 0 | 0 | 4 |
| Pre - requisite | | • Knowledge in Basics of foundational knowledge in database management, programming, and mathematics, specifically statistics and linear algebra | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- Introduce the concepts of data ware house and data mining and explain the methodologies used for analysis of data

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand the functionality of the various data mining and data warehousing Component | K2 |
| 2 | Describe different methodologies used in data mining and data ware housing. | K2 |
| 3 | Explain the analyzing techniques and Online Analytical Processing | K2 |
| 4 | Explain about the association rule mining and classification | K2 |
| 5 | Compare different approaches of data ware housing and data mining with various Technologies | K4 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Data Warehousing | 18 |
|---|---|---|

Data warehousing Components –Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.

| UNIT II | Business Analysis | 18 |
|---|---|---|

Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multirelational OLAP – Categories of Tools – OLAP Tools and the Internet.

| UNIT III | Data Mining | 17 |
|---|---|---|

Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing

| UNIT IV | Association Rule Mining and Classification | 19 |
|---|---|---|

Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction.

| UNIT V | Clustering And Trends In Data Mining | 18 |
|---|---|---|
| Cluster Analysis – Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods – Hierarchical Methods – Density-Based Methods –Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data – Constraint – Based Cluster Analysis – Outlier Analysis – Data Mining Applications. | | |
| | **Total Lecture Hours** | **90** |

| | |
|---|---|
| | **Text Book(s)** |
| **1** | Alex Berson and Stephen J.Smith, "Data Warehousing, Data Mining and OLAP", TataMcGraw – Hill Edition, Thirteenth Reprint 2008. |
| **2** | Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012. |
| | **Reference Book(s)** |
| **1** | Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Person Education, 2007. |
| **2** | K.P. Soman, ShyamDiwakar and V. Aja, "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006. |
| **3** | G. K. Gupta, "Introduction to Data Mining with Case Studies", Eastern Economy Edition, Prentice Hall of India, 2006. |
| **4** | Daniel T.Larose, "Data Mining Methods and Models", Wiley-Interscience, 2006. |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Python Programming - Lab | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core Lab : 5 | 0 | 0 | 3 | 2 |
| Pre - requisite | | • Knowledge in basic Programming | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of python programming constructs of C++

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Apply the concept of Decision making statements, looping constructs , functions for solving basic programs | K3 |
| 2 | Analyze the concepts of Lists, tuples and error handling mechanisms | K4 |
| 3 | Evaluate a program incorporating all the python language constructs | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **PROGRAM - 1** | | **5** |
| Write a python program that displays the following information: Your name, Full address Mobile number, College name, Course subjects. | | |
| **PROGRAM - 2** | | **5** |
| Write a python program to find the largest three integers using if-else and conditional operator. | | |
| **PROGRAM - 3** | | **5** |
| Write a python program that asks the user to enter a series of positive numbers (The user should enter a negative number to signal the end of the series) and the program should display the numbers in order and their sum. | | |
| **PROGRAM - 4** | | **5** |
| Write a python program to find the product of two matrices [A]mxp and [B]pxr | | |
| **PROGRAM - 5** | | **5** |
| Write recursive functions for GCD of two integers. | | |
| **PROGRAM - 6** | | **10** |
| Write recursive functions for the factorial of positive integer. | | |
| **PROGRAM - 7** | | **10** |
| Write recursive functions for Fibonacci Sequence up to given number n. | | |
| **PROGRAM - 8** | | **10** |
| Write recursive functions to display prime number from 2 to n. | | |
| **PROGRAM - 9** | | **10** |
| Write a python program that writes a series of random numbers to a file from 1 to n and display. | | |
| **PROGRAM - 10** | | **10** |

| | | |
|---|---|---|
| **PROGRAM -11** | | **10** |
| Write a python program to make a simple calculator. | | |
| **PROGRAM -12** | | **10** |
| Write a python program for Linear Search and Binary Search. | | |
| **Total Lecture Hours** | | **90 Hours** |

| | |
|---|---|
| **Text Book(s)** | |
| **1** | Mark Summerfield. —Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009. |
| **2** | Martin C. Brown, —PYTHON: The Complete Reference‖, McGraw-Hill, 2001 |
| **Reference Book(s)** | |
| **1** | Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist,,,,, 2nd edition, Updated for Python 3, Shroff/O,,Reilly Publishers, 2016 |
| **2** | Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011. |

**Course Designed by :**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | M | M | L | L | L | L | L | L | L |
| **CO2** | S | S | M | L | L | L | L | L | L | L |
| **CO3** | S | S | S | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Deep Learning | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Allied :4 | 4 | 0 | 0 | 4 |
| Pre - requisite | | A solid foundation in mathematics, programming, and data handling | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce students to the basic concepts and techniques of deep Learning.

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand the basic concepts and techniques of Deep Learning. | K2 |
| 2 | To understand and apply the Machine learning principles | K2 |
| 3 | To study the deep learning architectures | K2 |
| 4 | Explore and create deep learning applications with tensor flow | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNITI** | **Basics of Neural Network** | **18** |
| The Neural Network – Limits of Traditional Computing – Machine Learning – Neuron – FF Neural Networks – Types of Neurons – Softmax output layers | | |
| **UNIT II** | **Variables & Operations** | **18** |
| Tensor flow – Variables – Operations – Placeholders – Sessions – Sharing Variables – Graphs – Visualization | | |
| **UNIT III** | **Basics of CNN** | **19** |
| Convolution Neural Network – Feature Selection – Max Pooling – Filters and Feature Maps – Convolution Layer –Applications | | |
| **UNIT IV** | **Basics of RNN** | **17** |
| Recurrent Neural Network – Memory cells – sequence analysis – word2vec- LSTM - Memory augmented Neural Networks – NTM-– Application | | |
| **UNIT V** | **Reinforcement Learning** | **18** |
| Reinforcement Learning – MDP – Q Learning – Applications | | |
| **Total Lecture Hours** | | **90 Hours** |

**Text Book(s)**

| | |
|---|---|
| **1** | Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing NextGeneration Machine Intelligence Algorithms", O'ReillyMedia, 2017. |

**Reference Book(s)**

| | |
|---|---|
| **1** | Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning (Adaptive computation and Machine Learning series", MITPress, 2017. |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** |

**Course Designed by :**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | - | - | - | - | - | - | - | - |
| CO2 | M | L | - | - | - | - | - | - | - | - |
| CO3 | S | M | M | - | - | - | - | - | - | - |
| CO4 | S | S | S | - | - | - | - | - | - | - |

*S-Strong; M-Medium; L-Low

| Course Code | | Capstone Project Work Phase I | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Skill Based Subject 2 | 0 | 0 | 3 | 2 |
| Pre - requisite | | • Students should have a good understanding of software engineering<br>• Student should possess strong analytical skills | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

The main objectives of this course are to:

- To understand and select the task based on their core skills.
- To get the knowledge about analytical skill for solving the selected task.
- To get confidence for implementing the task and solving the real time problems.

**Expected Course Outcomes**

On the successful completion of the course, student will be able to:

| | | |
|---|---|---|
| 1 | Illustrate a real world problem and identify the list of project requirements | **K3** |
| 2 | Compare existing system with the proposed system and extract the innovative ideas | **K4** |
| 3 | Judge the features of the project including forms, databases and reports | **K5** |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

**Aim of the project work**

1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied.
2. Each student should carry out individually one project work and it may be a work using the software packages that they have learned or the implementation of concepts from the papers studied or implementation of any innovative idea focusing on application oriented concepts.
3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

**Viva Voce**

1. Viva-Voce will be conducted at the end of the year by both Internal (Respective Guides) and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 75 marks at the last day of the practical session.
2. Out of 75 marks, 45 marks for project report and 30 Marks for Viva Voce.

**Project Work Format**

**PROJECT WORK**

**TITLE OF THE DISSERTATION**

Bonafide Work Done by
STUDENT NAME

REG. NO.

Dissertation submitted in partial fulfillment of the requirements for the award of
<Name of the Degree>
of Bharathiar University, Coimbatore-46.

College Logo

Signature of the Guide Signature of the HOD
Submitted for the Viva-Voce Examination held on _____

Internal Examiner External Examiner
Month – Year

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| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
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| CO1 | S | S | S | M | L | L | L | L | L | L |
| CO2 | S | S | S | M | L | L | L | L | L | L |
| CO3 | S | S | S | M | M | L | L | L | L | L |

*S-Strong; M-Medium; L-Low


Fifth
Semester

| Course Code | | R Programming | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core :8 | 6 | 0 | 0 | 4 |
| Pre - requisite | | Basic Computer Literacy, Data Concepts | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To expose the student sot the fundamental concepts of R Programming

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand the basics in R programming in terms of constructs, control statements, string functions | K2 |
| 2 | Understand the use of R for Big Data analytics | K2 |
| 3 | Apply R programming for Text processing | K3 |
| 4 | Appreciate and apply the R programming from a statistical perspective | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNITI** | **Introduction to R** | **18** |

Introducing to R – R Data Structures – Help Functions in R – Vectors – Scalars – Declarations – Recycling – Common Vector Operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Victoriesed if-then else – Vector Element names.

| | | |
|---|---|---|
| **UNIT II** | **Matrices and operations** | **18** |

Creating matrices – Matrix Operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns - Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

| | | |
|---|---|---|
| **UNIT III** | **Data Frames** | **18** |

Creating Data Frames – Matrix-like operations in frames – merging Data frames – Applying functions to Data Frames – Factors and Tables – Factors and levels – Common Functions used with factors – Working with tables – Other factors and table related functions – Control statements – Arithmetic and Boolean operators and values – Default Values for arguments – Returning Boolean Values – Functions are objects – Environment and scope issues – Writing Upstairs – Recursion – Replacement functions – Tools for Composing function code – Math and Simulation in R.

| | | |
|---|---|---|
| **UNIT IV** | **Classes and Objects** | **18** |

S3 Classes – S4 Classes – Managing your objects – Input/output – accessing keyboard and monitor – reading and writing files – accessing the internet – String Manipulation – Graphics – Creating Graphs – Customizing Graphs – Saving Graphs to files – Creating Three-Dimensional plots.

| | | |
|---|---|---|
| **UNIT V** | **Modelling in R** | **18** |

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear Models – Time Series and Auto-Correlation – Clustering.

| | |
|---|---|
| **Total Lecture Hours** | **90 Hours** |

| | |
|---|---|
| **Text Book(s)** | |
| **1** | Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011. |
| **2** | Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013. |
| **Reference Book(s)** | |
| **1** | Mark Gardner, "Beginning R – The Statistical Programming Language", Wiley, 2013. |
| **2** | Robert Knell, "Introductory R: A Beginner‟s Guide to Data Visualisation, Statistical Analysis and programming in R", Amazon Digital South Asia Services Inc, 2013. Richard Cotton(2013). Learning R, O‟Reilly Media. |
| **3** | Garret Grolemund (2014). Hands-on Programming with R. O‟Reilly Media, Inc. |
| **4** | Roger D.Peng (2018). R Programming for Data Science. Lean Publishing. |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | R Programming Lab | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core Lab :6 | 0 | 0 | 6 | 2 |
| Pre - requisite | | Basic Computer Literacy, Data Concepts | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To expose the student sot the fundamental concepts of R Programming

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand the basics in R programming in terms of constructs, control statements, string functions | K2 |
| 2 | Understand the use of R for Big Data analytics | K2 |
| 3 | Apply R programming for Text processing | K3 |
| 4 | Appreciate and apply the R programming from a statistical perspective | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

**List of Programs**

1. R Expressions and Data Structures
2. Manipulation of vectors and matrix
3. Operators on Factors in R
4. Data Frames in R
5. Lists and Operators
6. Working with looping statements.
7. Graphs in R
8. 3D plots in R

| | |
|---|---|
| **Total Lecture Hours** | **90Hours** |

**Text Book(s)**

| | |
|---|---|
| **1** | Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011. |
| **2** | Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013. |

**Reference Book(s)**

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| **1** | Mark Gardner, "Beginning R – The Statistical Programming Language", Wiley, 2013. |
| **2** | Robert Knell, "Introductory R: A Beginner‟s Guide to Data Visualisation, Statistical Analysis and programming in R", Amazon Digital South Asia Services Inc, 2013. Richard Cotton(2013). Learning R, O‟Reilly Media. |
| **3** | Garret Grolemund (2014). Hands-on Programming with R. O‟Reilly Media, Inc. |
| **4** | Roger D.Peng (2018). R Programming for Data Science. Lean Publishing. |
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**Course Designed by :**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | L | L | L | L | L | L | L | L |
| CO2 | M | L | L | L | L | L | L | L | L | L |
| CO3 | S | M | L | L | L | L | L | L | L | L |
| CO4 | S | S | M | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Big Data Analytics | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core : 9 | 6 | 0 | 0 | 4 |
| Pre - requisite | | Need a strong foundation in statistics and mathematics, along with proficiency in programming languages like Python and R, and database management tools like SQL. | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concept of Big data analytics

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand the key issues in big data management and its associated applications in intelligent business and scientific computing. | K2 |
| 2 | Understand the concepts of Hadoop Distributed file system and hadoop file system interfaces. | K2 |
| 3 | Illustrate the concepts of PIG and HIVE | K2 |
| 4 | Identify the characteristics of datasets and compare the trivial data and big data for various applications. | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Introduction to Data | 17 |
|---|---|---|

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to InfosphereBigInsights and Big Sheets.

| UNIT II | Introduction to HDFS | 19 |
|---|---|---|

HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

| UNIT III | Jobs & Tasks | 17 |
|---|---|---|

Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

| UNIT IV | Hadoop Eco System Pig | 18 |
|---|---|---|

Hadoop Eco System Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase :HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction

| UNIT V | Data Analytics with R Machine Learning | 19 |
|---|---|---|

Data Analytics with R Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

| Total Lecture Hours | 90 |
|---|---|

| | | |
|---|---|---|
| | **Text Book(s)** | |
| **1** | Tom White " Hadoop: The Definitive Guide" Third Edit on, O"reily Media, 2012. | |
| **2** | SeemaAcharya, SubhasiniChellappan, "Big Data Analytics" Wiley 2015. References. | |
| **3** | Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. | |
| **4** | Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013) | |
| **5** | Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press. | |
| **6** | AnandRajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012. | |
| | **ReferenceBook(s)** | |
| **1** | Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012. | |
| **2** | Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007 | |
| **3** | Pete Warden, "Big Data Glossary", O"Reily, 2011. | |
| **4** | Michael Mineli, Michele Chambers, AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013. | |
| **5** | ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012 | |
| **6** | Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012 | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
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| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Capstone Project Work Phase II | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Skill Based Subject 3 | 0 | 0 | 6 | 2 |
| Pre - requisite | | • Students should have completed Capstone Project Work Phase – I<br>• Strong coding skills in any one programming paper | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

The main objectives of this course are to:

- To understand and select the task based on their core skills.
- To get the knowledge about analytical skill for solving the selected task.
- To get confidence for implementing the task and solving the real time problems.

**Expected Course Outcomes**

On the successful completion of the course, student will be able to:

| | | |
|---|---|---|
| 1 | Select appropriate input, output, form and table design | **K3** |
| 2 | Design code to meet the input requirements and to achieve the required output | **K6** |
| 3 | Compose a project report incorporating the features of the project | **K6** |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

**Aim of the project work**

1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied.
2. Each student should carry out individually one project work and it may be a work using the software packages that they have learned or the implementation of concepts from the papers studied or implementation of any innovative idea focusing on application oriented concepts.
3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

**Viva Voce**

1. Viva-Voce will be conducted at the end of the year by both Internal (Respective Guides) and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 75 marks at the last day of the practical session.
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**Project Work Format**

**PROJECT WORK**
**TITLE OF THE DISSERTATION**

Bonafide Work Done by
STUDENT NAME
REG. NO.

Dissertation submitted in partial fulfillment of the requirements for the award of
<Name of the Degree>
of Bharathiar University, Coimbatore-46.

College Logo

Signature of the Guide Signature of the HOD
Submitted for the Viva-Voce Examination held on _____

Internal Examiner External Examiner

Month – Year

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|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **S** | **S** | **S** | **S** | **S** | **M** | **M** | **L** | **L** | **L** |
| **CO3** | **S** | **S** | **S** | **S** | **S** | **M** | **M** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Business Data Analytics | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : I | 6 | 0 | 0 | 4 |
| Pre - requisite | | A background in mathematics, statistics | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the fundamental concepts of Business data analytics and associated methodologies

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand and critically apply the concepts and methods of business analytics | K2 |
| 2 | Demonstration the various methodologies of descriptive statistics | K2 |
| 3 | Understanding of modeling uncertainty and statistical inference | K2 |
| 4 | Understanding of analytical frameworks | K2 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | OVERVIEW OF BUSINESS ANALYTICS | 18 |
|---|---|---|

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

| UNIT II | ESSENTIALS OF BUSINESS ANALYTICS | 17 |
|---|---|---|

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

| UNIT III | MODELING UNCERTAINTY AND STATISTICAL INFERENCE | 19 |
|---|---|---|

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

| UNIT IV | ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK | 19 |
|---|---|---|

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

| UNIT V | OTHER DATA ANALYTICAL FRAMEWORKS | 17 |
|---|---|---|

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

| Total Lecture Hours | 90 Hours |
|---|---|

**Text Book(s)**


| | |
|---|---|
| 1 | VigneshPrajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013. |
| 2 | Umesh R Hodeghatta, UmeshaNayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017. |

| | Reference Book(s) | |
|---|---|---|
| 1 | AnandRajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012. | |
| 2 | Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, "Essentials of Business Analytics", Cengage Learning, second Edition, 2016 | |
| 3 | U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley, 2017. | |
| 4 | A. Ohri, "R for Business Analytics", Springer, 2012 7. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publication, 2015. | |
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| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | L | L | L | L | L |
| CO2 | M | M | L | L | L | L | L | L | L | L |
| CO3 | S | M | M | L | L | L | L | L | L | L |
| CO4 | S | S | S | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Social Network Analysis | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : I | 6 | 0 | 0 | 4 |
| Pre - requisite | | familiarity with programming languages like R or Python | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To explain the methodologies used in social network analysis

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand a broad range of network concepts and theories. | K2 |
| 2 | Appreciate how network analysis can contribute to increasing knowledge about diverse aspects of society. | K2 |
| 3 | Use a relational approach to answer questions of interest to them (i.e. be able to apply 'network thinking'). | K3 |
| 4 | Analyse social network data using various software packages. | K3 |
| 5 | Present results from social network analysis, both orally and in writing. | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | CLUSTERING AND CLASSIFICATION | 17 |
|---|---|---|

Supervised Learning – Decision tree - Naïve Bayesian Text Classification - Support Vector Machines - Ensemble of Classifiers – Unsupervised Learning – K-means Clustering – Hierarchical Clustering – Partially Supervised Learning – Markov Models – Probability-Based Clustering – Vector Space Model

| UNIT II | SOCIAL MEDIA MINING | 17 |
|---|---|---|

Data Mining Essentials –Data Mining Algorithms - Web Content Mining –Latent semantic Indexing – Automatic Topic Extraction – Opinion Mining and Sentiment Analysis – Document Sentiment Classification

| UNIT III | EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS | 18 |
|---|---|---|

Extracting evolution of Web Community from a Series of Web Archive – Detecting Communities in Social Networks – Definition of Community – Evaluating Communities – Methods for Community Detection & Mining – Applications of Community Mining Algorithms – Tools for Detecting Communities – Social Network Infrastructure and Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities

| UNIT IV | HUMAN BEHAVIOR ANALYSIS AND PRIVACY ISSUES | 19 |
|---|---|---|

Understanding and Predicting Human Behavior for Social Communities – Use Data Management, Inference and Distribution – Enabling New Human Experiences – Reality Mining – Context Awareness – Privacy in Online Social Networks – Trust in Online Environment – Trust Models Based on Subjective Logic – Trust Network Analysis – Trust Transitivity Analysis – Combining Trust and Reputation – Trust Derivation Based on Trust Comparisons – Attack Spectrum and Countermeasures.

| UNIT V | VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS | 19 |
|---|---|---|
| Graph Theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing Online Social Networks – Visualizing Social Networks with Matrix-Based Representations – Node-Link Diagrams – Hybrid Representations – Applications – Covert Networks – Community Welfare – Collaboration Networks – Co-Citation Networks – Recommendation in Social Media: Challenges – Classical Recommendation Algorithms – Recommendation Using Social Context – Evaluating Recommendations | | |
| **Total Lecture Hours** | | **90 Hours** |
| **Text Book(s)** | | |
| **1** | 1. Peter Mika, "Social networks and the Semantic Web", Springer, 2007. | |
| **2** | 2. BorkoFurht, "Handbook of Social Network Technologies and Applications", Springer, 2010. | |
| **Reference Book(s)** | | |
| **1** | Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (DataCentric Systems and Applications)", Springer; Second Edition, 2011. | |
| **2** | Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, "Social Media Mining", Cambridge University Press, 2014. | |
| **3** | GuandongXu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking Techniques and applications", Springer, 2011 | |
| **4** | Dion Goh and Schubert Foo, "Social information retrieval systems: emerging technologies and Applications for searching the Web effectively", Idea Group, 2007. | |
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| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Artificial Neural Network and Fuzzy Systems | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : I | 6 | 0 | 0 | 4 |
| Pre - requisite | | a solid foundation in mathematics, particularly calculus, linear algebra, and probability | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of artificial neural networks and fuzzy systems
- To explain the basic mathematical elements of the theory of fuzzy sets.

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Explain the concepts of neural networks and , fuzzy logic | K2 |
| 2 | Understanding of the basic mathematical elements of the theory of fuzzy sets. | K2 |
| 3 | Understanding the differences and similarities between fuzzy sets and classical sets Theories | K2 |
| 4 | Solve problems that are appropriately solved by neural networks and fuzzy logic | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Basic Concepts | 17 |
|---|---|---|

Basic concepts-single layer perceptron-Multi layer perceptron-Adaline-Madaline- Learning rules-Supervised learning-Back propagation networks-Training algorithm, Advanced algorithms-Adaptive network- Radial basis network modular network-Applications

| UNIT II | Unsupervised Learning | 19 |
|---|---|---|

Introduction- unsupervised learning –Competitive learning networks-Kohonen self uantizatinetworks-Learning vector uantization – Hebbian learning – Hopfield network-Content addressable nature, Binary Hopfield network, Continuous Hopfield network Travelling Salesperson problem –
Adaptive resonance theory –Bidirectional Associative Memory-Principle component Analysis

| UNIT III | Fuzzy Logic | 18 |
|---|---|---|

Introduction – crisp sets an overview – the notion of fuzzy sets – Basic concepts of fuzzy sets – classical logic an overview – Fuzzy logic. Operations on fuzzy sets - fuzzy complement – fuzzy union – fuzzy intersection – combinations of operations – general aggregation operations

| UNIT IV | Fuzzy Logic Contd.. | 17 |
|---|---|---|

Crisp and fuzzy relations – binary relations – binary relations on a single set– equivalence and similarity relations – Compatibility or tolerance relations– orderings – Membership functions – methods of generation – defuzzification methods

| UNIT V | Neuro Fuzzy Systems | 19 |
|---|---|---|

Adaptive Neuro Fuzzy based inference systems – classification and regression trees: decision tress, Cart algorithm – Data clustering algorithms: K means clustering, Fuzzy C means clustering, Mountain clustering, Subtractive clustering – rule base structure identification – Neuro fuzzy control: Feedback Control Systems, Expert Control, Inverse Learning, Specialized Learning, Back propagation through Real –Time Recurrent Learning.

| Total Lecture Hours | 90 Hours |
|---|---|

| | |
|---|---|
| | **Text Book(s)** |
| **1** | "Neuro Fuzzy and Soft computing", Jang J.S.R.,Sun C.T and Mizutani E – Pearson education, 2004 |
| **2** | "Fundamentals of Neural Networks", Laurene Fauseett, Prentice Hall India, New Delhi,1994. |
| | **Reference Book(s)** |
| **1** | "Fuzzy Logic Engineering Applications", Timothy J.Ross, McGrawHill,NewYork, 1997. |
| **2** | "Neural networks, Fuzzy logics, and Genetic algorithms", S.Rajasekaran and G.A.Vijayalakshmi Pai Prentice Hall of India,2003 |
| **3** | "Fuzzy Sets and Fuzzy Logic", George J.Klir and Bo Yuan, Prentice Hall Inc., New Jersey,1995 |
| **4** | "Principles of Soft Computing" S.N.Sivanandam, S.N.Deepa Wiley India Pvt Ltd. |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** |
| **Course Designed by :** | |

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low


Sixth
Semester

| Course Code | | Linux and Shell Programming | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core : 10 | 5 | 0 | 0 | 4 |
| Pre - requisite | | Basic knowledge about Operating Systems | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of Linux operating system
- To explain the various constructs associated with Linux

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Illustrate the various directory and fie commands in LINUX | K2 |
| 2 | Explain the methods of securing files in Linux | K2 |
| 3 | Explain the various kernel components of Linux | K2 |
| 4 | Apply the various commands of Linux to perform several operations | K3 |
| 5 | Solve various network administrative issues by writing Linux shell scripts | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **Introduction to Linux** | **15** |

Introduction to LINUX Operating System: Introduction - The LINUX Operating System - Basic commands in Linux

| | | |
|---|---|---|
| **UNIT II** | **Managing Files & Directories** | **18** |

Managing Files and Directories: Introduction – Directory Commands in LINUX – File Commands in LINUX. Creating files using the vi editor: Text editors – The vi editor. Managing Documents: Locating files in LINUX – Standard files – Redirection – Filters – Pipes.

| | | |
|---|---|---|
| **UNIT III** | **Shell script** | **20** |

Securing files in LINUX: File access permissions – viewing File access permissions – Changing File access permissions. Automating Tasks using Shell Scripts: Introduction – Variables- Local and Global Shell variables – Command Substitution.

| | | |
|---|---|---|
| **UNIT IV** | **Conditional & Looping Statements** | **19** |

Using Conditional Execution in Shell Scripts: Conditional Execution – The case…esac Construct. Managing repetitive tasks using Shell Scripts: Using Iteration in Shell Scripts – The while construct – until construct – for construct – break and continue commands – Simple Programs using Shell Scripts.

| | | |
|---|---|---|
| **UNIT V** | **Kernel & System Recovery** | **18** |

Linux Kernel- Kernel Components- compiling a kernel- Customizing a kernel – system startup- Customizing the boot process-System Recovery

| | |
|---|---|
| **Total Lecture Hours** | **90 Hours** |

**Text Book(s)**

| | |
|---|---|
| **1** | Operating System LINUX, NIIT, PHI, 2006, Eastern Economy Edition. |

**Reference Book(S)**

| | |
|---|---|
| **1** | Richard Petersen, Linux: The Complete Reference, Sixth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2008. |
| | |

| | | |
|---|---|---|
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO5** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Linux and Shell Programming Lab | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core Lab: 7 | 0 | 0 | 5 | 2 |
| Pre - requisite | | • Basic knowledge Linux commands | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

To introduce he concepts of Linux operating system commands execution and various programming construction in Linux shell script.

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | To create the directory, how to change and remove the directory. | K1 |
| 2 | To evaluate the concept of shell scripting programs by using an AWK and SED Commands | K2 |
| 3 | To demonstrate the basic knowledge of Linux commands and file handling utilities by using Linux shell environment. | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **EXERCISE 1** | | **6** |
| Write a Shell script that displays list of all the files in the current directory to which the user has read, write and execute permissions. | | |
| **EXERCISE 2** | | **6** |
| Write an awk script to find the number of characters, words and lines in a file? | | |
| **EXERCISE 3** | | **9** |
| Write a Shell script that accepts a filename, starting and ending line numbers as arguments and displays all the lines between the given line numbers? | | |
| **EXERCISE 4** | | **9** |
| Write a shell script to sort number in ascending order. | | |
| **EXERCISE 5** | | **12** |
| Write a shell script (small calculator) that adds, subtracts, multiplies and divides the two given numbers. | | |
| **EXERCISE 6** | | **9** |
| Write a shell script to determine whether a given number is a prime number or not. | | |
| **EXERCISE 7** | | **12** |
| Write a shell script to print the first n Fibonacci numbers. | | |
| **EXERCISE 8** | | **9** |
| Write a shell script to find the GCD of two given numbers. | | |
| **EXERCISE 9** | | **9** |
| Write a shell script to check whether given string is palindrome or not. | | |
| **EXERCISE 10** | | **9** |
| Write a shell script to find the factorial of given integer. | | |
| **Total Lecture Hours** | | **90** |

| | |
|---|---|
| | |
| **Text Book(s)** | |
| **1** | Operating System LINUX, NIIT, PHI, 2006, Eastern Economy Edition. |
| | |
| **Reference Book(S)** | |
| **1** | Richard Petersen, Linux: The Complete Reference, Sixth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2008. |
| | |
| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **S** | **S** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Project Work Lab | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Core - 11 | 0 | 0 | 5 | 4 |
| Pre - requisite | | Students should have the strong knowledge in any one of the programming languages in this course. | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

The main objectives of this course are to:

- To understand and select the task based on their core skills.
- To get the knowledge about analytical skill for solving the selected task.
- To get confidence for implementing the task and solving the real time problems.
- Express technical and behavioral ideas and thought in oral settings.
- Prepare and conduct oral presentations

**Expected Course Outcomes**

On the successful completion of the course, student will be able to:

| | | |
|---|---|---|
| 1 | Formulate a real world problem and develop its requirements develop a design solution for a set of requirements | K3 |
| 2 | Test and validate the conformance of the developed prototype against the original requirements of the problem | K5 |
| 3 | Work as a responsible member and possibly a leader of a team in developing software Solutions | K3 |
| 4 | Express technical ideas, strategies and methodologies in written form. Self-learn new tools, algorithms and techniques that contribute to the software solution of the project | K1-K4 |
| 5 | Generate alternative solutions, compare them and select the optimum one | K6 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

**Aim of the project work**

1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied.
2. Each student should carry out individually one project work and it may be a work using the software packages that they have learned or the implementation of concepts from the papers studied or implementation of any innovative idea focusing on application oriented concepts.
3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

**Viva Voce**

1. Viva-Voce will be conducted at the end of the year by both Internal (Respective Guides) and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 200 marks at the last day of the practical session.
2. Out of 200 marks, 160 marks for project report and 40 marks for Viva Voce.

**Project Work Format**

**PROJECT WORK**

**TITLE OF THE DISSERTATION**

Bonafide Work Done by

STUDENT NAME

REG. NO.

Dissertation submitted in partial fulfillment of the requirements for the award of

<Name of the Degree>

of Bharathiar University, Coimbatore-46.

College Logo

Signature of the Guide Signature of the HOD

Submitted for the Viva-Voce Examination held on _____

Internal Examiner External Examiner

Month – Year

**CONTENTS**

**Contents**

A. Data Flow Diagram

B. Table Structure

C. Sample Coding

D. Sample Input

E. Sample Output

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | S | M | L | L | L | L | L |
| CO2 | S | S | S | S | M | L | L | L | L | L |
| CO3 | S | S | S | S | M | M | M | L | L | L |
| CO4 | S | S | S | S | M | M | M | L | L | L |
| CO5 | S | S | S | S | M | M | M | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Machine Learning | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Skill based subject :4 | 3 | 0 | 0 | 2 |
| Pre - requisite | | Basic knowledge of Linear Algebra, Probability, and Statistics | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To explain about the basics of machine learning

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc. | K2 |
| 2 | Understanding of the strengths and weaknesses of many popular machine learning approaches. | K2 |
| 3 | Explain about the concepts of computational learning theory and dimensionality Reduction | K2 |
| 4 | Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning. | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNITI | Introduction to Learning | 12 |
|---|---|---|

Algorithmic models of learning, Learning classifiers, functions, relations, grammars, probabilistic models, value functions, behaviors and programs for experience. Bayesian, maximum some posterior, and minimum description length frameworks.

| UNIT II | Learning Models | 12 |
|---|---|---|

Parameter Estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, probabilistic relational models, association rules, nearest neighbor classifiers, locally weighted regression, ensemble classifiers.

| UNIT III | Computational Learning | 12 |
|---|---|---|

Computational Learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting, Dimensionality reduction: Principal component Analysis, feature selection and visualization.

| UNIT IV | Unsupervised Learning | 12 |
|---|---|---|

Unsupervised Learning: Clustering, mixture models, k-means clustering, hierarchical clustering, distributional clustering, Reinforcement learning; Learning from heterogeneous, distributed, data and knowledge.

| UNIT V | Learning Applications | 12 |
|---|---|---|
| Selected applications in data mining, automated knowledge acquisition, pattern recognition, program synthesis, text and language processing, internet-based information systems, human computer interaction, semantic web, and bioinformatics and computational biology. | | |
| | **Total Lecture Hours** | **60 Hours** |
| | **Text Book(s)** | |
| **1** | Bishop, C. (2006). Pattern Recognition and Machine Learning. Berlin: Springer-Verlag. | |
| | **ReferenceBook(s)** | |
| **1** | Russel, S. And Norving, P. (2003). Artificial Intelligence: A Modern Approach. 2nd Edition, New York: Prentice-Hall. | |
| **2** | Baldi, P., Frasconi, P., Smyth, P. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press. | |
| **3** | Baldi, P., Frasconi, P., Smyth, P. (2003). Modeling the Internet and the Web – Probabilistic Methods and Algorithms. New York: Wiley. | |
| **4** | Bishop, C.M. Neural Networks for pattern recognition. New York: Oxford University press (1995). | |
| **5** | Hastie, T., Tibshirani, R., and Friedman, J. (2001). The elements of Statistical Learning – Data mining, Inference, and Prediction, Berlin: Springer- Verlag. | |
| **6** | Cohen, P.R. (1995) Empirical Methods in Artificial Intelligence. Cambridge, MA: MIT Press. | |
| **7** | Cowell, R.G., Dawid, A.P., Lauritzen, S.L., and Spiegelhalter. D.J. (1999). Graphical Models and Expert Syatems. Berlin: Springer. | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Web Application Security | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : II | 6 | 0 | 0 | 4 |
| Pre - requisite | | Basic knowledge of Web Development (HTML, JavaScript, PHP/Python) | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of security in web applications
- To explain about crime prevention and routine duties in a police station

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Illustrate about the concept of HTML, DHTML, CSS and Java Script | K2 |
| 2 | Explain the history, characteristics, technologies, concepts, usage in web2.0 and web 3.0 | K2 |
| 3 | Apply the core concepts of web applications to create web pages | K3 |
| 4 | Apply the concepts of servers side programming | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Introduction to web applications | 14 |
|---|---|---|

Data with URL- HTML - DHTML: Cascading Style Sheets, Common Gateway Interface: Programming CG! Scripts - HTML Forms-:- Custom Database Query Scripts - Server Side Includes - Server _security issues.

| UNIT II | Introduction to Scripting Languages | 14 |
|---|---|---|

XHTML: Introduction, CSS- Scripting languages- Java Script: Control statements, Functions, Arrays, Objects - DOM- Aiax enable rich internet applications.

| UNIT III | Server Side Programming | 15 |
|---|---|---|

Server side Programming - Active server pages - Java server pages - Java Servlets: Servlet container- Exceptions - Sessions and Session Tracking_ - Using Servlet context - Dynamic Content Generation - Servlet Chaining and Communications.

| UNIT IV | HTML 5 & CSS 3 | 15 |
|---|---|---|

HTML review, Feature detection , The HTML5 new Elements, Canvas, Video and audio, Web storage, Geo location, Offline Web pages , Micro data, HTML5 APLS, Migrating from HTML4 to HTML5, CSS3 .

| UNIT V | Web 2.0 | 17 |
|---|---|---|

WEB 2.0- HISTORY, characteristics, technologies, concepts, usage, web2.0 in education, philanthropy, social work. Web 3.0- Theory-and history understanding. basic web artifacts and applications, implementation. MS share point - Share point 2013 overview, share (Put social to work, Share your stuff, Take share point on the go), Discover (find experts, discover answers, find what youare looking for), Manage (cost, risk, time)

| Total Lecture Hours | 75 Hours |
|---|---|

**Text Book(s)**

| | |
|---|---|
| 1 | Deitel, Deitel and Neita, -Internet and World Wide _Web- How to programll, Pearson Education Asia, 4th Edition, 2009. |
| 2 | Elliotte Rusty Herold, -Java Network Programming II, O'Reilly Publications, 3rd Edition, 2004. |

| Reference Book(s) | | |
|---|---|---|
| 1 | Jeffy Dwight, Michael Erwin and Robert Nikes -USING CGIII, PH.I Publications, 1997 | |
| 2 | Jason Hunter, William Crawford -Java Servlet Programming O'Reilly Publications, 2nd Edition, 2001. | |
| 3 | Eric Ladd and Jim O'Donnell, etal, -USING HTML4, XML, and JAVA1.2, Prentice Hall, 2003 | |
| 4 | Jeremy Keith, -Html5 for web designers | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| 1 | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| 2 | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | L | L | L | L | L |
| CO2 | M | L | L | L | L | L | L | L | L | L |
| CO3 | S | M | L | L | L | L | L | L | L | L |
| CO4 | S | M | L | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Software Agents | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : II | 6 | 0 | 0 | 4 |
| Pre - requisite | | Basic knowledge of Artificial Intelligence | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To explain the fundamentals of agents and agent programming paradigms.
- To explain about agents and security

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understanding the fundamentals of agents and agent programming paradigms. | K2 |
| 2 | Discussing the basics of java agents. | K2 |
| 3 | Learning the concepts of multivalent systems. | K2 |
| 4 | Understanding the concepts of intelligent software agents. | K2 |
| 5 | Understanding the agents and security. | K2 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **AGENTS – OVERVIEW** | **15** |

**UNIT I** Agent Definition – Agent Programming Paradigms – Agent Vs Object – Aglet – Mobile Agents –Agent Frameworks – Agent Reasoning

| | | |
|---|---|---|
| **UNIT II** | **JAVA AGENTS** | **15** |

**UNIT II** Processes – Threads – Daemons – Components – Java Beans – ActiveX – Sockets – RPCs – Distributed Computing –Aglets Programming – Jini Architecture – Actors and Agents – Typed and Proactive Messages

| | | |
|---|---|---|
| **UNIT III** | **MULTIAGENT SYSTEMS** | **15** |

Interaction between Agents – Reactive Agents – Cognitive Agents – Interaction Protocols – Agent Coordination – Agent negotiation – Agent Cooperation – Agent Organization – Self-Interested Agents in Electronic Commerce Applications

| | | |
|---|---|---|
| **UNIT IV** | **INTELLIGENT SOFTWARE AGENTS** | **15** |

Interface Agents – Agent Communication Languages – Agent Knowledge Representation – Agent Adaptability – Belief Desire Intension – Mobile Agent Applications

| | | |
|---|---|---|
| **UNIT V** | **AGENTS AND SECURITY** | **15** |

Agent Security Issues – Mobile Agents Security – Protecting Agents against Malicious Hosts – Untrusted Agent – Black Box Security – Authentication for Agents – Security Issues for Aglets

| | |
|---|---|
| **Total Lecture Hours** | **75 Hours** |

**Text Book(s)**

| | |
|---|---|
| **1** | Bigus & Bigus, “Constructing Intelligent agents with Java”, Wiley, 2010. |
| **2** | Bradshaw, “Software Agents”, MIT Press, 2012. |

**Reference Book(s)**

| | |
|---|---|
| **1** | Russel & Norvig, “Artificial Intelligence a modern approach”, Prentice Hall, 1994. |
| **2** | Richard Murch and Tony Johnson, “Intelligent Software Agents”, Prentice Hall, 2000. |
| **3** | Michael Wooldridge, “An Introduction to Multi Agent Systems”, John Wiley, 2002. |

| | Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc) | |
|---|---|---|
| 1 | https://onlinecourses.swayam2.ac.in/aic20_sp06/preview | |
| 2 | https://onlinecourses.swayam2.ac.in/arp19_ap79/preview | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | L | L | L | L | L |
| CO2 | M | L | L | L | L | L | L | L | L | L |
| CO3 | S | M | L | L | L | L | L | L | L | L |
| CO4 | S | M | L | L | L | L | L | L | L | L |
| CO5 | S | M | L | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Embedded Systems | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : II | 6 | 0 | 0 | 4 |
| Pre - requisite | | Fundamentals of Digital Electronics (logic gates, flip-flops, etc.) | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of embedded systems and its architecture

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Understand hardware and software design requirements of embedded systems. | K2 |
| 2 | Explain about the architecture of microprocessor and operating systems in embedded Systems | K2 |
| 3 | Analyze the embedded systems‟ specification and develop software programs. | K4 |
| 4 | Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems. | K5 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **Introduction to Embedded Systems** | **15** |

Examples of Embedded Systems – Typical Hardware – Memory – Microprocessors – Busses –Direct Memory Access – Introduction to 8051 Microcontroller – Architecture-Instruction set –Programming.

| | | |
|---|---|---|
| **UNIT II** | **Microprocessors** | **16** |

Microprocessor Architecture – Interrupt Basics – The Shared-Data problem – Interrupt Latency- Round–Robin Architecture - Round–Robin with Interrupts Architecture - Function-Queue Scheduling Architecture – Real-Time Operating Systems Architecture – Selection of Architecture.

| | | |
|---|---|---|
| **UNIT III** | **Tasks & Semaphores** | **14** |

Tasks and Task States – Tasks and Data – Semaphores and Shared Data – Semaphore Problems – Semaphore variants.

| | | |
|---|---|---|
| **UNIT IV** | **Message Queues & RTOS** | **15** |

Message Queues – Mailboxes – Pipes – Timer Functions – Events – Memory Management – Interrupt Routines in RTOS Environment. RTOS design – Principles – Encapsulation Semaphores and Queues – Hard Real-Time Scheduling Considerations – Saving Memory Space – Saving Power.

| | | |
|---|---|---|
| **UNIT V** | **Host & Target Machines** | **15** |

Host and Target Machines – Linker/Locator for Embedded Software- Getting Embedded Software into the Target System. Testing on your Host Machine – Instruction Set Simulators – Laboratory Tools used for Debugging.

| | |
|---|---|
| **Total Lecture Hours** | **75 Hours** |

**Text Book(s)**

| | |
|---|---|
| **1** | The 8051 Microcontroller Architecture, Programming & Applications, Kenneth J. Ayala, Penram International. |
| **2** | An Embedded Software Primer, David E. Simon, Pearson Education , 2005. |

| Reference Book(s) | | |
|---|---|---|
| 1 | Embedded Systems: Architecture , Programming and Design, Raj Kamal, Tata McGraw-Hill Education, 2008 | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| 1 | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| 2 | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | L | L | L | L | L |
| CO2 | M | L | L | L | L | L | L | L | L | L |
| CO3 | S | M | M | L | L | L | L | L | L | L |
| CO4 | S | S | M | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Client Server Computing | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : III | 6 | 0 | 0 | 4 |
| Pre - requisite | | Basic knowledge of computer networks | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To introduce the concepts of client and server
- To describe the various components of client server computing

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Explain about the various components of client server computing | K2 |
| 2 | Understand the roles of client and server in a network | K2 |
| 3 | Analyze the components of Client Server computing in terms of connectivity, hardware/software and service and support | K3 |
| 4 | Analyze the various types of worms and viruses | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **Introduction** | **14** |

Client / Server Computing–Advantages of Client / Server Computing–Technology Revolution – Connectivity – Ways to improve Performance – How to reduce network Traffic.

| | | |
|---|---|---|
| **UNIT II** | **Components of Client / Server Applications** | **16** |

Components of Client / Server Applications–The Client: Role of a Client–Client Services – Request for Service. Components of Client / Server Applications – The Server: The Role of a Server – Server Functionality in Detail – The Network Operating System – What are the Available Platforms – The Server Operating system.

| | | |
|---|---|---|
| **UNIT III** | **Connectivity & IPC** | **15** |

Components of Client / Server Applications–Connectivity: Open System Interconnect – Communications Interface Technology – Inter-process communication – WAN Technologies.

| | | |
|---|---|---|
| **UNIT IV** | **Components of C/S application H/W & S/W** | **14** |

Components of Client / Server Applications–Software. Components of Client /Server Applications – Hardware.

| | | |
|---|---|---|
| **UNIT V** | **Service & Support** | **16** |

Components of Client / Server applications–Service and Support: System Administration. The Future of Client / Server Computing: Enabling Technologies – Transformational Systems.

| | |
|---|---|
| **Total Lecture Hours** | **75 Hours** |

**Text Book(s)**

| | |
|---|---|
| **1** | Client /Server Computing, Patrick Smith, Steve Guenferich, 2nd edition, PHI. *(Chapters1-8 & 10)* |

**Reference Book(s)**

| | |
|---|---|
| **1** | RobertOrfali, Dan Harkey, Jeri Edwards: The Essential Client/Server Survival Guide, 2nd edition, Galgotia Publications. |
| **2** | Dewire and Dawana Travis, Client/ Server Computing, TMH |
| | |

**Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)**

| | |
|---|---|
| 1 | https://onlinecourses.swayam2.ac.in/aic20_sp06/preview |
| 2 | https://onlinecourses.swayam2.ac.in/arp19_ap79/preview |

**Course Designed by :**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | L | L | L | L | L |
| CO2 | M | L | L | L | L | L | L | L | L | L |
| CO3 | S | M | M | L | L | L | L | L | L | L |
| CO4 | S | S | M | L | L | L | L | L | L | L |

*S-Strong; M-Medium; L-Low

| Course Code | | Open Source Software | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : III | 6 | 0 | 0 | 4 |
| Pre - requisite | | Familiarity with Linux commands and software development environments | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To explain the need and importance of open source software
- To introduce the various open source softwares like Linux, MySql, PHP and Python

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Explain about the need and importance of open source software | K2 |
| 2 | Demonstrate the concepts of open source softwares | K2 |
| 3 | Apply the programming constructs of MYSql, PHP, Python and PERL to create Programs | K3 |
| 4 | Develop small programs using open source software's | K3 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| | | |
|---|---|---|
| **UNIT I** | **Introduction to open sources** | **14** |

Introduction to open sources–Need of open sources–advantages of open sources–application of open sources. Open source operating systems: LINUX: Introduction – general overview –Kernel mode and user mode –process – advanced concepts –scheduling – personalities – cloning – signals – development with Linux.

| | | |
|---|---|---|
| **UNIT II** | **MySQL** | **16** |

MySQL: Introduction–setting up account–starting, terminating and writing yourown SQL programs-record selection Technology – working with strings – Date and Time – sorting Query results – generating summary –working with meta data –using sequences – MySQL and Web.

| | | |
|---|---|---|
| **UNIT III** | **PHP** | **16** |

PHP: Introduction–programming in web environment–variables- constants–data types –operators – statements – functions – arrays – OOP – string manipulations and regular expression – file handling and data storage – PHP and SQL database – PHP andLDAP – PHP connectivity – sending and receiving E-mails – debugging and error handling – security –templates

| | | |
|---|---|---|
| **UNIT IV** | **Python** | **14** |

Syntax and style–python objects–numbers–sequences–strings–lists and tuples – dictionaries – conditional loops –files – input and output – errors and exceptions – functions – modules – classes and OOP – execution environment

| | | |
|---|---|---|
| **UNIT V** | **Pearl** | **15** |

Pearl overview–pearl parsing rules–variables and data–statements and control structures – subroutines -, packages and modules – working with files– data manipulation.

| | |
|---|---|
| **Total Lecture Hours** | **75 Hours** |

**Text Book(s)**

| | | |
|---|---|---|
| **1** | The Linux Kernel Book, Remy Card, Eric and Frank Mevel, Wiley Publications 2003 | |
| **2** | MySQL Bible, Steve Suchring, John Wiley 2002. | |
| | **Reference Book(s)** | |
| **1** | Programming PHP, RasmusLerdorf and Levin Tatroe, O_Reilly, 2002 | |
| **2** | Core Python Programming, Wesley J. Chun, Prentice Hall, 2001 | |
| **3** | Perl: The Complete Reference, 2nd Edn, Martin C. Brown, TMH , 2009 | |
| **4** | MySQL: The Complete Reference, 2nd Edn, VikramVaswani, TMH, 2009 | |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** | |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** | |
| **2** | **https://onlinecourses.swayam2.ac.in/arp19_ap79/preview** | |
| **Course Designed by :** | | |

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

| Course Code | | Principles of Secure Coding | L | T | P | C |
|---|---|---|---|---|---|---|
| Core/elective/Supportive | | Elective : III | 6 | 0 | 0 | 4 |
| Pre - requisite | | Basic understanding of programming (C/C++/Java/Python) | Syllabus version | | 2025-26 Onwards | |

**Course Objectives**

- To understand the secure software development life cycle
- To explain about the secure coding techniques

**Expected Course Outcomes**

| | | |
|---|---|---|
| 1 | Explain about the secure software development life cycle | K2 |
| 2 | Understand the secure coding techniques | K2 |
| 3 | Demonstrate the threat modeling process and benefits | K2 |
| 4 | Explain about the database and web specific issues | K2 |

**K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create**

| UNIT I | Need for secure systems | 14 |
|---|---|---|

Need for secure systems: Proactive Security development process, Secure Software Development Cycle (S-SDLC) , Security issues while writing SRS, Design phase security, Development Phase, TestPhase, Maintenance Phase, Writing Secure Code - Best Practices SD3 (Secure by design, default and deployment), Security principles and Secure Product Development Timeline

| UNIT II | Threat modelling process and its benefits | 14 |
|---|---|---|

Threat modelling process and its benefits: Identifying the Threats by Using Attack Trees and rating threats using DREAD, Risk Mitigation Techniques and Security Best Practices. Security techniques, authentication, authorization. Defense in Depth and Principle of Least Privilege .

| UNIT III | Secure Coding Techniques | 17 |
|---|---|---|

Secure Coding Techniques: Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, Insecure Coding Practices In Java Technology. ARP Spoofing and its countermeasures. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs. Security Issues in C Language: String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues, Code Injection Attacks, Canary based counter measures using Stack Guard and Pro police. Socket Security, Avoiding Server Hijacking, Securing RPC.

| UNIT IV | Database and Web-specific issues | 16 |
|---|---|---|

Database and Web-specific issues: SOL Injection Techniques and Remedies, Race conditions, Time of Check Versus Time of Use and its protection mechanisms. Validating Input and Inter process Communication, Securing Signal Handlers and File Operations. XSS scripting attack and its types - Persistent and Non persistent attack XSS Countermeasures and Bypassing the XSS Filters.

| UNIT V | Testing Secure Applications | 14 |
|---|---|---|

Testing Secure Applications: Security code overview, secure software installation. The Role of the Security Tester, Building the Security Test Plan. Testing HTTP- Based Applications, Testing File-Based Applications, Testing Clients with Rogue **Servers**

| Total Lecture Hours | 75 Hours |
|---|---|

| | |
|---|---|
| **Text Book(s)** | |
| **1** | Writing Secure Code, Michael Howard and David LeBlanc,Microsoft Press, 2nd Edition, 2004 |
| **Reference Book(s)** | |
| **1** | Programming PHP, RasmusLerdorf and Levin Tatroe, O_Reilly, 2002 |
| **2** | Core Python Programming, Wesley J. Chun, Prentice Hall, 2001 |
| **3** | Perl: The Complete Reference, 2nd Edn, Martin C. Brown, TMH , 2009 |
| **4** | MySQL: The Complete Reference, 2nd Edn, VikramVaswani, TMH, 2009 |
| | **Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)** |
| **1** | **https://onlinecourses.swayam2.ac.in/aic20_sp06/preview** |
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| **Course Designed by :** | |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO2** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO3** | **S** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |
| **CO4** | **S** | **M** | **M** | **L** | **L** | **L** | **L** | **L** | **L** | **L** |

*S-Strong; M-Medium; L-Low

# Annexure

# B.Sc. Computer Science with Data Analytics

**Syllabus**
(With effect from 2021 -22)

**Program Code:**

**DEPARTMENT OF COMPUTER SCIENCE**
**Bharathiar University**
**(A State University Accredited with "a" by NAAAC and13th Rank among Indian Universities by MHRD-NIRF) Coimbatore 641046, INDIA**

# MISSION

- ✓ To develop IT professionals with ethical and human values.
- ✓ To organize, connect, create and communicate mathematical ideas effectively, throughindustry 4.0.
- ✓ To provide a learning environment to enhance innovations, problem solving abilities,leadership potentials, team-spirit and moral tasks.
- ✓ To nurture the research values in the developing areas of Computer Science andinterdisciplinary fields.
- ✓ Promote inter-disciplinary research among the faculty and the students to create state ofart research facilities.
- ✓ To promote quality and ethics among the students.
- ✓ Motivate the students to acquire entrepreneurial skills to become global leaders.