**ANNAMALAI UNIVERSITY**

**(Affiliated Colleges)**

**412 - M. Sc. COMPUTER SCIENCE**

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

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| **Part** | **Course Code** | **Study Components & Course Title** | **Credit** | **Hours/ Week** | **Maximum Marks** |
| **CIA** | **ESE** | **Total** |
| **SEMESTER – I** |
| Part A | 23PCSCC11 | Core – I: Analysis & Design of Algorithms | 5 | 7 | 25 | 75 | 100 |
| 23PCSCC12 | Core – II: Python Programming | 5 | 7 | 25 | 75 | 100 |
| 23PCSCP13 | Core – III: Algorithm and Python Lab | 4 | 6 | 25 | 75 | 100 |
| 23PCSCE14-1/ 23PCSCE14-2/23PCSCE14-3 | Elective – I: (Generic / Discipline Specific) (One from Group A)Advance Software Engineering/Multimedia and its Applications/Object Oriented Analysis and Design | 3 | 5 | 25 | 75 | 100 |
| 23PCSCE15-1/ 23PCSCE15-2 | Elective – II: (Generic / Discipline Specific) (One from Group B)Embedded Systems/Internet of Things  | 3 | 5 | 25 | 75 | 100 |
|  | **Total** | **20** | **30** |  |  | **500** |
| **SEMESTER – II** |
| Part A | 23PCSCC21 | Core – IV: Data Mining and Warehousing | 5 | 6 | 25 | 75 | 100 |
| 23PCSCC22 | Core – V: Data Mining and Advance Java Programming Lab | 5 | 6 | 25 | 75 | 100 |
| 23PCSCC23 | Core – VI: Advanced Java Programming | 4 | 6 | 25 | 75 | 100 |
| 23PCSCE24-1/23PCSCE24-2/23PCSCE24-3 | Elective – III: (Generic / Discipline Specific)(One from Group C)Artificial Intelligence & Machine Learning/Critical Thinking, Design Thinking and Problem Solving Advanced Operating System | 3 | 4 | 25 | 75 | 100 |
| 23PCSCE25-1/23PCSCE25-2 | Elective – IV: (Computer / IT related) (One from Group D)Mobile Computing/Blockchain Technology | 3 | 4 | 25 | 75 | 100 |
| 23PCSCS26 | Skill Enhancement Course [SEC] – IObject Oriented Programming through Java, HTML Basics | 2 | 4 | 25 | 75 | 100 |
|  |  | **22** | **30** |  |  | **600** |

**List of** Discipline Centric Electives / Generic Electives

 **(Choose 1 out of 2 in each Group)**

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| **Electives** | **Group** | **Course Code** | **Course Title**  |
| Discipline Centric | A | 23PCSCE14-1 | Advance Software Engineering |
| 23PCSCE14-2 | Multimedia and its Applications |
| 23PCSCE14-3 | Object Oriented Analysis and Design |
| Generic | B | 23PCSCE15-1 | Embedded Systems |
| 23PCSCE15-2 | Internet of Things  |
| Discipline Centric | C | 23PCSCE24-1 | Artificial Intelligence & Machine Learning |
| 23PCSCE24-2 | Critical Thinking, Design Thinking and Problem Solving  |
| 23PCSCE24-3 | Advanced Operating System |
| Generic | D | 23PCSCE25-1 | Mobile Computing |
| 23PCSCE25-2 | Blockchain Technology |

**I – SEMESTER**

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| **SEMESTER: I****PART: A****CORE COURSE – I** | **23PCSCC11: ANALYSIS & DESIGN OF ALGORITHMS** | **CREDIT:5****HOURS:7** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Enable the students to learn the Elementary Data Structures and algorithms.
2. Presents an introduction to the algorithms, their analysis and design
3. Discuss various methods like Basic Traversal And Search Techniques, divide and conquer method, Dynamic programming, backtracking
4. Understood the various design and analysis of the algorithms.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Get knowledge about algorithms and determines their time complexity. Demonstrate specific search and sort algorithms using divide and conquer technique. | K1,K2 |
| 2 | Gain good understanding of Greedy method and its algorithm. | K2,K3 |
| 3 | Able to describe about graphs using dynamic programming technique. | K3,K4 |
| 4 | Demonstrate the concept of backtracking & branch and bound technique. | K5,K6 |
| 5 | Explore the traversal and searching technique and apply it for trees and graphs. | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **15hours** |
| Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity- Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heapsort- Graph. |
| **Unit:2** | **TRAVERSAL AND SEARCH TECHNIQUES** | **15hours** |
| Basic Traversal And Search Techniques: Techniques for Binary Trees-Techniques for Graphs -Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort. |
| **Unit:3** | **GREEDY METHOD** | **15hours** |
| The Greedy Method:- General Method–Knapsack Problem–Minimum Cost Spanning Tree– Single Source Shortest Path. |
| **Unit:4** | **DYNAMIC PROGRAMMING** | **15hours** |
| Dynamic Programming-General Method–Multistage Graphs–All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling. |
| **Unit:5** | **BACK TRACKING** | **13hours** |
| Backtracking:-General Method–8-Queens Problem–Sum Of Subsets–Graph Coloring– Hamiltonian Cycles – Branch And Bound: - The Method – Traveling Salesperson. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars– webinars |
|  | **Total Lecture hours** | **75hours** |
| **Text Books** |
| 1 | Ellis Horowitz, “Computer Algorithms”, Galgotia Publications. |
| 2 | Alfred V.Aho ,John E.Hopcroft,Jeffrey D.Ullman, "Data Structures and Algorithms". |
| **Reference Books** |
| 1 | Goodrich,“DataStructures&AlgorithmsinJava”,Wiley3rd edition. |
| 2 | Skiena,”TheAlgorithmDesignManual”,SecondEdition,Springer,2008 |
| 3 | Anany Levith,”Introduction to the Design and Analysis of algorithm”, Pearson Education Asia, 2003. |
| 4 | Robert Sedgewick, Phillipe Flajolet, ”An Introduction to the Analysis of Algorithms”, Addison-Wesley Publishing Company,1996. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://nptel.ac.in/courses/106/106/106106131/> |
| 2 | <https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm> |
| 3 | <https://www.javatpoint.com/daa-tutorial> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | M | S | L | M | L | S | M |
| **CO2** | S | S | S | S | S | M | S | M | S | M |
| **CO3** | S | S | S | S | S | M | S | M | S | M |
| **CO4** | S | S | S | S | S | M | S | M | S | M |
| **CO5** | S | S | S | S | S | M | S | M | S | M |

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

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| **SEMESTER: I****PART: A****CORE COURSE – II** | **23PCSCC12: PYTHON PROGRAMMING** | **CREDIT:5****HOURS:7** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Presents an introduction to Python, creation of web applications, network applications and working in the clouds
2. Use functions for structuring Python programs
3. Understand different Data Structures of Python
4. Represent compound data using Python lists, tuples and dictionaries
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course ,student will be able to: |
| 1 | Understand the basic concepts of Python Programming | K1,K2 |
| 2 | Understand File operations, Classes and Objects | K2,K3 |
| 3 | Acquire Object Oriented Skills in Python | K3,K4 |
| 4 | Develop web applications using Python | K5 |
| 5 | Develop Client Server Networking applications | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **15hours** |
| **Python:** Introduction–Numbers–Strings–Variables–Lists–Tuples–Dictionaries–Sets– Comparison. |
| **Unit:2** | **CODE STRUCTURES** | **15hours** |
| **Code Structures:** if, elseif, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions. |
| **Unit:3** | **MODULES, PACKAGES AND CLASSES** | **15hours** |
| **Modules, Packages, and Programs:** Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. **Objects and Classes:** Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent with super–In self Defense –Get and Set Attribute Values with Properties –Name Mangling for Privacy – Method Types – Duck Typing – Special Methods –Composition. |
| **Unit:4** | **DATA TYPES AND WEB** | **13hours** |
| **Data Types:** Text Strings–Binary Data. **Storing and Retrieving Data:** File Input/Output– Structured Text Files – Structured Binary Files - Relational Databases – No SQL Data Stores. **Web:** Web Clients –Web Servers–Web Services and Automation |
| **Unit:5** | **SYSTEMS AND NETWORKS** | **15hours** |
| **Systems:** Files–Directories–Programs and Processes–Calendars and Clocks.**Concurrency:** Queues– Processes–Threads–Green Threads and gevent–twisted–Redis.**Networks:** Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – ZeroMQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and MapReduce – Working in the Clouds. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **75hours** |
| **Text Books** |
| 1 | Bill Lubanovic, “Introducing Python”, O’Reilly, First Edition-Second Release, 2014. |
| 2 | Mark Lutz, “Learning Python”, O’ Reilly, Fifth Edition, 2013. |
| **Reference Books** |
| 1 | David M. Beazley,“Python Essential Edition,2009. Reference”, Developer’s Library Fourth |
| 2 | Sheetal Taneja, Naveen Kumar, Approach”, Pearson Publications. “PythonProgramming-A Modular. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.programiz.com/python-programming/> |
| 2 | <https://www.tutorialspoint.com/python/index.htm> |
| 3 | <https://onlinecourses.swayam2.ac.in/aic20_sp33/preview> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | M |
| **CO2** | S | S | S | S | S | S | S | M | S | M |
| **CO3** | S | S | S | S | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | S | M |
| **CO5** | S | S | S | S | S | S | S | M | S | M |

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

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| **SEMESTER: I****PART: A****PRACTICAL - I** | **23PCSCP13: ALGORITHM AND PYTHON LAB** | **CREDIT: 4****HOURS: 6** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. This course covers the basic data structures like Stack, Queue, Tree, List and Elementary data items, lists, dictionaries, sets and tuples in Python.
2. This course enables the students to learn the applications of the data structures using various techniques
3. It also enable the students to understand C++language with respect to OOAD concepts
4. Application of OOPS concepts in Python.
5. To develop web applications using Python
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand the concepts of object oriented with respect to C++ and able to write programs in Python using OOPS concepts. | K1,K2 |
| 2 | Able to understand and implement OOPS concepts and to understand the concepts of File operations and Modules in Python. | K3,K4 |
| 3 | Implementation of data structures like Stack, Queue, Tree, List using C++ and Implementation of lists, dictionaries, sets and tuples as programs. | K4,K5 |
| 4 | Application of the data structures for Sorting, Searching using different techniques and to develop web applications using Python. | K5,K6 |
| **K1**-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create |
| **LIST OF PROGRAMS** | **75 hours** |
|  **Algorithm Lab:**1. Write a program to solve the tower of Hanoi using recursion.
2. Write a program to traverse through binary search tree using traversals.
3. Write a program to perform various operations on stack using linked list.
4. Write a program to perform various operation in circular queue.
5. Write a program to sort an array of an elements using quick sort.
6. Write a program to solve number of elements in ascending order using heap sort.
7. Write a program to solve the knapsack problem using greedy method
8. Write a program to search for an element in a tree using divide& conquer strategy.
9. Write a program to place the 8 queens on an 8X8 matrix so that no two queens Attack.

**Python Lab:**1. Programs using elementary data items, lists, dictionaries and tuples
2. Programs using conditional branches,
3. Programs using loops.
4. Programs using functions
5. Programs using exception handling
6. Programs using inheritance
7. Programs using polymorphism
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive webpages using forms.
 |
| **Expert lectures, online seminars –webinars** |
| **Total Lecture hours** | **75hours** |
| **Text Books** |
| 1 | Goodrich, “Data Structures & Algorithms in Java”, Wiley 3rd edition. |
| 2 | Skiena, ”The Algorithm Design Manual”, Second Edition, Springer, 2008. |
| 3 | Bill Lubanovic, “Introducing Python”, O’Reilly, First Edition-Second Release, 2014. |
| 4 | Mark Lutz,“ Learning Python”, O’Reilly, Fifth Edition, 2013. |
| **Reference Books** |
| 1 | Anany Levith,”Introduction to the Design and Analysis of algorithm”, Pearson Education Asia, 2003. |
| 2 | Robert Sedge wick, Phillipe Flajolet, ”An Introduction to the Analysis of Algorithms”, Addison-Wesley Publishing Company,1996. |
| 3 | David M. Beazley, “ Python Essential Reference”, Developer’s Library, Fourth Edition, 2009. |
| 4 | Sheetal Taneja, Naveen Kumar, ”Python Programming-A Modular Approach” ,Pearson Publications. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc19_cs48/preview> |
| 2 | <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/> |
| 3 | <https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm> |
| 4 | <https://www.programiz.com/python-programming/> |
| 5 | <https://www.tutorialspoint.com/python/index.htm> |
| 6 | <https://onlinecourses.swayam2.ac.in/aic20_sp33/preview> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

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

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| **SEMESTER: I****PART: A****ELECTIVE : I** | **23PCSCE14-1: ADVANCE SOFTWARE ENGINEERING** | **CREDIT: 3****HOURS: 5** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Introduce Software Engineering, Design, Testing and Maintenance.
2. Enable the students to learn the concepts of Software Engineering.
3. Learn about Software Project Management, Software Design &Testing.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand about Software Engineering process | K1,K2 |
| 2 | Understand about Software project management skills, design and quality management | K2,K3 |
| 3 | Analyze on Software Requirements and Specification | K3,K4 |
| 4 | Analyze on Software Testing, Maintenance and Software Re-Engineering | K4,K5 |
| 5 | Design and conduct various types and levels of software quality for a software project | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **15hours** |
| Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes. |
| **Unit:2** | **SOFTWARE REQUIREMENTS** | **15hours** |
| Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Result management system. Software Quality Management –Software Quality, Software Quality Management System, ISO 9000, SEI CMM. |
| **Unit:3** | **PROJECT MANAGEMENT** | **15hours** |
| Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead‟s software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan. |
| **Unit:4** | **SOFTWARE DESIGN** | **15hours** |
| Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions. |

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| **Unit:5** | **SOFTWARE TESTING** | **13hours** |
| Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging–Testingtools-Metrics-ReliabilityEstimation.SoftwareMaintenance -Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **75hours** |
| **Text Books** |
| 1 | An Integrated Approach to Software Engineering–Pankaj Jalote, Narosa Publishing House, Delhi, 3rd Edition. |
| 2 | Fundamentals of Software Engineering –Rajib Mall, PHI Publication,3rd Edition. |
| **Reference Books** |
| 1 | Software Engineering–K.K.Aggarwal and Yogesh Singh, New Age International Publishers, 3rd edition. |
| 2 | A Practitioners Approach-Software Engineering,-R.S.Pressman, McGraw Hill. |
| 3 | Fundamentals of Software Engineering - Carlo Ghezzi, M. Jarayeri, D. Manodrioli, PHI Publication. |
| **Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.javatpoint.com/software-engineering-tutorial> |
| 2 | <https://onlinecourses.swayam2.ac.in/cec20_cs07/preview> |
| 3 | <https://onlinecourses.nptel.ac.in/noc19_cs69/preview> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | M | M |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

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

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| **SEMESTER: I****PART: A****ELECTIVE : I** | **23PCSCE14-2: MULTIMEDIA AND ITS APPLICATIONS** | **CREDIT: 3****HOURS: 5** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. To introduce the students about the concepts of Multimedia, Images & Animation.
2. To introduce Multimedia authoring tools
3. To understand the role of Multimedia in Internet
4. To know about High Definition Television and Desktop Computing– Knowledge based Multimedia systems
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand the basic concepts of Multimedia | K1,K2 |
| 2 | Demonstrate Multimedia authoring tools | K2,K3 |
| 3 | Analyze the concepts of Sound, Images, Video & Animation | K4 |
| 4 | Apply and Analyze the role of Multimedia in Internet and realtime applications | K4,K5 |
| 5 | Analyze multimedia applications using HDTV | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| What is Multimedia?–Introduction to making Multimedia–Macintosh and Windows Production platforms – Basic Software tools. |
| **Unit:2** | **MULTIMEDIA TOOLS** | **12hours** |
| Making Instant Multimedia–Multimedia authoring tools–Multimedia building blocks–Text– Sound. |
| **Unit:3** | **ANIMATION** | **10hours** |
| Images–Animation–Video. |
| **Unit:4** | **INTERNET** | **12hours** |
| Multimedia and the Internet–The Internet and how it works–Tools for WorldWideWeb– Designing for the World Wide Web. |
| **Unit:5** | **MULTIMEDIA SYSTEMS** | **12hours** |
| High Definition Television and Desktop Computing –Knowledge based Multimedia systems. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars - webinars |
|  | **Total Lecture hours** | **60hours** |
| **Text Books** |
| 1 | Tay Vaughan, “Multimedia making it work”, Fifth Edition, Tata McGraw Hill. |
| 2 | John F.Koegel Bufford, “Multimedia Systems”, Pearson Education. |
| **Reference Books** |
| 1 | Judith Jeffloate, “Multimedia in Practice (Technology and Applications)”, PHI,2003. |

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| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.tutorialspoint.com/multimedia/index.htm> |
| 2 | <https://www.tutorialspoint.com/basics_of_computer_science/basics_of_computer_science_multimedia.htm> |
| 3 | <https://nptel.ac.in/courses/117/105/117105083/> |

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| **Mapping with Programming Outcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | M | S | M | M | M | S |
| **CO2** | S | S | S | S | M | S | M | S | S | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **SEMESTER: I****PART: A****ELECTIVE - I** | **23PCSCE14-3: OBJECT ORIENTED ANALYSIS AND DESIGN** | **CREDIT:3****HOURS:5** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Present the object model, classes and objects, object orientation, machine view and model management view.
2. Enables the students to learn the basic functions, principles and concepts of object oriented analysis and design.
3. Enable the students to understand C++ language with respect to OOAD
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand the concept of Object-Oriented development and modeling techniques | K1,K2 |
| 2 | Gain knowledge about the various steps performed during object design | K2,K3 |
| 3 | Abstract object-based views for generic software systems | K3 |
| 4 | Link OOAD with C++ language | K4,K5 |
| 5 | Apply the basic concept of OOPs and familiarize to write C++ program | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **OBJECT MODEL** | **15hours** |
| The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. Classes and Objects: The Nature of an Object – Relationship among Objects**.** |
| **Unit:2** | **CLASSES AND OBJECTS** | **15hours** |
| Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. Classification: The importance of Proper Classification –identifying classes and objects –Key Abstractions and Mechanism. |
| **Unit:3** | **C++ INTRODUCTION** | **15hours** |
| IntroductiontoC++-InputandoutputstatementsinC++-Declarations-controlstructures– Functions in C++. |
| **Unit:4** | **INHERITANCE AND OVERLOADING** | **13hours** |
| Classes and Objects–Constructors and Destructors–operators overloading –Type Conversion- Inheritance – Pointers and Arrays. |
| **Unit:5** | **POLYMORPHISM AND FILES** | **15hours** |
| MemoryManagementOperators-Polymorphism–Virtualfunctions–Files–Exception Handling – String Handling -Templates. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **75hours** |

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| **Text Books** |
| 1 | “Object Oriented Analysis and Design with Applications”, Grady Booch, Second Edition, Pearson Education. |
| 2 | “Object- Oriented Programming with ANSI& Turbo C++”,Ashok N.Kamthane, First Indian Print -2003, Pearson Education. |
| **Reference Books** |
| 1 | Balagurusamy “Object Oriented Programming with C++”, TMH, Second Edition,2003. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc19_cs48/preview> |
| 2 | <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs19/> |
| 3 | <https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis.htm> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | M | S | M | S | M | S | S |
| **CO2** | S | S | S | M | S | M | S | M | S | S |
| **CO3** | S | S | S | M | S | M | S | M | S | S |
| **CO4** | S | S | S | M | S | M | S | M | S | S |
| **CO5** | S | S | S | M | S | M | S | M | S | S |

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

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| **SEMESTER: I****PART: A****ELECTIVE : II** | **23PCSCE15-1: EMBEDDED SYSTEMS** | **CREDIT: 3****HOURS: 5** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Present the introduction to 8051 Microcontroller Instruction Set, concepts on RTOS & Software tools.
2. Gain the knowledge about the embedded software development.
3. Learn about Micro controller and software tools in the embedded systems.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand the concept of 8051 microcontroller | K1,K2 |
| 2 | Understand the Instruction Set and Programming | K2,K3 |
| 3 | Analyze the concepts of RTOS | K3,K4 |
| 4 | Analyze and design various real time embedded systems using RTOS | K5 |
| 5 | Debug them all functioning system using various debugging techniques | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**– Create |
| **Unit:1** | **8051 MICRO CONTROLLER** | **12Hours** |
| 8051Microcontroller:Introduction-8051Architecture-Input/OutputPins,PortsandCircuits- External Memory - Counters / Timers - Serial Data Input / Output –Interrupts |
| **Unit:2** | **PROGRAMMING BASICS** | **12Hours** |
| Instruction Set and Programming Moving Data-Addressing Modes-Logical operations- Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts. |
| **Unit:3** | **CONCEPTS ON RTOS** | **12Hours** |
| CONCEPTS ON RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data- Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions-Events - Memory Management-Interrupt Routines in an RTOS Environment. |
| **Unit:4** | **DESIGN USING RTOS** | **10Hours** |
| Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power- introductions to RTL &QNX. |
| **Unit:5** | **SOFTWARE TOOLS** | **12Hours** |
| SOFTWARETOOLS:EmbeddedsoftwareDevelopmentTools:HostsandTargetMachines- |
| Linker/Locators for Embedded software-getting Embedded software into the Target systems. Debugging Techniques: Testing on your Host machine -Instruction set simulators- The assert macro- using laboratory tools. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **60Hours** |
| **Text Books** |
| 1 | David E.Simon, “An Embedded Software primer” Pearson Education Asia, 2003. |
| 2 | Kenneth J Ayala, “The 8051Microcontroller and Architecture programming and application”, Second Edition, Penram International. |
| **Reference Books** |
| 1 | Raj Kamal, “ Embedded Systems –Architecture, programming and design”, Tata McGraw– Hill, 2003. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Website setc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc20_cs14/preview> |
| 2 | <https://www.javatpoint.com/embedded-system-tutorial> |
| 3 | <https://www.tutorialspoint.com/embedded_systems/index.htm> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | L | L | S | M | S | S | M | M | S |
| **CO2** | M | M | S | S | M | S | M | S | S | S |
| **CO3** | M | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **SEMESTER: I****PART: A****ELECTIVE : II** | **23PCSCE15-2: INTERNET OF THINGS** | **CREDIT: 3****HOURS: 5** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. About Internet of Things where various communicating entities are controlled and managed for decision making in the application domain.
2. Enable students to learn the Architecture of IoT and IoT Technologies
3. Developing IoT applications and Security in IoT, Basic Electronics for IoT, ArduinoIDE, Sensors and Actuators Programming NODEMCU using Arduino IDE.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand about IoT, its Architecture and its Applications | K1,K2 |
| 2 | Understand basic electronics used in IoT & its role | K2,K3 |
| 3 | Develop applications with C using Arduino IDE | K4 |
| 4 | Analyze about sensors and actuators | K5,K6 |
| 5 | Design IoT in rea ltime applications using today’s internet &wireless technologies | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT– Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT |
| **Unit:2** | **BASIC ELECTRONICS FOR IoT** | **12hours** |
| Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – Binary Calculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation. |
| **Unit:3** | **PROGRAMMING USING ARDUINO** | **12hours** |
| Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions. |
| **Unit:4** | **SENSORS AND ACTUATORS** | **10hours** |
| Sensors and Actuators: Analog and Digital Sensors–Interfacing temperature sensor, ultrasound Sensor and infrared(IR) sensor with Arduino– Interfacing LED and Buzzer with Arduino. |
| **Unit:5** | **SENSOR DATA IN INTERNET** | **12hours** |
| Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (ThingSpeak). |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **hours** |
| **Text Books** |
| 1 | Arshdeep Bahga,Vijay Madisetti,“InternetofThings:AHands-OnApproach”,2014. ISBN: 978-0996025515 |
| 2 | Boris Adryan, Dominik Obermaier, Paul Fremantle, “The Technical Foundations of IoT”, Artech Houser Publishers, 2017. |
| **Reference Books** |
| 1 | Michael Margolis, “Arduino Cookbook”, O‟Reilly,2011 |
| 2 | Marco Schwartz, “Internet of Things withESP8266”,Packt Publishing, 2016. |
| 3 | DhivyaBala, “ESP8266: Step by Step Tutorial for ESP8266 IoT, Arduino NODEMCU Dev. Kit”, 2018. |
| **Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc20_cs66/preview> |
| 2 | <https://www.javatpoint.com/iot-internet-of-things> |
| 3 | <https://www.tutorialspoint.com/internet_of_things/index.htm> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | M | M | M | S | M | S | M | M | S | M |
| **CO2** | M | S | M | S | M | S | M | S | S | S |
| **CO3** | S | S | S | S | M | S | M | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **SEMESTER: II****PART: A****CORE COURSE – IV** | **23PCSCC21: DATA MINING AND WAREHOUSING** | **CREDIT:5****HOURS:6** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.
2. Develop skills of using recent data mining software for solving practical problems.
3. Develop and apply critical thinking, problem-solving, and decision-making skills.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand the basic data mining techniques and algorithms | K1,K2 |
| 2 | Understand the Association rules, Clustering techniques and Data warehousing contents | K2,K3 |
| 3 | Compare and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining | K4,K5 |
| 4 | Design data warehouse with dimensional modeling and apply OLAP operations | K5,K6 |
| 5 | Identify appropriate data mining algorithms to solve real world problems | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **BASICS AND TECHNIQUES** | **12hours** |
| Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms. |
| **Unit:2** | **ALGORITHMS** | **12hours** |
| Classification: Introduction –Statistical –based algorithms -distance–based algorithms-decision tree-basedalgorithms-neuralnetwork–basedalgorithms–rule-basedalgorithms–combiningtechniques. |
| **Unit:3** | **CLUSTERING AND ASSOCIATION** | **12hours** |
| Clustering: Introduction–Similarity and Distance Measures–Outliers–Hierarchical Algorithms -Partitional Algorithms. Association rules: Introduction - large item sets - basic algorithms – parallel &distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules. |
| **Unit:4** | **DATA WAREHOUSING AND MODELING** | **11hours** |
| Data warehousing: introduction- characteristics of a data warehouse–data marts–other aspects of datamart. Online analytical processing: introduction –OLTP & OLAP systemsData modeling –star schema for multidimensional view –data modeling – multifact star schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet. |

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| **Unit:5** | **APPLICATIONS OF DATA WAREHOUSE** | **11** | **hours** |
| Developing a data WAREHOUSE: why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse.Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **60hours** |
| **Text Books** |
| 1 | Margaret H. Dunham,“Data Mining: Introductory and Advanced Topics”, Pearson education,2003. |
| 2 | C.S.R. Prabhu, “Data Warehousing Concepts, Techniques, Products and Applications”, PHI, Second Edition. |
| **Reference Books** |
| 1 | ArunK.Pujari,“Data Mining Techniques”, Universities Press(India)Pvt. Ltd.,2003. |
| 2 | Alex Berson, Stephen J.Smith,“ Data Warehousing, Data Mining and OLAP”,TMCH, 2001. |
| 3 | Jiawei Han& Micheline Kamber, Academic press. | “Data Mining Concepts | &Techniques”, | 2001, |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.javatpoint.com/data-warehouse> |
| 2 | <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/> |
| 3 | <https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html> |

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| **Mapping with Programming Outcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | S | S | S | M | M | M | M |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

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

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| **SEMESTER: II****PART: A****PRACTICAL -II** | **23PCSCP22: DATA MINING AND ADVANCE JAVA PROGRAMMING LAB** | **CREDIT: 6****HOURS: 5** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, regression.
2. To apply statistical interpretations for the solutions and use visualizations techniques for interpretations.
3. To enable the students to implement the simple programs using JSP, JAR and provide knowledge on using Servlets, Applets.
4. To introduce JDBC and navigation of records and to understand RMI& its implementation.
5. To introduce Socket programming in Java.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Able to write programs using R for Association rules, Clustering techniques and simple Java programmes. | K1,K2 |
| 2 | To implement data mining techniques like classification, prediction and must be capable of implementing JDBC and RMI concepts. | K2,K3 |
| 3 | Able to use different visualizations techniques using R and able to write Applets with Event handling mechanism. | K4,K5 |
| 4 | To apply different data mining algorithms to solve real world applications and To create interactive web based applications using servlets and JSP. | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **LIST OF PROGRAMS IN DATA MINING** | **75hours** |
| 1. Implement Apriori algorithm to extract association rule of data mining.
2. Implement k-means clustering technique.
3. Implement any one Hierarchal Clustering.
4. Implement Classification algorithm.
5. Implement Decision Tree.
6. Linear Regression.
7. Data Visualization.
 |
| **LIST OF PROGRAMS IN ADVANCE JAVA** | **75hours** |
| 1. Display a welcome message using Servlet.
2. Design a Purchase Order form using Html form and Servlet.
3. Develop a program for calculating the percentage of marks of a student using JSP.
4. Design a Purchase Order form using Html form and JSP.
5. Prepare a Employee payslip using JSP.
6. Write a program using JDBC for creating a table, Inserting, Deleting records and list out the records.
7. Write a program using Java servlet to handle form data.
8. Write a simple Servlet program to create a table of all the headers it receives along with their associated values.
9. Write a program in JSP by using session object.
10. Write a program to build a simple Client Server application using RMI.
11. Create an applet for a calculator application.
12. Program to send a text message to another system and receive the text message from the system (use socket programming).
 |
| **Total Lecture hours** | **75hours** |
| **Text Books** |
| 1 | Margaret H. Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson education,2003. |
| 2 | C.S.R. Prabhu, “Data Warehousing Concepts, Techniques, Products and Applications”, PHI, Second Edition. |
| 3 | Jamie Jaworski,“Java Unleashed” ,SAMS Techmedia Publications,1999. |
| 4 | Campione, Walrath and Huml,“TheJavaTutorial”,AddisonWesley,1999. |
| **Reference Books** |
| 1 | Arun K.Pujari,“ Data Mining Techniques”, Universities Press(India)Pvt. Ltd.,2003. |
| 2 | Alex Berson, Stephen J.Smith, “Data Warehousing, Data Mining and OLAP”,TMCH, 2001. |
| 3 | Jim Keogh,”The Complete Reference J2EE”,Tata McGraw Hill Publishing Company Ltd,2010. |
| 4 | David Sawyer McFarland, “Java Script And JQuery-The Missing Manual”,Oreilly Publications, 3rd Edition,2011. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.javatpoint.com/data-warehouse> |
| 2 | <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/> |
| 3 | <https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html> |
| 4 | <https://www.javatpoint.com/servlet-tutorial> |
| 5 | <https://www.tutorialspoint.com/java/index.htm> |
| 6 | <https://onlinecourses.nptel.ac.in/noc19_cs84/preview> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | M | S | S |
| **CO2** | S | S | S | S | S | S | S | M | S | M |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |

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

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| **SEMESTER: II****PART: A****CORE COURSE – VI** | **23PCSCC23: ADVANCED JAVA PROGRAMMING** | **CREDIT:4****HOURS:6** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Enable the students to learn the basic functions, principles and concepts of advanced java programming.
2. Provide knowledge on concepts needed for distributed Application Architecture.
3. Learn JDBC, Servlet packages, JQuery, Java Server Pages and JAR file format
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand the advanced concepts of Java Programming | K1,K2 |
| 2 | Understand JDBC and RMI concepts | K2,K3 |
| 3 | Apply and analyze Java in Database | K3,K4 |
| 4 | Handle different event in java using the delegation event model, event listener and class | K5 |
| 5 | Design interactive applications using Java Servlet, JSP and JDBC | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **BASICS OF JAVA** | **12hours** |
| Java Basics Review: Components and event handling–Threading concepts–Networking features – Media techniques |
| **Unit:2** | **REMOTE METHOD INVOCATION** | **12hours** |
| Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons- Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces |
| **Unit:3** | **DATABASE** | **10hours** |
| JavainDatabases-JDBCprinciples–databaseaccess-Interacting-databasesearch–Creating multimedia databases – Database support in web applications |
| **Unit:4** | **SERVLETS** | **12hours** |
| Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Reading data from a client-Reading http request header-sending data to a client and writing the http response header-working with cookies Java Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page-Expressions- Scriptlets-Directives-Declarations-A complete example |
| **Unit:5** | **ADVANCED TECHNIQUES** | **12hours** |
| JAR file format creation–Internationalization–Swing Programming–Advanced java techniques |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **60hours** |
| **Text Books** |
| 1 | Jamie Jaworski, “Java Unleashed”, SAMS Tech media Publications,1999. |
| 2 | Campione, Walrath and Huml,“The Java Tutorial”,AddisonWesley,1999. |
| **Reference Books** |
| 1 | JimKeogh,”The Complete Reference J2EE”,Tata McGraw Hill Publishing Company Ltd, 2010. |
| 2 | David Sawyer McFarland, “Java Script And JQuery-The Missing Manual”, Oreilly Publications, 3rd Edition, 2011. |
| 3 | Deitel and Deitel, “Java How to Program”, Third Edition, PHI/Pearson Education Asia. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.javatpoint.com/servlet-tutorial> |
| 2 | <https://www.tutorialspoint.com/java/index.htm> |
| 3 | <https://onlinecourses.nptel.ac.in/noc19_cs84/preview> |

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| **Mapping with Programming Outcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | M | M | M | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

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

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| **SEMESTER: II****PART: A****ELECTIVE : III** | **23PCSCE24-1: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING** | **CREDIT:3****HOURS:4** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Enable the students to learn the basic functions of AI, Heuristic Search Techniques.
2. Provide knowledge on concepts of Representations and Mappings and Predicate Logic.
3. Introduce Machine Learning with respect Data Mining, Big Data and Cloud.
4. Study about Applications & Impact of ML.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Demonstrate AI problems and techniques | K1,K2 |
| 2 | Understand machine learning concepts | K2,K3 |
| 3 | Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning | K3,K4 |
| 4 | Analyze the impact of machine learning on applications | K4,K5 |
| 5 | Analyze and design a real world problem for implementation and understand the dynamic behavior of a system | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search. |
| **Unit:2** | **SEARCH TECHNIQUES** | **12hours** |
| Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem. |
| **Unit:3** | **PREDICATE LOGIC** | **12hours** |
| Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming-Forward Vs Backward reasoning -Matching-Control knowledge. |
| **Unit:4** | **MACHINE LEARNING** | **12hours** |
| Understanding Machine Learning: What Is Machine Learning?-Defining Big Data-Big Data in ContextwithMachineLearning-TheImportanceoftheHybridCloud-LeveragingthePowerof Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning. |

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| **Unit:5** | **APPLICATIONS OF MACHINE LEARNING** | **10hours** |
| Looking Inside Machine Learning: The Impact of Machine Learning on Applications-Data Preparation-The Machine Learning Cycle. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **60hours** |
| **Text Books** |
| 1 | Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Publishers company Pvt Ltd, Second Edition, 1991. |
| 2 | George F Luger," Artificial Intelligence",4th Edition, Pearson Education Publ,2002. |
| **Reference Books** |
| 1 | Machine Learning For Dummies ®,IBM Limited Edition by Judith Hurwitz, Daniel Kirsch. |
| **Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.ibm.com/downloads/cas/GB8ZMQZ3> |
| 2 | <https://www.javatpoint.com/artificial-intelligence-tutorial> |
| 3 | <https://nptel.ac.in/courses/106/105/106105077/> |

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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | M | S |
| **CO2** | S | S | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | S | S | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | S | S | S | S | S | S | S | M | S | S |

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

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| **SEMESTER: II****PART: A****ELECTIVE : III** | **23PCSCE24-2: CRITICAL THINKING, DESIGN THINKING AND PROBLEM SOLVING** | **CREDIT:3****HOURS:4** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Learn critical thinking and its related concepts
2. Learn design thinking and its related concepts
3. Develop Thinking patterns, Problem solving & Reasoning
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course ,student will be able to: |
| 1 | Understand the concepts of Critical thinking and its related technology | K1,K2 |
| 2 | Focus on the explicit development of critical thinking and problem solving skills | K2,K3 |
| 3 | Apply design thinking in problems | K3,K4 |
| 4 | Make a decision and take actions based on analysis | K4,K5 |
| 5 | Analyze the concepts of Thinking patterns, Problem solving & Reasoning in real time applications | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **CRITICAL THINKING** | **12hours** |
| Critical Thinking: Definition, Conclusions and Decisions, Beliefs and Claims, Evidence –finding, evaluation, Inferences, Facts – opinion, probable truth, probably false, Venn diagram. Applied critical thinking: Inference, Explanation, Evidence, Credibility, Two Case Studies, critical thinking and science, critical evaluation, self assessment. |
| **Unit:2** | **DESIGN THINKING** | **12hours** |
| Design Thinking: Introduction, Need of Design Thinking, problem to question - design thinking process, Traditional Problem Solving versus Design Thinking, phases of Design Thinking, problem exploration, Stake holder assessment, design thinking for manufacturers, smart Idea to implementation. |
| **Unit:3** | **CASE STUDY** | **12hours** |
| Thinking to confidence, fear management, duty Vs passion, Team management, Tools for Thinking, prototype design, Relevance of Design and Design Thinking in engineering, human centered design, case study: apply design thinking in problem. |
| **Unit:4** | **PROBLEM SOLVING** | **10hours** |
| Problem solving: problem definition, problem solving methods, selecting and using information, dataprocessing,solutionmethods,solvingproblemsbysearching,recognizingpatterns,spatial |
| reasoning, necessity and sufficiency, choosing and using models, making choices and decisions. |

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| **Unit:5** | **REASONING** | **12hours** |
| Reasoning: Deductive and hypothetical reasoning, computational problem solving; generating, implementing, and evaluating solutions, interpersonal problem solving. Advanced problem solving: Combining skills – using imagination, developing models, Carrying out investigations, Data analysis and inference. Graphical methods of solution, Probability, tree diagrams and decision trees |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **60hours** |
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| **Text Books** |
| 1 | John Butterworth and Geoff Thwaites, Thinking skills: Critical Thinking and Problem Solving, Cambridge University Press, 2013. |
| 2 | H.S.Fogler and S .E.Le Blanc, Strategies for Creative Problem Solving, 2nd edition, Pearson, Upper Saddle River, NJ, 2008. |
| **Reference Books** |
| 1 | A. Whimbey and J. Lochhead, Problem Solving & Comprehension, 6th edition, Lawrence Erlbaum, Mahwah, NJ, 1999. |
| 2 | M. Levine, Effective Problem Solving, 2nd edition, Prentice Hall, Upper Saddle River, NJ, 1994. |
| 3 | Michael Baker, The Basic of Critical Thinking, The Critical Thinking Copress, 2015. |
| 4 | David Kelley and Tom Kelley, Creative Confidence,2013. |
| **Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.tutorialspoint.com/critical_thinking/index.htm> |
| 2 | <https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm> |
| 3 | <https://nptel.ac.in/courses/109/104/109104109/> |
| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | S | M | S | S | S |
| **CO2** | S | S | M | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **SEMESTER: II****PART: A****ELECTIVE - III** | **23PCSCE24-3: ADVANCED OPERATING SYSTEMS** | **CREDIT:3****HOURS:4** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Enable the students to learn the different types of operating systems and their functioning.
2. Gain knowledge on Distributed Operating Systems
3. Gain insight into the components and management aspects of real time and mobile operating systems.
4. Learn case studies in Linux Operating Systems
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Understand the design issues associated with operating systems | K1,K2 |
| 2 | Master various process management concepts including scheduling, deadlocks and distributed file systems | K3,K4 |
| 3 | Prepare Real Time Task Scheduling | K4,K5 |
| 4 | Analyze Operating Systems for Handheld Systems | K5 |
| 5 | Analyze Operating Systems like LINUX and iOS | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **BASICS OF OPERATING SYSTEMS** | **12hours** |
| Basics of Operating Systems: What is an Operating System? – Main frame Systems –Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems –Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery. |
| **Unit:2** | **DISTRIBUTED OPERATING SYSTEMS** | **12hours** |
| Distributed Operating Systems: Issues – Communication Primitives – Lamport‟s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda. |
| **Unit:3** | **REAL TIME OPERATING SYSTEM** | **10hours** |
| Realtime Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling |
| **Unit:4** | **HANDHELD SYSTEM** | **12hours** |
| Operating Systems for Handheld Systems: Requirements–Technology Overview– Handheld Operating Systems–Palm OS-Symbian Operating System-Android–Architecture of android– Securing handheld systems |
| **Unit:5** | **CASE STUDIES** | **12hours** |
| Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars–webinars |
|  | **Total Lecture hours** | **60hours** |
| **Text Books** |
| 1 | Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, “Operating System Concepts”, Seventh Edition, John Wiley & Sons, 2004. |
| 2 | Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems –Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001. |
| **Reference Books** |
| 1 | Rajib Mall,“Real-Time Systems:TheoryandPractice”,PearsonEducationIndia,2006. |
| 2 | Pramod Chandra P.Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010. |
| 3 | Daniel.P.Bovet&MarcoCesati,“UnderstandingtheLinuxkernel”,3rdedition,O‟Reilly,2005 |
| 4 | NeilSmyth,“iPhoneiOS4DevelopmentEssentials–Xcode”,FourthEdition,Payload media, 2011. |
| **Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://onlinecourses.nptel.ac.in/noc20_cs04/preview> |
| 2 | <https://www.udacity.com/course/advanced-operating-systems--ud189> |
| 3 | <https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf> |

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| **Mapping with Programming Outcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | S | S | S | M | M | M | M |
| **CO2** | S | M | S | S | S | S | S | M | S | M |
| **CO3** | S | M | S | S | S | S | S | M | S | M |
| **CO4** | S | M | S | S | S | S | S | M | S | M |
| **CO5** | S | M | S | S | S | S | S | M | S | M |

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

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| **SEMESTER: II****PART: A****ELECTIVE : IV** | **23PCSCE25-1: MOBILE COMPUTING** | **CREDIT:3****HOURS:4** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Present the overview of Mobile computing, Applications and Architectures.
2. Describe the futuristic computing challenges.
3. Enable the students to learn the concept of mobile computing.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, students will be able to: |
| 1 | Understand the need and requirements of mobile communication | K1,K2 |
| 2 | Focus on mobile computing applications and techniques | K2,K3 |
| 3 | Demonstrate satellite communication in mobile computing | K4 |
| 4 | Analyze about wireless local loop architecture | K5,K6 |
| 5 | Analyze various mobile communication technologies | K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply; **K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction: Advantages of Digital Information - Introduction to Telephone Systems –Mobile communication: Need for Mobile Communication – Requirements of Mobile Communication – History of Mobile Communication. |
| **Unit:2** | **MOBILE COMMUNICATION** | **12hours** |
| Introduction to Cellular Mobile Communication – Mobile Communication Standards –Mobility Management – Frequency Management – Cordless Mobile Communication Systems. |
| **Unit:3** | **MOBILE COMPUTING** | **12hours** |
| Mobile Computing: History of data networks – Classification of Mobile data networks - CDPD System – Satellites in Mobile Communication: Satellite classification – Global Satellite Communication – Changeover from one satellite to other – Global Mobile Communication – Interferences in Cellular Mobile Communication. |
| **Unit:4** | **MOBILE COMMUNICATION SYSTEM** | **11hours** |
| Important Parameters of Mobile Communication System – Mobile Internet: Working of Mobile IP – Wireless Network Security – Wireless Local Loop Architecture: Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol. |
| **Unit:5** | **COMMUNICATION TECHNOLOGY** | **11hours** |
| WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system – Fourth Generation Mobile Communication systems. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars–webinars |
|  | **Total Lecture hours** | **60hours** |
| **Text Books** |
| 1 | T.G.Palanivelu,R.Nakkeeran,“Wireless and Mobile Communication”, PHI Limited, 2009. |
| 2 | Jochen S chiller,“ Mobile Communications”,Second Edition, Pearson Education, 2007. |
| **Reference Books** |
| 1 | Asoke K Talukder, Hasan Ahmed,Roopa Yavagal,“[Mobile Computing](http://mheducation.co.in/html/9780070144576.html)”,TMH,2010. |
| **Related Online Contents[MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.tutorialspoint.com/mobile_computing/index.htm> |
| 2 | <https://www.javatpoint.com/mobile-computing> |
| 3 | <https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/> |

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| **Mapping with Programming Outcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | L | M | L | L | M | S | M | M | M | M |
| **CO2** | S | S | S | M | M | S | M | S | S | S |
| **CO3** | S | S | S | S | M | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **SEMESTER: II****PART: A****ELECTIVE : IV** | **23PCSCE25-2: BLOCKCHAIN TECHNOLOGY** | **CREDIT:3****HOURS:4** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. Understand the fundamentals of block chain and cryptocurrency.
2. Understand the influence and role of block chain in various other fields.
3. Learn security features and its significance.
4. Identify problems & challenges posed by BlockChain.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Demonstrate blockchain technology and crypto currency | K1,K2 |
| 2 | Understand the mining mechanism in blockchain | K2 |
| 3 | Apply and identify security measures, and various types of services that allow people to trade and transact with bitcoins | K3,K4 |
| 4 | Apply and analyze Block chain in health care industry | K4,K5 |
| 5 | Analyze security, privacy, and efficiency of a given Block chain system | K5,K6 |
| **K1**-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create |
| **Unit:1** | **INTRODUCTION** | **12hours** |
| Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major application: currency, identity, chain of custody. |
| **Unit:2** | **NETWORKAND SECURITY** | **12hours** |
| Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain. |
| **Unit:3** | **CRYPTOCURRENCY** | **12hours** |
| Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain |
| **Unit:4** | **CRYPTOCURRENCY REGULATION** | **11hours** |
| Cryptocurrency Regulation-Stakeholders, Roots of Bitcoin, Legal views-exchange of cryptocurrency- Black Market-Global Economy. Cyrpto economics– assets, supply and demand, in flat ion and deflation – Regulation. |

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| **Unit:5** | **CHALLENGES IN BLOCKCHAIN** | **11hours** |
| Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machine to machine communication –Data management in industry 4.0–future prospects. Block chain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data |
| **Unit : 6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars –webinars |
|  | **Total Lecture hours** | **60hours** |
| **Text Books** |
| 1 | Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press (July 19, 2016). |
| 2 | Antonopoulos, “Mastering Bit coin: Unlocking Digital Cryptocurrencies” |
| **Reference Books** |
| 1 | Satoshi Nakamoto, “Bitcoin: A Peer-to-Peer Electronic Cash System” |
| 2 | Rodrigoda Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh, “Blockchain Technology for Industry 4.0” Springer 2020. |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | <https://www.javatpoint.com/blockchain-tutorial> |
| 2 | <https://www.tutorialspoint.com/blockchain/index.htm> |
| 3 | <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/> |

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| **Mapping with Programming Outcomes** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | S | S | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **SEMESTER: II****PART: A****SEC: 1** | **23PCSCS26: OBJECT ORIENTED PROGRAMMING THROUGH JAVA, HTML BASICS** | **CREDIT:2****HOURS:4** |

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| **Course Objectives:** |
| The main objectives of this course are to:1. To implement the static web pages using HTML and do client side validation using JavaScript.
2. To introduce Node JS implementation for server side programming.
3. To experiment with single page application development using React.
 |
| **Expected Course Outcomes:** |
| On the successful completion of the course, student will be able to: |
| 1 | Develop a proper understanding of Web Development Architecture. | K1, K2 |
| 2 | Create application using React components. | K2, K3 |
| 3 | Perform Navigation using Routes. | K3, K4 |
| 4 | Build Web Applications using React with Redux. | K5, K6 |
| 5 | Perform ReactJS animations | K6 |
| **K1**-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create |
| **Unit:1** |  | **15hours** |
| ReactJS introduction, why to learn ReactJS, React Environment Setup- pre-requisite for ReactJS, ways to install ReactJS, ReactJS - Architecture, ReactJS - creating a React Application, React create-react-app, Features of ReactJS, ReactJS vs Native React, ReactJSvs AngularJS. |
| **Unit:2** |  | **15hours** |
| ReactJS - JSX, ReactJS - components: creating a React component, creating a class component, creating a function component, ReactJS - styling, ReactJs - properties (props), React Props Validation. |
| **Unit:3** |  | **15hours** |
| ReactJS state management, ReactJS event Management, React Constructor, React component API, React component Life-cycle, React Forms and user input, controlled Component, Un-Controlled Component, Form link. |
| **Unit:4** |  | **15hours** |
| ReactJS - Http client Programming, React Lists, The map() function, React Keys, React Refs, React Fragments, React Router, ReactCSS, React Animation, React Date picker, DoM in React. |
| **Unit:5** |  | **13hours** |
| React AJAX call - HTTP GET request, HTTP GET Request and Looping through data, React Bootstrap, React Table, React Hooks, React building and deployment. |
| **Unit:6** | **Contemporary Issues** | **2 hours** |
| Expert lectures, online seminars– webinars |
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|  | **Total Lecture hours** | **75hours** |
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| **Text Books** |
| 1 | Learning React: Functional web Development with React and Redux 1st Edition by Alex Banks. |
| 2 | The Road to React: your journey to master plain yet pragmatic React.js by Robin Wieruch |
| **Reference Books** |
| 1 | React.js Essentials: A fast-paced guide to designing and building scalable and maintainable web apps with React.js Artemij Fedosejev. |
| 2 | Full-Stack React projects: Learn MERN stack development by building modem web apps using MongoDB, Express, React, and Node.js, 2nd Edition paperback by shama Hoque |
| 3 | React.js Book: Learning React Javascript Library From Scratch by Greg Sidelnikov |
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| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** |
| 1 | https://www.mygreatlearning.com/academy/learn-for-free/courses/react-js-tutorial |
| 2 | https://www.classcentral.com/course/edx-introduction-to-reactjs-8770 |
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| **Mapping with Programming Outcomes** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | M | S | M | S | L | M | L | S | M |
| **CO2** | S | S | S | S | S | M | S | M | S | M |
| **CO3** | S | S | S | S | S | M | S | M | S | M |
| **CO4** | S | S | S | S | S | M | S | M | S | M |
| **CO5** | S | S | S | S | S | M | S | M | S | M |

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