

**Faculty of IT & Computer Application**

**Scheme**

**Master of Computer Applications (MCA)**

**Amazon Web Service (AWS)**

**Academic Programme**

**July 2021-22**

**MCA**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Semester wise Credit** | | | | **Total Credits** | **Minimum Credits Required for Degree** |
| **I** | **II** | **III** | **IV** |
| **22** | **23** | **19** | **16** | **80** | **80** |

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| --- | --- | --- | --- | --- | --- | --- |
| **Semester – I** | | | | | | |
| **Course Code** | **Course Name** | **L**  **(Hr.)** | **T (Hr.)** | **P**  **(Hr.)** | **Credits** | **Type** |
| MCA201 | Programming in Java | 4 | 0 | 0 | 4 | CORE |
| MCA203 | Data Structures and Algorithms | 3 | 1 | 0 | 4 | F |
| AWS001A | Cloud Computing Fundamentals | 4 | 0 | 0 | 4 | CORE |
| MCA204 | Software Testing Lab | 0 | 0 | 2 | 1 | CORE |
| MCA205 | Project Lab in Java | 0 | 0 | 2 | 1 | CORE |
| MCA206 | Data Structures Lab -I | 0 | 0 | 2 | 1 | F |
| MCA207 | Computer Programming Lab |  |  | 2 | 1 | F |
|  | Communication Skills | 2 | 0 | 2 | 3 | ID |
|  | Open Elective -I | 3 | 0 | 0 | 3 | GE |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | **Total** | 5 | 0 | 10 | 22 |  |

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| **Semester – II** | | | | | | |
| **Course Code** | **Course Name** | **L**  **(Hr.)** | **T (Hr.)** | **P (Hr.)** | **Credits** | **Type** |
| MCA208 | Programming in Python | 3 | 0 | 0 | 3 | CORE |
| MCA209 | Data Structures Lab Using JAVA-II | 0 | 0 | 2 | 1 | F |
| MCA210 | Advance Database Management System | 3 | 0 | 0 | 3 | CORE |
| AWS002A | AWS Academy Cloud Foundation Course | 3 | 0 | 0 | 3 | CORE |
| MCA211 | Project Lab in Python | 0 | 0 | 2 | 1 | CORE |
| MCA212 | Project Lab in Advance Database Management Systems | 0 | 0 | 2 | 1 | CORE |
| MCA213 | Minor Project | 0 | 0 | 4 | 2 | CORE |
|  | Program Elective – II | 3 | 0 | 2 | 4 | CORE |
|  | Life Skills-I (Aptitude) | 1 | 0 | 0 | 1 | F |
|  | Life Skills-I Lab | 0 | 0 | 2 | 1 | F |
|  | Open Elective -II | 3 | 0 | 0 | 3 | GE |
|  | **Total** | 15 | 0 | 8 | 23 |  |
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| **Semester – III** | | | | | | |
| **Course Code** | **Course Name** | **L**  **(Hr.)** | **T (Hr.)** | **P (Hr.)** | **Credits** | **Type** |
| MCA214 | Statistical Computing Using R | 2 | 0 | 0 | 2 | CORE |
| MCA215 | Internet Security and Cryptography | 3 | 0 | 0 | 3 | CORE |
| AWS 003A | Cloud Security | 3 | 0 | 0 | 3 | CORE |
| MCA216 | Project Lab in Statistical Computing Using R | 0 | 0 | 2 | 1 | CORE |
| MCA217 | Cryptography Lab | 0 | 0 | 2 | 1 | CORE |
| AWS 005 | AWS Academy Cloud Developing(Elective) | 4 | 0 | 0 | 4 | CORE |
|  | Life Skills-II ( Personality Development) | 1 | 0 | 0 | 1 | F |
|  | Life Skills-II -Lab | 0 | 0 | 2 | 1 | F |
|  | Open Elective -III | 3 | 0 | 0 | 3 | GE |
|  | **Total** | **15** | **0** | **8** | **19** |  |

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| **Semester – IV** | | | | | |
| **Course Code** | **Course Name** | **L**  **(Hr.)** | **P**  **(Hr.)** | **Credits** | **Type** |
| MCA218 | Industrial Training/Internship/Dissertation Project Presentation | 0 | 0 | 16 | CORE |

**List of Elective Courses**

|  |  |  |  |
| --- | --- | --- | --- |
| **Elective-II/IV** | | **Elective-I/III** | |
| **Course Code** | **Course name** | **Course Code** | **Course name** |
| MCA219 | Programming in ASP.Net | MCA241 | Data warehousing and Data Mining |
| MCA220 | Programming in R | MCA242 | Data Science and Analytics |
| MCA221 | Programming in C# | MCA243 | Distributed Computing |
| MCA222 | Professional Java | MCA244 | Big Data Analytics |
| MCA223 | MEAN Fullstack Development | MCA245 | Cloud Computing |
| MCA224 | Programming Using Ruby On Rails | MCA246 | Introduction to Salesforce |
| MCA225 | Programming Using Scala | MCA247 | Big Data Analytics using Hadoop |
| MCA226 | Design & Analysis of Algorithms | MCA248 | System and Network Administrator |
| MCA227 | Machine Learning | MCA249 | Artificial Intelligence and Expert System |
| MCA228 | Programming in ASP.Net Lab | MCA250 | Compiler Design |
| MCA229 | Programming in R Lab | MCA251 | Advance Computer Network |
| MCA230 | Programming in C# Lab | MCA252 | Theory of Computation |
| MCA231 | Professional Java Lab | MCA253 | Robotics Process Automation |
| MCA232 | MEAN Fullstack Development Lab | MCA254 | Advance Computer Architecture |
| MCA233 | Programming Using Ruby On Rails Lab | MCA255 | Agile Software Development |
| MCA234 | Programming Using Scala Lab | MCA256 | Introduction to Blockchain |
| MCA235 | Design & Analysis of Algorithms Lab | MCA257 | Software Project Management |
| MCA236 | Machine Learning Lab |  |  |
| MCA237 | Introduction to Linux System Administration |  |  |
| MCA238 | Linux Server Administration and Automation |  |  |
| MCA239 | Software Development Using OpenShift Architecture |  |  |
| MCA240 | Network Virtualization Using OpenStack |  |  |
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**Semester I**

**Course Name: Programming in Java**

**Course Code: MCA201**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T (Hr.)** | **Pr (Hr.)** | **Credits** |
| 4 | 0 | 0 | 4 |

**Course Objectives:**

1. To be able to understanding the concept of programming paradigms, basic concept of object oriented programming and features of java.
2. To demonstrate the concept of data types, literals and basic structure of java programming.
3. To enhance the practical knowledge of decision making statements and control statements.
4. To be able to use variety technologies of Java and work with different platforms.
5. To examine the life cycle of applets and packages.

**Syllabus**

**Unit I**

**Introduction to OOPS:** Paradigms of Programming Languages – Basic concepts of Object Oriented Programming – Differences between Procedure, Oriented Programming and Object Oriented , History of Java features – Java Environment, JDK ,API.

Introduction to Java: Types of java program, Creating and Executing a Java program, Java Tokens: Keywords, Character set, Identifiers, Literals, Separator, Java Virtual Machine (JVM) – Command Line Arguments, Comments in Java program.

**Unit II**

**Control Structures, Arrays, and Vectors:** Elements, Constants, Variables, Data types, Scope of variables, Type casting – Operators: Special operators, Expressions, Evaluation of Expressions.

Decision making and Branching: Simple if statement, if – else statement, nesting if – else, else if Ladder – switch statement – Decision making and looping: While loop, do - While loop for loop, break, loop continue Statement.

**Unit III**

**Array, Strings:**Arrays: One Dimensional Array – Creating an array, Array processing, Multidimensional Array, Vectors ArrayList, Advantages of Array List over Array Wrapper classes.Strings: String Array, String Methods, String Buffer Class.

**Unit IV**

**Classes and Inheritance**: Class and objects: Defining a class, Methods, Creating objects, Accessing class members, Constructors, Method overloading, Static members, Nesting of Methods, this keyword – Command line input.

Inheritance: introduction and its definition, Final variables and methods, Final classes, Final methods, Abstract methods and classes.

**Unit V**

**Packages, Applets and Awt Controls**: Packages: Java API Packages System Packages, Naming Conventions, Creating & Accessing a Package, Adding Class to a Package Hiding.

Classes Applets: Introduction, Applet Life Cycle, Creating & Executing an Applet, Applet tags in HTML, Parameter tag aligning the display, Graphics Class: Drawing and filling lines, Rectangles, Polygon, Circles, Arcs, Line Graphs, Drawing Bar charts.

**Course Outcomes (COs):**

Upon successful completion of this subject students should be able to:

CO1: Understand how object-oriented concepts are incorporated into the Javaprogramming language

CO2: Develop problem-solving and programming skills using OOP concept

CO3: Understand the benefits of a well-structured program

CO4: Develop the ability to solve real-world problems through software development inhigh-level programming language like Java

CO5: Develop efficient Java applets, threading and applications using OOP concept

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | H |  |  | M |  |  | M |  | M |  |  |
| CO2 | H |  |  |  |  |  |  |  | M |  |  |  |
| CO3 |  |  |  | H |  |  |  |  |  |  | M |  |
| CO4 |  |  | M |  |  |  |  | M |  | H |  |  |
| CO5 |  | M |  | H |  |  |  |  |  | M |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. Programming in Java, SachinMalhotra, Oxford University, November 2013
2. Java One step ahead, Seth and Juneja, Oxford University, May 2017.

**Reference Books**

1. Programming with Java A Primer, E. Balaguruswamy Tata McGraw Hill Companies
2. R. NageswaraRao, “Core Java**:** An Integrated Approach”, First Edition, DT Editorial Services, 2016.
3. Herbert Schildt, “The Complete Reference”, Ninth Edition, McGraw Hill, 2014.
4. Cay S. Horstmann,” Core Java”, Ninth Edition, Prentice Hall,2012.

**Semester I**

**Course Name: Data Structures and Algorithms**

**Course Code: MCA203**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 1 | 0 | 4 |

**Course Objectives:**

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques.
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.
5. To impart the basic concepts of algorithms implementation in optimized time .

**Syllabus**

**Unit I**

**Introduction to Data Structures and Algorithms:** Elementary Data Structure Organization, Classification of Data Structures, Operation of Data Structures, Operations on Data Structures ,Abstract Data Type ,Algorithms, Different Approaches to, Designing an Algorithm, Control Structures Used in Algorithms, Time and Space Complexity, Omega Notation (Ω), Theta Notation (Q) ,Other Useful Notations.

**UNIT II**

**Array and Linked List:** Declaration of Arrays, Accessing the Elements of an Array, Storing Values in Array, operations, Passing Array to functions, Pointers and Arrays, Arrays of Pointers, Two-dimensional Arrays, Operations on , Passing Two-dimensional Arrays to Functions, Pointers and Two-dimensional Arrays, Sparse Matrices .

Linked list Basic Terminologies, Memory Allocation and De-allocation for a Linked List, Singly Linked Lists, Circular Linked Lists, Doubly Linked Lists, Circular Doubly Linked Lists, Header Linked Lists, Multi-linked Lists, Applications of Linked Lists.

**UNIT III**

**Stack:** Array Representation of Stack, Operations on Stack, inked Representation of Stacks, Operations on a Linked Stack, Multiple Stacks, Applications of Stack,

**Queues:** Introduction to Queues, Array Representation of Queues ,Linked Representation of Queues, Types of Queues , Applications of Queues

**UNIT IV**

**Trees and BST**Trees: Types of trees , Creating a Binary Tree from a General Tree, Traversing a Binary Tree, Huffman’s Tree

Binary Search Trees: BST Operations, Threaded Binary Trees, AVL Trees, Red-Black Trees, Splay Trees

**UNIT V**

**Graph, Searching & Sorting:** Basic Terminologies, Directed Graphs, Representations of Graphs, Graph Traversals Algorithms, Topological Sorting, Shortest-Path Algorithms.

**Searching & Sorting:** Introduction to searching, Linear and Binary Search, Interpolation Search, jump search, Sorting Types, Bubble, Insertion, Selection , Merge Sort, Radix Sort Shell Sort, Quick Sort, Heap Sort.

**Course Outcomes (COs):**

**Upon successful completion of this subject students will able**

CO1: Ability to analyse algorithms and a algorithm correctness.

CO2: Ability to implement various techniques of link list.

CO3: Ability to describe stack, queue with linked list operation.

CO4: Ability to have knowledge of tree and graphs concepts.

CO5: Ability to summarize searching and sorting techniques

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | H |  |  |  |  |  |  | M |  |  |  |
| CO2 |  |  |  |  |  | M |  |  |  | H |  |  |
| CO3 |  |  |  | H |  |  |  | M |  |  |  |  |
| CO4 |  |  |  |  |  | M |  |  |  |  | H |  |
| CO5 | H |  |  |  | M |  |  |  |  |  |  | L |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. R. G. Dromey, “How to Solve it by Computer”, Second Edition, Prentice-Hall of India, 2002.
2. Reema Thereja,, ''Data Structure using C" , Second Edition , Oxford University Press, 2014

**Reference Books**

1. M. A. Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education Asia, 2002.
2. ISRD Group, “Data Structures using C”, Fifth Edition Tata McGraw Hill, 2007
3. Richard F. Gilberg, Behrouz A. Forouzan, “Data Structures – A Pseudocode” Third Edition Prentice-Hall of India, 2004.

**Semester I**

**Course Name: Software Testing Lab**

**Course Code: MCA 204**

**Experiment 1.**[Identifying the Requirements from Problem Statement](http://vlabs.iitkgp.ac.in/se/1/)

**Experiment 2.** [Estimation of Project Metrics](http://vlabs.iitkgp.ac.in/se/2/)

**Experiment 3.** [Modeling UML Use Case Diagrams and Capturing Use Case Scenarios](http://vlabs.iitkgp.ac.in/se/3/)

**Experiment 4.** [E-R Modeling from the Problem Statements](http://vlabs.iitkgp.ac.in/se/4/)

**Experiment 5.** [Identifying Domain Classes from the Problem Statements](http://vlabs.iitkgp.ac.in/se/5/)

**Experiment 6.** [State chart and Activity Modeling](http://vlabs.iitkgp.ac.in/se/6/)

**Experiment 7.** [Modeling UML Class Diagrams and Sequence diagrams](http://vlabs.iitkgp.ac.in/se/7/)

**Experiment 8.** [Modeling Data Flow Diagrams](http://vlabs.iitkgp.ac.in/se/8/)

**Experiment 9.** [Estimation of Test Coverage Metrics and Structural Complexity](http://vlabs.iitkgp.ac.in/se/9/)

**Experiment 10.** [Designing Test Suites](http://vlabs.iitkgp.ac.in/se/10/)

**Semester I**

**Course Name: Project Lab in Java**

**Course Code: MCA 205**

**Experiment 1**. Introduction to Java programming language

**Experiment 2**. Creating Classes and their Objects in Java

**Experiment 3.** Using constructors to create objects

**Experiment 4.** To understand the inheritance in Java

**Experiment 5.** Implementing Method Overloading

**Experiment 6.** Implementing Method Overriding

**Experiment 7.** Learning of abstraction through Interface

**Experiment 8**. Learning of Encapsulation through Package

**Experiment 9.** Handling Exceptions in Java

**Experiment 10.** Understanding Life cycle of a Thread

**Semester I**

**Course Name: Data Structure Lab-I**

**Course Code: MCA 206**

**Experiment 1.** Number Systems

**Experiment 2.** Expression Evaluation using Stacks

**Experiment 3.** Sorting using Arrays

**Experiment 4.** Polynomials via Linked Lists

**Experiment 5.** Search Trees

**Experiment 6.** Expression Trees

**Experiment 7.** Graph Traversals

**Experiment 8.** Shortest Paths in Graphs

**Experiment 9.** Minimum Spanning Trees

**Semester I**

**Course Name: Computer Programming Lab**

**Course Code: MCA 207**

**Experiment 1.** Numerical Approximation

**Experiment 2.** Functions

**Experiment 3.** Advanced Control Flow

**Experiment 4.** Arrays

**Experiment 5.**Structures

**Experiment 6.**  Basic Control Flow

**Experiment 7.**  Pointers

**Experiment 8.**  Recursion

**Experiment 9.** Expression Evaluation

**Semester I**

**Course Name: Communication Skills**

**Course code:-----**

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| **L (Hr.)** | **T (Hr.)** | **Pr (Hr.)** | **Credits** |
| 2 | 0 | 2 | 3 |

**Course Objectives:**

**Course Name: Communication Skills-I (BMC105A)**

**The objectives of this course are:**

1. To learn the essentials of grammar and vocabulary including idioms, homophones, homonyms, one-word substitutes.
2. To emphasizes and elaborate the basics of technical communication, such as its importance, process, levels, and fl ow of communication.
3. To explain the importance of developing active listening and effective speaking skills.
4. To highlight all the important aspects of reading, including skimming and scanning, to improve comprehension skills.
5. To analyze technical letter writing giving examples of various types of business letters and report writing.

**Unit I Grammar and Vocabulary Building:** Formation of Tenses, Active and Passive Voice, Reported speech. Conditional Sentences. **Sy**nonyms and Antonyms, One-word Substitutes, Homonyms, Homophones.

**Unit II Basics of Technical Communication**Introduction, Importance of Technical Communication, General and Technical Communication, Objectives and Characteristics of Technical Communication, Process of Communication, Levels of Communication, Flow of Communication, Visual Aids in Technical Communication, Barriers to Communication. Non-verbal Communication: Introduction, Kinesics, Proxemics, Chromatics

**Unit III Active Listening and Effective Speaking :** Introduction, Reasons for Poor Listening, Traits of a Good Listener, Listening Modes, Types of Listening, Barriers to Effective Listening, Effective Speaking: Introduction, Basic Sounds of English, Word Stress, Sentence Stress, Intonation, Achieving Confidence, Clarity, and Fluency, Conversations and Dialogues  
Telephonic Conversations and Etiquette.

**Unit IV Reading Comprehension**: Introduction, Improving Comprehension Skills, Techniques for Good Comprehension, Predicting the Content, Understanding the Gist, SQ3R Reading Technique, Study Skills

**Unit V Elements of Effective Writing**: Introduction, Rights Words and Phrases, Sentences  
Writing for the Web, The Art of Condensation , Steps to Effective Precise Writing, Technical Reports, Characteristics of a Report, Categories of Reports, Formats, Structure of Reports, Types of Reports, Writing the Report, Formal Letters, Memos, and Email  
**Text Books :**

1. Meenakshi Raman and Sangeeta Sharma, "Technical Communication: Principles and Practices " New Delhi, Oxford university press, 2015.
2. Current English Grammar and Usage with Composition” by R.P. Sinha, Oxford University Press (New Delhi).

**Reference Books:**

1. Bovee, Courtland, L., John V. Thill and Barbara E. Schatzman.

2.Business Communication Today: Seventh Edition. Delhi: Pearson Education, 2004.

1. Lesikar, Raymond V and Marie E. Flatley. Basic Business Communication: Skills for Empowering the Internet Generation: Ninth Edition. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2002.
2. “Learn Correct English: Grammar, Usage and Composition” by Shiv K. Kumar & Hemalatha Nagarajan, Pearson (New Delhi).
3. “Grammar of the Modern English Language”, by Sukhdev Singh &Balbir Singh, Foundation Books (New Delhi).
4. Andrea J. Rutherford , "Basic communication skills for technology" second edition, Pearson education, 2007.
5. Mithra, B.K. Effective Technical Communication. A guide for scientists and engineers, New Delhi, Oxford University press,2000.

**Course Outcomes (COs):**

**Upon successful completion of this subject students should be able to:**

CO1: Understand the communication processes and practices in academic and professional contexts.

CO2: Able to understand the concept and basics of communication and essentials of grammar.

CO3: Students are able to work with jumble words and grammar.

CO4: Enhance the knowledge of composition; produce written academic and professional documents.

CO5: Have the capability to apply an ability to properly carry out the purpose and significance of the channels of Communication and improve writing skills for stories and poems.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | M | H |  |  |  |  |  |  |  |  | M |  |
| CO2 |  |  |  |  | M |  |  |  |  |  |  | H |
| CO3 |  |  |  |  |  |  |  | H | M |  |  |  |
| CO4 |  |  |  |  |  |  |  |  | H |  | M |  |
| CO5 | H |  |  |  |  |  |  |  |  | H |  |  |

H = Highly Related; M = Medium; L = Low

**Semester II**

**Course Name: Programming in Python**

**Course Code: MCA208**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To outline the basics of python programming, Features, history, data types and variables.
2. To able to solve real-world problems through python programming.
3. To be able to exploit problem solving approaches, programming languages, object oriented programming.
4. To constructs of Python language such as control statements, functions, strings, files, data structures.
5. To apply the concept of Classes and objects, functions and array in python.

**Syllabus**

**Unit I**

**Introduction to Procedural Programming:** Data types in Python: Comments in Python, identifiers, keywords, Integral Types, Integers, and Booleans Floating-Point Types: Floating-Point Numbers, Complex Numbers, Decimal Numbers, Strings, Comparing Strings, Slicing and Striding Strings, String Operators and Methods, Operators in Python, Input and Output

**Unit II**

**Collection Data Types:** Sequence Types, Tuples Named Tuples, Lists Set Types: Sets. Frozen Sets, Mapping Types: Dictionaries, Default Dictionaries, Ordered Dictionaries, Iterating and Copying Collections, Arrays in Python

**Unit III**

**Control Structures and Functions** :Control Structures .Conditional Branching, Looping, Exception Handling, Catching and Raising Exceptions Custom Exceptions Custom Functions Names and Docstrings Argument and Parameter Unpacking, Accessing Variables in the Global Scope, Lambda Functions.

**Unit IV**

**File handling:** Writing and Reading Binary Data, Pickles with Optional Compression, Raw Binary Data with Optional Compression, Writing and Parsing Text Files, Writing Text, Parsing Text, Parsing Text Using Regular Expressions, Writing and Parsing XML Files, Element Trees DOM (Document Object Model), Manually Writing XML Parsing XML with SAX (Simple API for XML), Random Access Binary Files ,A Generic BinaryRecordFile Class.

**Unit V**

**Object Oriented Programming:** The Object-Oriented Approach, Object oriented approach

Custom Classes, Attributes and Methods, Inheritance and Polymorphism, Using Properties to Control Attribute Access, Creating Complete Fully Integrated Data Types, Custom Collection Classes, Creating Classes That Aggregate Collections, Creating Collection Classes Using Aggregation, creating Collection Classes Using Inheritance, Python’s Database Connectivity, Libraries in python for Machine Learning: Panda, Numpy, Matplotlib, Scikit-learn, Tensorflow.

**Course Outcomes (COs):**

**Upon successful completion of this subject students should be able to:**

CO1: Outline the basics of python programming, Features, history, data types and variables.

CO2: Understanding of Python especially Decision control, function and modules.

CO3: Understanding of the file handling and Data Structure.

CO4: Be exposed to object oriented concepts in Python programming, decision controls and function.

CO5: Understand the concept of class and object, class methods and Garbage.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  |  |  |  |  |  |  | M |  |  |  |
| CO2 | H |  | M |  |  |  |  |  |  |  |  | M |
| CO3 |  |  |  | M |  |  |  |  |  | M |  |  |
| CO4 |  |  |  |  |  |  | H |  |  |  |  |  |
| CO5 |  | M |  |  | M |  |  | H |  |  |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. Core Python Programming, Black Book-Dreamtech, Dr. R. Nageswara Rao, 2017
2. Python Programming, Oxford, ReemaThareja, June 2017

**Reference Books**

1. “Python Testing Cookbook” by Greg L Turnquist
2. “Head First Programming” by Paul Barry and David Griffiths
3. “Python Crash Course: A Hands-On, Project-Based Introduction to Programming” by Eric Matthes.

**Semester II**

**Course Name:Data Structures Lab Using JAVA-II**

**Course Code: MCA209**

**Experiment 1.** Sorting

1. [Selection Sort](https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html)
2. [Radix Sort](https://ds2-iiith.vlabs.ac.in/exp/radix-sort/index.html)

**Experiment2**. Graphs

1. [Topological Sort](https://ds2-iiith.vlabs.ac.in/exp/topo-sort/index.html)
2. [Minimum Spanning Trees](https://ds2-iiith.vlabs.ac.in/exp/min-spanning-trees/index.html)
3. [Path algorithms: Dijkstra’s shortest path](https://ds2-iiith.vlabs.ac.in/exp/dijkstra-algorithm/index.html)

**Experiment 3.**  Search Trees

1. [2-3 Tree](https://ds2-iiith.vlabs.ac.in/exp/2-3-tree/index.html)
2. [Red Black Tree](https://ds2-iiith.vlabs.ac.in/exp/red-black-tree/index.html)

**Experiment4.** Strings

1. [Tries and Suffix Trees](https://ds2-iiith.vlabs.ac.in/exp/tries-suffix-trees/index.html)
2. [Substring search: KMP algorithm](https://ds2-iiith.vlabs.ac.in/exp/kmp-algorithm/index.html)

**Semester II**

**Course Name: Advance Database Management System**

**Course Code: MCA210**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 0 | 0 | 3 |

**Course Objectives**

1. To enhance the fundamentals knowledge of data models and to conceptualize and depict a database system using ER diagram.
2. To know fundamentals of Operations of Relational Algebra and calculus.
3. To know the fundamental concepts of normalization.
4. To justify the concept of transaction processing management, concurrency control techniques and recovery procedure.
5. To have an introductory knowledge about the Storage and Query processing Techniques.

**Syllabus**

**Unit I**

**Data modeling:** Entity Relationship Model, Relational, Network, Hierarchical and object oriented models, Data Modeling using the Entity Relationship Model. Relational Constraints, Domain Constraints, Key Constraints Referential Integrity Constraints, Relational Algebra and Relational Calculus.

**Unit II**

**Database Design**: Integrity Constraints – Domain Constraints- Referential integrity – Functional Dependency- Normalization using Functional Dependencies, Normal forms based on primary keys- general definitions of Second and Third Normal Forms. Boyce Codd Normal Form– Multivalued Dependencies and Forth Normal Form – Join Dependencies and Fifth Normal Form.

**Unit III**

**Object Relational Databases:** Complex Data Types and Object Orientation, Structured Data Types and Inheritance in SQL, Table Inheritance, Array and Multiset Types in SQL, Object Identity and Reference Types in SQL, Implementing O-R Features, Persistent Programming Languages, Comparison of Object-Oriented and Object-Relational Database

**Unit IV**

**Physical Database Design**: Overview of Physical Storage Media, Magnetic Disks, RAID, Tertiary Storage , Storage Access, File Organization, Organization of Records in Files, Data-Dictionary Storage, Storage Structures for Object-Oriented Databases, Basic Concepts, Ordered Indices , B+-Tree Index Files, B-Tree Index Files, Static Hashing, Dynamic Hashing , Comparison of Ordered Indexing and Hashing , Index Definition in SQL.

**Unit V**

**Transaction Management:** Transaction Concept, ACID Properties, Transaction State, Implementation of ACID properties, Schedules and Serializability: Conflict Serializability, View Serializability. Concurrency Control: Need of concurrency control, Concurrency control techniques, Lock based protocols, binary lock, share and exclusive lock, two phase locking protocol. Introduction to recovery.

**Course Outcomes (Cos)**

**After successfully completing this subject, students will be able to:**

CO1: Understand practical implications of transaction properties and concurrency control techniques.

CO2: Understand the fundamentals of Object Relational database and complex data types.

CO3: Gain about the fundamentals of physical storage media and indexing.

CO4: Enhance the fundamentals knowledge of data models and to conceptualize and depict a database system using ER diagram.

CO5: Contrast the concept of functional dependency, Norm forms, constraints and integrity

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  |  |  |  |  |  |  | M |  |  |  |
| CO2 | H |  | M |  |  |  |  |  |  |  |  | M |
| CO3 |  |  |  | M |  |  |  |  |  | M |  |  |
| CO4 |  |  |  |  |  |  | H |  |  |  |  |  |
| CO5 |  | M |  |  | M |  |  | H |  |  |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Fifth Edition, Pearson, 2008
2. A.Silberschatz, H. Korth and S. Sudarshan, Database System Concepts, 5th Edition, McGraw Hill.

**Reference Books**

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
2. .
3. Raghu Ramakrishnan, “Database Management Systems”, Fourth Edition, Tata McGraw Hill, 2010.
4. G.K.Gupta,”Database Management Systems”, Tata McGraw Hill, 2011.

**Semester II**

**Course Name: AWS Academy Cloud Foundation Course**

**Course code:AWS002A**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 0 | 0 | 3 |

**Course Objectives** : Upon completion of this course, students will be able to

CO 1 Define the AWS Cloud

CO 2 Explain the AWS pricing philosophy

CO3 Identify the global infrastructure components of AWS

CO 4 Describe the security and compliance measures of the AWS Cloud, including AWS Identity and Access Management (IAM)

CO 5Create a virtual private cloud (VPC) by using Amazon Virtual Private Cloud (Amazon VPC)

**Module 1**. **Cloud Concepts Overview:**

Introduction to cloud computing, Advantages of the cloud, Introduction to AWS, Moving to the AWS Cloud.

**Module 2**. **Cloud Economic and Billing:**

Introduction, Fundamentals of Pricing, Total cost of ownership, Delaware North Case study, AWS organization, AWS Billing and cost Management, Billing dashboard, Technical Support Model,

**Module 3**. **AWS Global Infrastructure Overview:**

Introduction, AWS Global Infrastructure, AWS Services and Service category, AWS management console click through.

**Module 4:**

Introduction, AWS shared responsibility model, AWS IAM, Securing a New AWS Account, Securing account and data, working to ensure compliance

**Module 5:**.**Networking and Content Delivery:**

Introduction, Networking Basics, Amazon VPC, VPC Networking, VPC Security, Route 53, Cloud front,

**Module 6. Compute:** Introduction, compute services overview, amazon EC2 part 1, amazon EC2 part 2, amazon EC2 part 3,amazon EC2 cost optimization, container service, Introduction to AWS Lambda, Introduction to AWS Elastic Beanstalk,

**Module 7. Storage:**

Introduction, AWS EBS( Elastic Block Store Console), AWS S3, AWS EFS, AWS S3 Glacier.

**Module 8. Databases:**

Introduction , Amazon RDS, Amazon DynamoDB, Amazon Redshift, Amazon Aurora.

**Module 9. Cloud Architecture:**

Introduction, AWS Well Architected framework design principles, operational excellence, security, reliability, performance efficiency, cost optimization, reliability and high availability, AWS trusted advisor,

**Module 10. Automatic Scaling Monitoring:**

Introduction, Elastic Load Balancing, Amazon Cloud watch, Amazon EC2 Auto Scaling,

**Semester II**

**Course Name: Project Lab in Python**

**Course Code: MCA 211**

**Experiment 1**. Arithmetic Operations

**Experiment 2**. Built-in Functions

**Experiment 3**. Loops

**Experiment 4**. Data Types

**Experiment 5**. Strings

**Experiment 6**. Classes and Objects

**Experiment 7**. Built-in Modules

**Experiment 8**. Constructors and Inheritance

**Experiment 9**. File Operators

**Semester II**

**Course Name: Project Lab in Advance Database Management Systems**

**Course Code: MCA112**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 0 | 0 | 2 | 2 |

**Course Objective**

The purpose of this course is to enhance the practical knowledge based on prescribed theory course. The students will be able to enhance their analyzing and problem solving skills after implementation of all the given experiments.

**List of Sample Programs**

1. Create a relational database that contains the some tables and insert records into these tables. Solve the different SQL Queries**.**
2. Create the 3 structured record data type named as address\_type(street, city, state, pin\_code), person\_type(firstname, lastname, DOB) and business\_type( title, company). Create 2 tables based on person\_type and business\_type. Create one more table which is referred by first two tables. ( Reference type)
3. Write a program to enter a number and find the factorial of the number.
4. Write a code to create a type with an array of number 10.
5. Write a PL/SQL code to take the input from the user for 3 subjects and calculate total marks and percentage.
6. Write a program to create a function for add two numbers and call it by passing the values as an argument.
7. Write a program to enter two number and find greater number using function
8. Write a program to create a PL/SQL function for count the number of records in any existing table.
9. Write a PL/SQL code to create a table using the already created array type and insert 5 records.
10. Write a PL/SQL code to enter two numbers and perform the arithmetic operations. (Addition, Subtraction, Multiplication, Division)
11. Write a PL/SQL code to retrieve the employee name and city from employee database of an employee whose number is input by the user. (Create a Employee table with the field named as emp\_no, employee name, street, city)
12. Write a program to create a table with at least 3 fields and create a procedure for insert data in the existing table. Insert 5 records through this procedure.

**Semester II**

**Course Name: Minor Project**

**Course Code: MCA213**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 0 | 0 | 4 | 2 |

**Course Objectives**

The purpose of minor project is to enhance the practical knowledge based on prescribed languages which are introduced in this program. The students will be able to enhance their analyzing and problem solving skills after implementation of all the given experiments.

**Semester II**

**Course Name: Life Skills - 1 (Personality Development)**

**Course Code:**

**MCA. (common to all disciplines)-II Semester**

**Contact Hours (L-T-P): 1-0-2**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **Life Skills I** | **Credits 1-0-1 2** |

**Objectives**

1. To prepare the students as per the industry demands.
2. Switching to Activity and Task based Teaching modules.
3. To focus on the linguistic aspects in relation to life situations.
4. Facilitating the aspects of behavioral skills in language.
5. Ability to master three major forms of communications which are vital in academic and professional settings namely professional presentations, interviews and group communications respectively.
6. Providing a deep insight into the techniques for delivering effective presentations, winning job interviews, and actively participating in various forms of group communication.

**Course Outcomes (CO):**

**At the end of this course students will have:**

CO1: Ability to use appropriate language while communicating with the people ranging from personal to professional settings in order to meet the desired needs of economic, environmental, social, political, ethical fields.

CO2: Ability to learn by doing it practically in the classroom.

CO3: Ability to learn by creating an environment and adapting to the environment.

CO4: The ability to prepare the students as per the need of the Multi-cultural scenario around.

**Syllabus: Theory**

|  |  |
| --- | --- |
| **UNIT 1** | * Basics of Debates / Speeches / Addressing the public / Extempore/Group Discussion * Basics of Narrating and describing things |
| **UNIT 2** | * Telephonic Etiquette: Casual and formal Telephonic Communication, Telephonic Interview * CV/Resume Drafting and HR Interview advance theory * Basics of Video Interviews and Video Profiles for Job |
| **UNIT 3** | * Types of listening, advantages and disadvantages |
| **UNIT 4** | * Basics of Group Discussion, Presenting New Idea/Concept/Proposal/ Project/ Report |
| **UNIT 5** | Types of personalities, Perspective towards things, ideas, views, codes, Life skills related to Multicultural environment and emotional intelligence like- Self-confidence, Self-esteem, Self-motivation, Decision making, Resourcefulness, Risk Taking, Conflict management, Stress management, Team Buildingetc |

**Semester II**

**Course Name: Life Skills - 1 (Lab)**

**Course Code:**

**Syllabus: Lab**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **Life Skills Lab** | **Credit 1-0-1 2** |

|  |  |
| --- | --- |
| **UNIT 1** | * Debates / Speeches / Addressing the public / Extempore/Group Discussion * Describing a hypothetical situation / theme / surroundings / appearance/personality traits/company/ a professional Concept/New Idea, / New Project through PPT and video aids |
| **UNIT 2** | * Telephonic Etiquette: Casual and formal Telephonic Communication, Telephonic Interview * CV/Resume Drafting and HR Interview practice sessions elaborating the points as per the CV and industry demand * Video Interviews and Video Profiles for Job-Practice session for Online Interviews |
| **UNIT 3** | * Listening to variety of audio/video conversations including interviews, news, reports, reports, GDs, dialogues from body language, logic, wit and vocabulary perspectives |
| **UNIT 4** | * Group Discussion-Practice sessions, Presenting New Idea/Concept/Proposal/ Project/ Report |
| **UNIT 5** | Activities on how to be a strong Personality, Motivation, Case studies for Resourcefulness and out of the box thinking, Role plays and Case studies on Risk taking, Self confidence and Self-esteem, Decision Making, Emotion Management, Cultural Adaptability, Multicultural Perspective towards things, ideas, views, codes etc |

**Suggested Readings:**

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.
4. The Hard Truth about Soft Skills, by Amazone Publication.
5. 101 Great Answers to the Toughest Interview Questions. Ron Fry. HighBridge Company. 1996.
6. Michael Swan. Practical English Usage, Oxford University Press.

**Semester III**

**Course Name: Statistical Computing Using R**

**Course Code: MCA214**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 2 | 0 | 0 | 2 |

**Course Objectives**

1. To explain the key differences between the tasks of classification, clustering, regression, and dimensionality reduction
2. To identify the key differences between supervised and unsupervised learning paradigms
3. To explain how noisy observations affect the result of data mining methods.
4. To deal with missing data and Manipulate strings in R
5. To understand basic regular expressions in R and base R graphics

**Syllabus**

**Unit I**

**Introduction to R**: Basics of R, R-Environment Setup, Installation of R, Rstudio, Installing and Configuring, RStudio in Windows, Installing and Configuring, RStudio in Linux, Programming with R, Basic Data Types, Vectors, Matrices, Arrays.

Factors and data Frames: Factor Levels, Data Frame, Creating a Data Frame, Sub setting of Data Frames, Extending Data Frames, Sorting Data Frames

**Unit II**

**List:** Creating a List, Creating a Named List, Lists Operations , Conditionals and Control Flow, Relational Operators, Relational Operators and Vectors, Logical Operators, AND Operator, OR Operator, NOT Operator, Logical Operators and Vectors, Conditional Statements

**Unit III**

**Iterative Programming & Function in R**: Iterative Programming : While Loop, For Loop, Looping Over List, Loops for Vectors, Loops for Matrices, Loops for Data Frames, Loops for Lists, Functions in r

Functions: Writing a Function in R, Nested Functions, Function Scoping, Function Environment, Function Scope, Default Values for Arguments, Returning Complex, Recursion, Loading an R Package, Methods of Loading, Mathematical Functions in R, Cumulative Sums and Products, Calculus in R, Input and Output Operations

**Unit IV**

**Apply Family in R , Charts & Graphs**: Apply Family : Using apply in R, Using lapply in R, Using sapply in R, Using tapply in R, Using mapply in R.

Charts & Graphs: Pie Chart, Bar Chart, Box Plot, Histogram, Line Graph, Scatter

**Unit V**

**Data Interfaces**: Introduction to Data interfaces, CSV Files, Excel Files, Binary Files , XML files, JSON files, Web Data, , Databases

**Course Outcomes (Cos):**

CO1: Students will able to explain Basics of R programming, Installation of R, Rstudio, Installing and Configuring, RStudio in Windows.

CO2: Students will able to estimate the effects data interfaces, Conditionals and Control Flow, Relational Operators and condition flow.

CO3: Able to design data mining experiments using R and existing data mining tools.

CO4: Students will be able to learn about data interfaces, CSV files, Excel files and XML files.

CO5: Able explain the working of lists in R and will be able working with bar and charts.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  |  |  | H |  |  |  |  | M |  |  |  |
| CO2 |  | M |  | M |  |  |  |  |  | M |  |  |
| CO3 | M |  |  |  | M |  | L |  |  |  |  | M |
| CO4 |  |  | L |  |  |  |  | M |  |  |  |  |
| CO5 | H |  |  |  | L |  |  |  | M |  |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. Statistical Programming in R (Oxford) Srinivasa, Siddesh, Shetty and Sowmya, June 2017.
2. Lawrence Leemis. Learning Base R. Lightning Source, 2016

**Reference Books**

1. VikramDayal. An Introduction to R for Quantitative Economics: Graphing, Simulating and Computing. Springer, 2015
2. Matthias Kohl. Introduction to statistical data analysis with R. bookboon.com, London, 2015.
3. Matthias Kohl. Introduction to statistical data analysis with R. bookboon.com, London, 2015.

**Semester III**

**Course Name: Cryptography and Cyber Security**

**Course Code: MCA215**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 1 | 0 | 4 |

**Course Objectives**

1. To learn today‘s increasing network security threats and explain the need to implement a comprehensive security policy to mitigate the threats.
2. To provide extended security using authentication, Substitution Techniques, Transposition Techniques, Encryption and Decryption
3. To introduce security services for email and email protocols, Digital Certificates, Private Key Management, E-mail Security and Wireless Application Protocol (WAP) Security
4. To be aware about Prohibited actions on Cyber, Cyber Squatting Banking/Credit card related crime E-commerce.
5. To gain the knowledge about Cyber Crime and Prohibited actions on Cyber.

**Syllabus**

**Unit I**

**Introduction to the Concepts of Security**: The need for security, Security Approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Key Range and Key Size, Possible Types of Attacks.

**Unit II**

**Computer-based Symmetric Key Cryptographic Algorithms:** Algorithm Types and Modes, An overview of Symmetric Key Cryptography, DES, International Data Encryption, Algorithm (IDEA), RC5, Blowfish, AES, Differential and Linear Cryptanalysis.

**Unit III**

**Computer-based Asymmetric Key Cryptography:** Brief History of Asymmetric Key Cryptography, An overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm, Some other Algorithms.

**Unit IV**

**Public Key Infrastructure:** Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography Standards, XML, PKI and Security. Internet Security Protocols: Basic Concepts, Secure Socket Layer, SHTTP, Time Stamping Protocol, Secure Electronic Transaction, SSL versus SET, 3-D Secure Protocol, Electronic Money, E-mail Security, Wireless Application Protocol (WAP) Security, Security in GSM.

**Unit V**

**Prohibited Actions on Cyber**: Pornography, IPR violations: software piracy, copyright infringement, trademarks violations, theft of computer source code, patent violations, Cyber Squatting Banking/Credit card Related crime E-commerce/ Investment Frauds, Defamation (Cyber smearing),Cyber Stacking

**Course Outcomes (Cos):**

**Upon successful completion of this subject students should be able to:**

CO1: Demonstrate the threats in networks and security concepts, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption.

CO2: Apply authentication applications in different networks.

CO3: Understand security services for email, the RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together and Digital Signatures.

CO4: Know of Digital Certificates, Private Key Management, E-mail Security and Wireless Application Protocol (WAP) Security

CO5: Awareness of Prohibited actions on Cyber, Cyber Squatting Banking/Credit card related crime E-commerce.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  |  |  | H |  |  |  |  |  | M |  |  |
| CO2 |  | H |  |  |  |  |  |  |  |  |  |  |
| CO3 |  |  |  |  |  |  | M |  |  |  |  | M |
| CO4 | M |  |  |  | H |  |  |  |  |  | M |  |
| CO5 |  | H |  |  |  |  |  | M |  | L |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. William Stallings, ―Cryptography and Network Security, Prentice Hall, New Delhi, 2006.

# Atul Kahate, Cryptography and Network Security, Mc Graw Hill Education, 3rd Edition.

**Reference Books**

1. Neal Krawetz, ―Introduction to Network Security‖, Thomson Learning, Boston, 2007.
2. Bruce Schneier, ―Applied Cryptography‖, John Wiley & Sons, New York, 2004.
3. Frontiers of of Electronic Commerce Kalakota and Whinstn Addition Wesley

**Semester III**

**Course Name: Cloud Security**

**Course Code: AWS 003A**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 1 | 0 | 4 |

**Unit 1:**

**Fundamentals of Cloud Computing and Architectural Characteristics-** Understand what is Cloud computing , Architectural and Technological Influences of Cloud Computing •,Understand the Cloud deployment models a. Public, Private, Community and Hybrid models ,Scope of Control a. Software as a Service (SaaS) b. Platform as a Service (PaaS) c. Infrastructure as a Service (IaaS) • Cloud Computing Roles •,Risks and Security Concern.

**Unit 2:**

**Security Design and Architecture for Cloud Computing-** Guiding Security design principles for Cloud Computing ,Cloud Security ,Secure Isolation , Comprehensive data protection , End-to-end access control , Monitoring and auditing , Common attack vectors and threats.

**Unit 3:**

**Data Protection for Cloud Infrastructure and Services-** Understand the Cloud based Information Life Cycle Data protection for Confidentiality and Integrity, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key, Management, Assuring data deletion, Data retention, deletion and archiving procedures for tenant data, Data Protection Strategies.

**Unit 4:**

**Enforcing Access Control for Cloud Infrastructure based Services**- Understand the access control requirements for Cloud infrastructure Common attack vectors and threats, Enforcing Access Control Strategies, Compute, Network and Storage, Authentication and Authorization, Roles-based Access Control, Multi-factor authentication, Host, storage and network access control options, OS Hardening and minimization, securing remote access, Verified and measured boot, Firewalls, IDS, IPS and honeypots.

**Unit 5:** Security Patterns for Cloud Computing – Network Security, Identity & Access Management & Trust Secure On-Premise Internet Access Secure External Cloud Connection Cloud Denial-of-Service Protection Cloud Traffic Hijacking Protection Automatically Defined Perimeter Cloud Authentication Gateway Federated Cloud Authentication Cloud Key Management Trust Attestation Service Collaborative Monitoring and Logging Independent Cloud Auditing.

**Semester III**

**Course Name: Project Lab in Statistical Computing Using R**

**Course Code: MCA216**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 0 | 0 | 2 | 2 |

**Course Objectives**

The purpose of this course is to enhance the practical knowledge based on prescribed theory course. The students will be able to enhance their analyzing and problem solving skills after implementation of all the given experiments.

**List of Sample Programs**

Following are the list of sample programs. Students have to perform accordingly.

1. Illustrate addition, multiplication and division between vectors.
2. Enumerate multiplication and division operations between matrices and vectors in R console.
3. Write the command in R console to create a list containing a vector, a matrix and a list. Also give names to the elements in the list and display the list.
4. Write the command in R console to add a new element at the end of the list and display the same.
5. Write the command in R console to delete the fourth element from a list and display the resultant list.
6. Write the command in R console to update the third element of the list and display the resultant list.
7. Write the command in R console to create two lists, each containing 5 elements. Convert the list into vectors and perform addition on the two vectors. Display the resultant vector.
8. Write an R programme to print the values in vectors using the while loop.
9. Write an R programme to print the values in vectors using for loop.
10. Write an R programme to create four vectors namely patientid, age, diabetes and status. Put these four vectors into a Data frame patientdata and print the values using the for loop.
11. Write an R programme to print HELLO 10 times using for loop.
12. Write an R programme to print the Fibonacci series.
13. Write an R programme to print if the given number is ODD/EVEN.
14. Write an R programme to print the first 100 prime numbers.
15. Write an R programme to calculate the factorial of a number.
16. Write an R programme to calculate LCM of 2 numbers.
17. Write an R programme to calculate GCD of 2 numbers.
18. Write a programme to illustrate the use of local and global variable.
19. Write a programme to multiply two numbers using a function with a default value. Assume default value as NULL.
20. Demonstrate the creation of a complex number.
21. Add two complex numbers using the complex functions and test whether the sum of the complex numbers is complex or not.
22. Write a programme to calculate factorial of a number using recursive computation.
23. Write a programme to sum n natural numbers.
24. Write a programme to find nth Fibonacci number using recursive computation.
25. Write a programme to calculate the GCD of two numbers using recursive computation.
26. Write the commands in R console to find mean number of leaves for each day (data frame) using apply function.
27. Write the command in R console to specify the columns that needs to be excluded in the apply function.
28. Write the command in R console to change a value in the duckweed data frame.
29. Write the command in R console to determine the proportion of the total number of leaves counted on each day.
30. Write the command in R console to obtain mean using tapply function by considering a vector having 10 normal and 10 uniform variables. Assume that these vectors have three groups.
31. Calculate the mean of ozone, solar radiation, and wind within each month using lapply for air quality dataframe.
32. Calculate the mean of ozone, solar radiation, and wind within each month using sapply for air quality dataframe.
33. Using R pie chart, demonstrate the percentage conveyance of various ways for travelling to office such as walking, car, bus, cycle and train.
34. Using a chart legend, Show the percentage conveyance of various ways for travelling to office such as walking, car, bus, cycle and train.
35. Using R bar chart, demonstrate the percentage conveyance of various ways for travelling to office such as walking, car, bus, cycle and train.
36. Using box plots demonstrate the relation between the cars speed and the distance taken to stop.
37. Using R histogram, demonstrate the relation between the cars speed and the distance taken to stop.
38. Using R line graphs, demonstrate the relation between the cars speed and the distance taken to stop.
39. Using scatters plots in R, demonstrate the relation between the cars speed and the distance taken to stop.
40. Write the commands in R console to read a CSV file and display the number of rows and columns.

**Semester III**

**Course Name: Cryptography Lab**

**Course Code: MCA217**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 0 | 0 | 2 | 1 |

1. [Breaking the Shift Cipher](https://cse29-iiith.vlabs.ac.in/exp/shift-cipher/)
2. [Breaking the Mono-alphabetic Substitution Cipher](https://cse29-iiith.vlabs.ac.in/exp/substitution-cipher/)
3. [One-Time Pad and Perfect Secrecy](https://cse29-iiith.vlabs.ac.in/exp/one-time-pad/)
4. [Message Authentication Codes](https://cse29-iiith.vlabs.ac.in/exp/message-authentication-codes/)
5. [Cryptographic Hash Functions and Applications](https://cse29-iiith.vlabs.ac.in/exp/hash-functions/)
6. [Symmetric Key Encryption Standards (DES)](https://cse29-iiith.vlabs.ac.in/exp/des/)
7. [Symmetric Key Encryption Standards (AES)](https://cse29-iiith.vlabs.ac.in/exp/aes/)
8. [Diffie-Hellman Key Establishment](https://cse29-iiith.vlabs.ac.in/exp/diffie-hellman/)
9. [Public-Key Cryptosystems (PKCSv1.5)](https://cse29-iiith.vlabs.ac.in/exp/pkcs/)
10. [Digital Signatures](https://cse29-iiith.vlabs.ac.in/exp/digital-signatures/)

**Semester III**

**Course Name: AWS Academy Cloud Developing (Elective)**

**Course Code: AWS 005**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 4 | 0 | 0 | 4 |

**Course Objectives**

CO1 Recall cloud computing services and models.

CO2. Describe developing on AWS.

CO3. Configure AWS Identity and Access Management for programmatic access

CO4. Configure storage with Amazon S3 programmatically.

CO5. Develop with DynamoDB and explain caching.

**Module 1 – Welcome to Academy Cloud Developing (ACD)**

Cloud prerequisites objectives and overview, AWS training portal, AWS free tier, AWS educate, AWS documentation scavenger hunt.

**Module 2 – Introduction to Developing on AWS**

System development lifecycle, steps to get started developing on AWS, working with AWS SDKs, errors and exceptions, introduction to AWS X-rays, introduction to amazon cloudwatch and AWS cloudtrail.

**Module 3 – Introduction to AWS Identity and Access Management (IAM)**

Shared responsibility model , overview of IAM, authentication with IAM , authorization with IAM.

**Module 4 – Developing Storage Solutions with Amazon S3**

Introduction to Amazon S3, Creating amazon S3 buckets, working with amazon S3 objects, protecting data and managing access to amazon S3 resources.

**Module 5 – Developing NoSQL Solutions with Amazon DynamoDB**

Introduction to amazon dynamoDB, amazon dynamo DB Key concepts, partition and data distribution, secondary indexes, read/write throughput, streams and global tables, backup and restore, basic operations for amazon dynamoDB tables.

**Module 6 - Caching Information for Scalability**

Caching overview, caching with amazon cloudfront, caching with amazon elasticache, caching strategies.

**Module 7 - Introduction to Containers**

Introduction to containers, Container VS Hardware virtualization, Microservices-use case for containers, Amazon container services.

**Module 8 - Developing Solutions with Amazon SQS and Amazon SNS**

Introduction to message queues, introduction to amazon SQS, amazon SQS developer concepts, introduction to amazon SNS, amazon SNS developer concepts, introduction to amazon MQ.

**Module 9 - Developing Event-Driven Solutions with AWS Lambda**

Introduction to server less computing with AWS lambda, overview of AWS lambda, Execution model for invoking lambda functions, AWS lambda permissions, overview of authoring and configuring lambda functions, overview of deploying lambda functions.

**Module 10 - Developing Solutions with Amazon API Gateway**

Application Programming Interfaces, Amazon API Gateway, Creating a RESTful API, Controlling Access to a RESTful API, Testing a RESTful API, Deploying a RESTful API, Invoking a RESTful API, Monitoring a RESTful API.

**Module 11 - Developing Solutions with AWS Step Functions**

Workflow Coordination in Distributed Applications, Introduction to AWS Step Functions, State Types, AWS Step Functions Use Case, AWS Step Functions API.

**Module 12 - Developing Secure Applications on AWS**

Secure Network Connections. Manage Application Secrets, Authenticate with AWS Security Token Service, Authenticate with Amazon Cognito.

**Module 13 - Deploying Applications on AWS.**

Introducing DevOps, Using AWS Code Services for CI/CD, Introducing Deployment and Testing Strategies, Deploying Applications with AWS Elastic Beanstalk, Deploying Applications with AWS CloudFormation, Deploying Serverless Applications with AWS SAM.

**List of Elective Courses**

**Elective-I/III**

**Course Name: Professional Java**

**Course Code: MCA222**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To be able to exhaustive coverage of advanced topics on Java from tools to enterprise Java
2. To provide ample application-based examples, with step-by-step explanations
3. To provide thorough understanding of each topic through extensive examples along with the program codes and screenshots
4. To provide relevant software installation and configuration information wherever necessary
5. To be able to work with comprises keywords, objective-type questions (with answers) and subjective-type questions for students at the end of all the chapters

Syllabus

**Unit 1**

**Revisited of GUI, Database Programming using JDBC Introduction to JDBC, JDBC Drivers& Architecture CURD operation Using JDBC Connecting to non-conventional Databases.Connectivity with SQL server, Oracle and MS access.**

**Unit 2**

**Networking , Networking Basics ,The Networking Classes and Interfaces InetAddress,Factory Methods ,Instance Methods ,Inet4Address and Inet6Address, TCP/IP Client Sockets,URL,URLConnection,Http URL Connection, The URI Class,Cookies, TCP/IP ServerSockets,Datagram, DatagramSocket ,DatagramPacket,**

**Unit 3**

**RMI (Remote Method Invocation) RMI overview RMI architecture, Designing RMIapplication, Executing RMI application. Example demonstrating RMI**

**Unit 4**

**Servlet: Web Application Basics. Architecture and challenges of WebApplication.Introduction to servlet life cycle Developing and Deploying Servlets ExploringDeployment Descriptor (web.xml). Handling Request and Response Initializing a ServletAccessing Database Servlet Chaining Session Tracking & Management Dealing withcookies Transferring Request Accessing Web Context Passing INIT and CONTEXTParameter Sharing information using scope object Controlling concurrent access UserAuthentication Filtering Request and Response Programming Filter Filter Mapping ServletListeners .**

**Unit 5**

Basic JSP Architecture Life Cycle of JSP (Translation, compilation) JSP Tags andExpressions Role of JSP in MVC-2 JSP with Database JSP Implicit Objects Tag LibrariesJSP Expression Language (EL) Using Custom Tag JSP Capabilities: Exception HandlingSession Management Directives JSP with Java Bean.

Course Outcomes (Cos):

Upon successful completion of this subject students should be able to:

CO1: Demonstrate the connectivity with SQL through JDBC and describe the JDBC architecture.

CO2: Learnthe essentials of the Java Networking Classes and Interfaces library.

CO3: Understand the RMI architecture, and Designing RMI application.

CO4: Develop applications using Servlet classand Web application using Java

CO5: Study JSP Architecture Life Cycle and Implementing JSP Tags in Web Applications

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | H | H |  |  |  |  |  | M |  |  |  |
| CO2 |  |  | M |  |  | L |  |  |  | M |  |  |
| CO3 |  |  |  | H |  |  |  |  |  |  |  | M |
| CO4 | L |  |  |  |  |  |  | H |  |  |  |  |
| CO5 |  | M |  |  | H |  |  |  |  | L |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. SachinMalhotra, SaurabhChaudhary, ''Programming in Java”,Second Edition, Oxford University Press , 2014.
2. Advance java programming, Oxford, Uttam Kumar Roy, April 2015.

**Reference Books**

1. Programming with Java A Primer, E.Balaguruswamy Tata McGraw Hill Companies
2. Java Programzing Language Ken Arnold Pearson
3. The complete reference JAVA2, Herbert schildt. TMH

**Course Name: Machine Learning**

**Course Code: MCA227**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**UNIT I Basics of Machine Learning and Python**

Review of Linear Algebra, Definition of learning systems; Designing a learning system, Goals andapplications of machine learning; Classification of learning system, Basic concepts in Machine Learning.

Python Basics – string, number, list, tuple, Dictionary, functions, conditional statement, Loopstatements, Numpy, Matplotlib, simple programming exercises using python.

**UNIT II Supervised Learning**

Linear regression with one variable, Linear regression with multiple variables, Logistic regression; LinearMethods for Classification; Linear Methods for Regression; Decision trees, overfitting.

**UNIT III Support Vector Machines**

Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification,Maximum Margin linear separators, non-linear SVM, Kernels for learning non-linear functions.

**UNIT IV Unsupervised Learning**

Learning from unclassified data, Clustering - Hierarchical Agglomerative Clustering, K-means partitionalclustering, Expectation maximization (EM) for soft clustering; Dimensionality reduction – PrincipalComponent Analysis, factor Analysis, Multidimensional scaling, Linear Discriminant Analysis.

**UNIT V Applications of Machine Learning**

Strategies, guidelines for good design, performance measurement, Reading Data, PreProcessing Data,handwriting recognition, object detection, face detection.

**Reference Books**

1. EthemAlpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010

2. Tom Mitchell, Machine Learning, McGraw-Hill, 1997

3. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.

4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning,

Second edition Springer 2007.

5. Richert& Coelho, Building Machine Learning Systems with Python

**Online Resources**

1. AndrewNg,“MachineLearning”,StanfordUniversity<https://www.coursera.org/learn/machine>

[-learning/home/info](https://www.coursera.org/learn/machine)

2. SudeshnaSarkar, “Introduction to Machine Learning”, IIT Kharagpur.<https://nptel.ac.in/courses/106105152/1>

3. Prof. BalaramanRavindran, “Introduction to Machine Learning”, IIT Madras.<https://nptel.ac.in/courses/106106139/1>

**COURSE OBJECTIVES**

1. To understand the basic concepts of Machine learning and decision trees.

2. To understand the Supervised Learning concepts

3. To understand the Support Vector Machine concepts.

4. To understand the unsupervised learning concepts

5. To understand the simple Machine Learning applications

**COURSE OUTCOMES**

By the end of the course, students will be able to

CO1. Explain Machine Learning concepts, classifications ofMachine Learning and write simple programs using python.

CO2. Describe Supervised Learning concepts

CO3. Explain Support Vector Machine concepts.

CO4. Describe unsupervised learning concepts anddimensionality reduction techniques

CO5. Discuss simple Machine Learning applications in a range ofreal-world applications using Python programming

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  |  | M |  | M | M |  |  | M |  |  |
| CO2 | H |  |  |  |  |  |  |  |  |  |  | M |
| CO3 | H | H |  |  |  |  |  | M |  |  |  |  |
| CO4 | H |  |  |  | H | L | H |  |  |  | M |  |
| CO5 |  | M | M |  |  | H |  |  |  |  |  |  |

H = Highly Related; M = Medium; L = Low

**Course Name: Data Warehousing and Data Mining**

**Course Code: MCA241**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**Course Objective:**

1. To know the basic concept of data mining, Architecture of a Data Mining System and the Knowledge Discovery Process
2. To provide the fundamental concepts of data warehousing technology.
3. To incorporates a step-by-step approach to designing and building a data warehouse.
4. To provides numerous review questions, multiple choice questions and other exercises at the end of each chapter.
5. To contain a running fabricate case-study to bring out practical aspects of building a data warehouse.

**Syllabus**

**Unit I**

**Introduction to Data mining**: Introduction, Architecture of a Data Mining System, The Knowledge Discovery Process , Integrating Data Mining with Data Warehouse, Related Areas of Data Mining , Data Mining Techniques

**Unit II**

**Data Warehousing**: Introduction to Data Warehousing: Historical Background, Increasing Demand for Strategic Information, Data Warehouse Defined, Data Warehouse Users, Benefits of Data Warehousing, Concerns in Data Warehousing. Features of a Data Warehouse, Data Granularity, the Information Flow Mechanism, Metadata, Two Classes of Data, The Lifecycle of Data, Data Flow from Warehouse to Operational Systems.

**Unit III**

**Architecture, Planning and Project Management**: Architecture, Characteristics of Data Warehouse Architecture, Data Warehouse Architecture Goals, Data Warehouse Architecture, Data Warehouse and Data Mart, Building Data Marts and its issues, Building Data Marts, Other Data Mart Issues.

Planning and Project Management: Project Management Principle, Data Warehouse Readiness Assessment, Data Warehouse Project Team, Planning for the Data Warehouse, Data Warehouse Project Plan, Planning for the Data Warehouse Server, Capacity Planning, Selecting the Operating System, Selecting the Database Software.

**Unit IV**

**Schema & Dimensional Modeling**: Schema: Dimensional Modeling, The Star Schema, The Snowflake Schema, Aggregate Tables, Fact Constellation Schema, The Strengths of Dimensional Modeling, Data Warehouse and the Data Model.

Dimensional Modeling: Characteristics of a Dimension Table, Characteristics of a Fact Table, T Types of Dimension Tables, Keys in the Data Warehouse (Star) Schema, Enhancing the Data Warehouse Performance, Technology Requirements.

**Unit V**

**Testing, Growth, Maintenance & OLAP**: Data Warehouse Design Review, Developing the Data Warehouse Iteratively, Testing, Monitoring the Data Warehouse, Tuning the Data Warehouse. OLAP: Need For OLAP, OLAP and Multidimensional Analysis, OLAP Functions, OLAP Applications, OLAP Models, OLAP Design Considerations, OLAP Tools and Products, Existing OLAP Tools, Data Design, Administration and Performance, OLAP Platforms.

**Course Outcomes (COs):**

**On successful completion of this course, the learner will be able to**

CO1: Describe the fundamental concepts, benefits and problem areas associated with data warehousing.

CO2: Describe the various architectures and main components of a data warehouse.

CO3: Design a data warehouse, and be able to address issues that arise when implementing a data warehouse.

CO4: Understand various schemes and data models.

CO5: Compare and contrast OLAP and data mining as techniques for extracting knowledge from a data warehouse.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  | H |  |  |  |  | H | M |  |  |  |
| CO2 |  |  |  | H |  | H |  |  |  | L |  |  |
| CO3 |  |  |  |  |  |  |  |  |  |  |  | M |
| CO4 |  |  |  | M |  |  |  | H |  |  |  |  |
| CO5 |  | H |  |  |  |  | M |  | H |  | M |  |

H = Highly Related; M = Medium; L = Low

**Text Books:**

1. Jiawei Han and MichelineKamber, “Data Mining- Concepts and Techniques”, (3e), Morgan Kaufmann Publishers, 2011
2. VikramPudi, ''Data Mining" , Third Edition, Oxford university Press

**Reference Books :**

1. PaulrajPonniah, “Data Warehousing”, (2e), Wiley India Pvt. Ltd., 2010
2. H. Witten and E. Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann, 2000.
3. M.H.Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson Education 2006.

**Course Name: Data Science & Analytics**

**Course Code: MCA242**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**Course Objectives**

1. Able to explain Statistical Analysis, Python Environment Setup and working of Numpy.
2. Able to design Data Visualization in Python using matplotlib.
3. Able to perform linear and multiple linear regression analyses.
4. Ability to select and implement machine learning techniques in real life applications.
5. Learn about computing environment that is suitable for the applications under consideration.

**Syllabus**

**Unit - I**

Data Science Overview, Data Analytics Overview, Statistical Analysis and Business Applications, Python Environment Setup and Essentials, Mathematical Computing with Python – NumPy: - Introduction to Numpy, Creating and Printing an ndarray, Class and Attributes of ndarray, Basic Operations, Slicing, Mathematical Functions of Numpy.

**Unit- II**

Data Manipulation with Pandas: - Introduction to Pandas, Understanding DataFrame, View and Select Data, Missing Values, Data Operations, File Read and Write Support, Pandas Sql Operation, Analyse different Dataset using Pandas.

**Unit- III**

Data Visualization in Python using matplotlib: - Introduction to Data Visualization, Line Properties, Plot and Subplots, Types of Plots, Draw a pair plot using seaborn library.

**Unit- IV**

Scientific computing with Python (Scipy):- Introduction to SciPy, SciPy Sub Package - Integration and Optimization, SciPy sub package - Statistics, Weave and IO, Solving Linear Algebra problem using SciPy.

**Unit- V**

Machine Learning with Scikit–Learn: Machine Learning Approach, Supervised Learning Model Considerations, Supervised Learning Models - Linear Regression, Logistic Regression, K Nearest Neighbours, Decision Tree: Regression and Classification Trees, Support Vector Machines, Unsupervised Learning Models.

**Course Outcomes (Cos):**

CO1: Students will able to explain Statistical Analysis,Python Environment Setup and working of Numpy.

CO2: Students will able to Manipulate and analysis data with Pandas

CO3: Students will able to design Data Visualization in Python using matplotlib.

CO4: Students will be able to learn about scientific computing with Python

CO5: Students will be able to learn Machine Learning Approaches using Scikit Learn.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  |  |  | H |  |  |  |  | M |  |  |  |
| CO2 |  | M |  | M |  |  |  |  |  | M |  |  |
| CO3 | M |  |  |  | M |  | L |  |  |  |  | M |
| CO4 |  |  | L |  |  |  |  | M |  |  |  |  |
| CO5 | H |  |  |  | L |  |  |  | M |  |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. Hastie, Trevor, et al., The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger., Applied statistics and probability for engineers. John Wiley & Sons, 2010.

**Course Name: Distributed Computing**

**Course Code: MCA243**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
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**Course Objective:**

1. To be familiar with the differences among: concurrent, networked, distributed, and mobile.
2. To be familiar with the Resource allocation, Inter Process and remote Communication.
3. To be familiar with the deadlock detection and avoidance techniques in distributed system.
4. To gain the knowledge of concept of shared memory in Distributed environment.
5. To be familiar with the Distributed file system, it’s Implementation and new trends in distributed file systems and their naming.

**Syllabus**

**Unit I**

**Introduction:** Distributed System definition , Architectures for distributed systems, Distributed Computing Models , Software concepts , Network Operating System , Distributed Operating System , Multiprocessor Time-sharing System , Comparison of operating systems , Issues in designing Distributed Systems , Client–Server Model , Case Studies

Network Communication: LAN and WAN Technologies , Introduction to LAN and WAN , Classification of networks , Protocols for Network Systems , The ISO/OSI Reference Model , Internet Protocols , Asynchronous Transfer Mode , Protocols for distributed systems

**Unit II**

**Inter-process and Remote Communication:** Inter-process Communication: Message Passing, Introduction to Message Passing, Advantages and Features of Message- passing Systems , IPC Message format, Group Communication,

Remote Communication: Introduction to remote communication, Middleware, Remote Procedural Call Basics, RPC Implementation, RPC Communication

**Unit III**

**Synchronization:** Synchronization in distributed systems, Clock synchronization Mutual exclusion , Election algorithms , Atomic transactions , Deadlocks in distributed system , Threads, Thread usage and Implementation of thread packages, processor allocation

**Unit IV**

**Distributed Shared Memory:** Basic concepts of DSM, DSM architecture, Message passing vs shared memory, Types of DSMs, Advantages of DSM, Hardware DSM, On-chip memory DSM, Bus-based multiprocessor, Ring-based multiprocessor, Design Issues in DSM Systems , Granularity, Consistency models, Coherence protocols, Issues in implementing DSM Systems, Thrashing, Responsibility for DSM management, Replication vs migration strategies ,Replacement Strategy ,Heterogeneous and Other DSM Systems

**Unit V**

**File Systems and Naming:** Distributed File system: File service interface, semantics of the file sharing, Distributed file system, Implementation of new trends in distributed file systems

Naming: Features of Good Naming, System Oriented Names, Object, Locating Mechanisms, Name Caches, Naming and Security

**Course Outcomes (COs):**

**Upon successful completion of this subject students will able**

CO1: Describe the architecture and model of distributed computing and communication over network.

CO2: Develop, test and debug RPC based client-server programs in Unix.

CO3: Design and build application programs synchronous distributed systems.

CO4: Improve the performance and reliability of distributed shared memory.

CO5: Design and build newer distributed file systems for any OS.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | H |  |  |  | L |  |  |  |  | H |  |
| CO2 |  |  |  | H |  |  |  |  |  | M |  |  |
| CO3 | H |  |  |  |  |  |  | M |  |  |  | M |
| CO4 |  |  |  | H |  |  |  |  |  |  |  |  |
| CO5 |  | M |  |  | H |  |  |  | M |  |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books:**

1. Distributed Computing, Oxford University, Mahajan and Shah, June 2013.
2. “Distributed Computing South Asian Edition: Principles, Algorithms, and Systems” by Professor Ajay D Kshemkalyani and Professor MukeshSinghal.

**Reference Books**

1. “Distributed and Cloud Computing: From Parallel Processing to the Internet of Things” by Hwang
2. “Distributed Computing: Principles and Applications” by Liu
3. “Distributed Computing” by Sunita Mahajan and Seema Shah.

**Course Name: Big Data Analytics**

**Course Code: MCA244**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**Course Objective:**

1. To know the fundamental concepts of big data and analytics.
2. To explore tools and practices for working with big data
3. To learn about stream computing.
4. To know about the research that requires the integration of large amounts of data.
5. To know about clustering and classification.

**Syllabus**

**Unit I**

**Introduction To Big Data:** Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating- The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage – A General Overview of High-Performance Architecture - HDFS – Map Reduce and YARN – Map Reduce Programming Model

**Unit II**

**Clustering and Classification:** Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases -Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons toChoose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree – TheGeneral Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees inR - Naïve Bayes - Bayes‘ Theorem - Naïve Bayes Classifier.

**Unit III**

**Association and Recommendation System:** Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity - Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid Recommendation Approaches.

**Unit IV**

**Graph Memory And Stream Memory:** Using Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases - Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform - Considerations: Dedicated Appliances for Graph - Introduction to Streams Concepts – Stream Data Model and Architecture -Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elementsin a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

**Unit V**

**Nosql Data Management For Big Data And Visualization:** NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive -Sharding –- Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs- Review of Basic Data Analytic Methods using R.

**Course Outcomes (COs):**

**On successful completion of this course, the learner will be able to :**

CO1: Identify the difference between structured, semi-structured and unstructured data.

CO2: summarize the challenges of big data and how to deal with the same.

CO3: Explain the significance of NoSQL databases.

CO4: Explain about Hadoop Ecosystem.

CO5: Identify the difference between Pig and Hive.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | M |  |  |  | M |  |  |  | M |  |  |
| CO2 |  |  |  | M |  |  |  | M |  |  |  |  |
| CO3 |  |  |  |  | M |  |  |  |  |  | M |  |
| CO4 |  |  |  |  |  |  | H |  |  |  |  |  |
| CO5 | H | M |  |  |  | M |  |  | M |  |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration

**Reference Books**

1. Tom White, “Hadoop: The Definitive Guide”, Second Edition, O’Reilly Yahoo Press.
2. Robert D. Schneider, “Hadoop for Dummies”, Wiley.

VigneshPrajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing.

**Course Name: Cloud Computing**

**Course Code: MCA245**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**Course Objective:**

1. To understand basic cloud concepts and AWS Global Infrastructure.
2. To learn the basic concepts of networking in AWS.
3. To know the basic concepts of Computing Services in AWS
4. To demonstrate the basic concepts of AWS EBS.
5. To illustrate the basic concepts of AWS Cloud Architecture and Automatic Scaling and Monitoring.

**Syllabus**

**Unit I**

**Cloud Concepts Overview**: Introduction to cloud computing, advantages of cloud, Introduction to AWS, moving to AWS Cloud.

**AWS Global Infrastructure**: AWS Global Infrastructure, AWS services and AWS categories. AWS management console.

**Unit II**

**Networking in AWS**: Introduction, networking basics, Amazon VPC, VPC networking.

**Unit III**

**AWS Compute Services**: Introduction, Computer Services Overview, Amazon EC2, Amazon Lambda and Amazon Beasnstalk

**Unit IV**

**AWS EBS**: Introduction, Amazon Elastic Block Store Console, Working with EBS

**Unit V**

**AWS Cloud Architecture**: Introduction, AWS Well-Architected Framework Design Principles

**Automatic Scaling and Monitoring**: Introduction, Amazon Elastic Load Balancing, Amazon CloudWatch, Amazon EC2 Auto Scaling.

**Course Outcomes (COs):**

**Upon successful completion of this subject students should be able to:**

CO1: Understand basic cloud concepts and AWS Global Infrastructure.

CO2: Learn the basic concepts of networking in AWS.

CO3: Know the basic concepts of Computing Services in AWS.

CO4: Demonstrate the basic concepts of AWS EBS.

CO5: Illustrate the basic concepts of AWS Cloud Architecture and Automatic Scaling and Monitoring.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | √ |  |  |  | √ |  |  |  |  |  |  |
| CO2 |  |  |  | √ |  |  |  |  |  | √ |  |  |
| CO3 | √ |  |  |  |  |  |  |  |  |  |  | √ |
| CO4 |  |  |  | √ |  |  |  |  |  |  | √ |  |
| CO5 |  | √ |  |  | √ |  |  | √ | √ |  |  |  |

**Text Books:**

1. Cloud Computing by Dr. Kumar Saurabh, Wiley India, 2011.
2. Michael Miller, Cloud Computing: Web based applications that change the way you work and collaborate online, Que publishing, August 2009.

**Reference Books**

1. RajkumarBuyya, James Broberg, Andrzej M. Goscinski,”Cloud Computing**:**Principles and Paradigms”, Edition1, Wiley,2011
2. Barrie Sosinsky,”Cloud Computing Bible”,Edition1, Wiley-India, 2010
3. Ronald L. Krutz, Russell Dean Vines,”Cloud Security**:**A Comprehensive Guide to Secure Cloud Computing”, Edition 1 , Wiley- India,2010

**Course Name: Introduction to Salesforce**

**Course Code: MCA246**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**Course Objective:**

1. To introduce cloud computing and sales force approaches.
2. To understand the concept and features of CRM, Data Migration Import Wizard and Data Loader.
3. To describe needs of APEX as a Programming Language, Various Statements and Operators.
4. To demonstrate class and visual force.
5. To be able to understand the concept of Trigger Context Variables, Validation and Automation, Components, Client Controller and Server Controller.

**Syllabus**

**Unit I**

**Introduction to Cloud Computing & Sales force:** On premise and Cloud approach, IaaS, PaaS and SaaS, Clouds, Versions, Editions & Environments, Product & Project Development

MVC Pattern and Multitenent Architecture: Configuration, Development, Testing and Admin, along with 15 steps of Salesfroce.com, MVC Diagram, Multi-Tenant Diagram

Starting Designing Applications on Force.com: Basic Vocabulary, Registration, Navigation and Principles, Understanding the Same with Lightning, Relationships, All 6 Types, Validation, Page Layouts and Record Types

**Unit II**

**CRM:** Campaign, Lead, Account, Contact and Opportunity, Campaign, Lead, Account, Contact and Opportunity, Product, Proce Book, Quote, Forecast, Order, Asset, Case, Solution, Activity, Task, Event, Calendar, PaaS features for CRM.

Data Migration Import Wizard and Data Loader: Reports and Dash-Boards, Work flows, Process Builder, Approval Process, Security Profile, Role, Queues, Public Group, OWD, Sharing Rules, Permission Sets.

**Unit III**

**Introduction to Programming:** Need of APEX as a Programming Language, Various Statements and Operators, 9 types of operators and 5 types of statements, System.debug, Comments, Indentation, Naming Conventions, OOP, Business Class , Test Class, Test Methods, Creating object, calling methods, executing a program, Constructor / Method / Operator Over Loading / this, Default , Parameterised .

**Unit IV**

**Class and Visual Force:** Static and non-static members of a class, Class Summary, try catch, Collections list: Set, Map, Exception Handling, Assertions and Annotations: 6 types of Assertions and 3 Annotations, Database Statements: DML , MC inter relation, Database Statements : SOQL / SOSL, Visual Force - Types of Tags: 6 Types, Visual Force -Static / Dynamic Data, Org Sobject $User: {! } $User, Standard Controllers: Save, Save and New, Cancel ,Edit, Delete, Explanation of for each loop / Standard list Controller : Previous, Next, First Last, Custom Controller, VC / MVC Examples: Add numbers, Insert and fetch Record

**Unit V**

**Custom List Controller:** Insert and fetch Records, Schedule Apex: Interface, Batch Apex: 50 K, 50 Million, Triggers: if and its types, Trigger Context Variables, Validation and Automation, Components, Client Controller, Server Controller

**Course Outcomes (COs):**

**Upon successful completion of this subject students will able**

CO1: Introduce cloud computing and sales force approaches.

CO2: Able to understand the concept and features of CRM, Data Migration Import Wizard and Data Loader.

CO3: Describe needs of APEX as a Programming Language, Various Statements and Operators.

CO4: To demonstrate class and visual force.

CO5: Able to understand the concept of Trigger Context Variables, Validation and Automation, Components, Client Controller and Server Controller.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | √ |  |  |  | √ |  |  |  |  |  | √ |
| CO2 |  |  |  | √ |  |  |  |  |  | √ |  |  |
| CO3 | √ |  |  |  |  |  |  |  |  |  | √ |  |
| CO4 |  |  |  | √ |  |  |  |  |  |  |  |  |
| CO5 |  | √ |  |  | √ |  |  |  | √ |  | √ |  |

**Text Books:**

1. Wes Nolte ,‎ Jeff Douglas , “Salesforce Handbook” (3e), Lulu.com, 2011.

2. David Taber, “Salesforce.com Secrets of Success: Best Practices for Growth and Profitability”, 1 edition, Prentice Hall, 2009.

**Reference Books:**

1. Tom Wong, Liz Kao & Matt Kaufman “Salesforce for Dummies”,4th Revised edition edition ,John Wiley & Sons, 2010
2. Visual force practices by Michael Floyd, Don Robins, Dan Appleman, et al.
3. **Development with the Force.com Platform,** Jason Ouellette

**Course Name: Artificial Intelligence and Machine Learning**

**Course Code: MCA249**

|  |  |  |  |
| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**UNIT I Basics of Machine Learning and Python**

Review of Linear Algebra, Definition of learning systems; Designing a learning system, Goals andapplications of machine learning; Classification of learning system, Basic concepts in Machine Learning.

Python Basics – string, number, list, tuple, Dictionary, functions, conditional statement, Loopstatements, Numpy, Matplotlib, simple programming exercises using python.

**UNIT II Supervised Learning**

Linear regression with one variable, Linear regression with multiple variables, Logistic regression; LinearMethods for Classification; Linear Methods for Regression; Decision trees, overfitting.Ensemble Methods: Boosting, Bagging, Random Forests.

**UNIT III Support Vector Machines**

Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification,Maximum Margin linear separators, non-linear SVM, Kernels for learning non-linear functions.

**UNIT IV Unsupervised Learning**

Learning from unclassified data, Clustering - Hierarchical Agglomerative Clustering, K-means partitionalclustering, Expectation maximization (EM) for soft clustering; Dimensionality reduction – PrincipalComponent Analysis, factor Analysis, Multidimensional scaling, Linear Discriminant Analysis.

**UNIT V Neural Networks and Deep Learning**

Introduction to Neural Networks, Perceptron,Training Neural Network, Feed forward neural network, Convolutional Neural Networks, Recurrent Neural Networks

**Reference Books**

1. EthemAlpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010

2. Tom Mitchell, Machine Learning, McGraw-Hill, 1997

3. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..

4. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

5. Richert& Coelho, Building Machine Learning Systems with Python

**Online Resources**

1. AndrewNg,“MachineLearning”,StanfordUniversity<https://www.coursera.org/learn/machine>

[-learning/home/info](https://www.coursera.org/learn/machine)

2. SudeshnaSarkar, “Introduction to Machine Learning”, IIT Kharagpur.<https://nptel.ac.in/courses/106105152/1>

3. Prof. BalaramanRavindran, “Introduction to Machine Learning”, IIT Madras.<https://nptel.ac.in/courses/106106139/1>

**COURSE OBJECTIVES**

1. To understand the basic concepts of Machine learning and decision trees.

2. To understand the Supervised Learning concepts

3. To understand the Support Vector Machine concepts.

4. To understand the unsupervised learning concepts

5. To understand the simple Machine Learning applications

**COURSE OUTCOMES**

By the end of the course, students will be able to

CO1. Explain Machine Learning concepts, classifications ofMachine Learning and write simple programs using python.

CO2. Describe Supervised Learning concepts

CO3. Explain Support Vector Machine concepts.

CO4. Describe unsupervised learning concepts anddimensionality reduction techniques

CO5. Discuss simple Machine Learning applications in a range ofreal-world applications using Python programming

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  |  | M | M | M | M |  |  |  |  | M |
| CO2 | H | H |  |  |  |  |  |  |  |  |  | M |
| CO3 | H | H |  |  |  |  |  | M |  |  |  |  |
| CO4 | H |  | H | M | H | L |  |  |  |  | M |  |
| CO5 |  | M |  |  | M |  |  | H |  |  |  |  |

H = Highly Related; M = Medium; L = Low

**Course Name: Compiler Design**

**Course Code: MCA250**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
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**Course Objectives:**

1. To understand, design and implement a lexical analyzer.
2. To understand, design and implement a parser.
3. To understand, design code generation schemes.
4. To understand optimization of codes and run time environment.
5. To understand various compiler writing tools.

Syllabus

Unit I

Introduction to Compiler: Theory of Computer Languages, Design of a Language, Evolution of Compilers, Stages of Compilation: Lexical Analysis, Syntactic Analysis, Semantic Analysis, Intermediate Code Generation, Code Optimization, Code Generation, Symbol Table Management, Error Management.

**Unit II**

**Lexical Analysis and Syntax Analysis:** Lexical Analysis: Alphabets and Tokens in Computer Languages, Representation of Tokens and Regular Expression, Token Recognition and Finite State Automata, Implementation, Error Recovery.Syntax Analysis: Context-free Grammar and Structure of Language, Parser and its Types, Top down Parser, Bottom-up Parser, Parser Generator Tool (Yacc).

### Unit III

### Run-time Storage Organization Intermediate Code Generation: Need for Intermediate Code, Types of Intermediate Code, Representations of All Language Constructs by Three-address, Grammar Symbols and Attributes, Semantic Analysis, Semantic Routines for Intermediate Code Generation.

**Unit IV**

**Code Optimization:** Need for Optimization, Objectives, Performance factors, Writing Optimized Code at User Level, Construction of Basic Blocks and Processing, Data-flow Analysis Using Flow Graph, Principal Sources of Optimization and Transformations, Alias, Procedural Optimization, Loops in Flow Graphs, Loop Optimization.

**Unit V**

**Code Generations and Compiler Writing Tools**: Issues in Code Generation, Target Machine Architecture, Subsequent Use Information,Register Allocation, Directed Acyclic Graph Representation of Basic Blocks, Code Generation From Intermediate Code, Peephole Optimization, Code Scheduling, Lexical Tools, Syntactic Tools.

**Course Outcomes (COs):**

**On successful completion of this course, the learner will be able to :**

CO1: Learn the design and develop a comprehensive Compiler for a given language or an Introduction.

CO2: Analyze and able to design a compiler development with lexical and syntax analysis.

CO3: Describe all aspects of Run time storage with intermediate Code generation.

CO4: Implement various code optimization techniques.

CO5: Implement various optimization and code generation algorithms for the design of a compiler.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  |  |  | H |  |  |  |  |  | M |  |  |
| CO2 |  | H |  |  | L |  |  | M |  |  |  |  |
| CO3 |  |  | H |  |  |  |  |  |  |  | M |  |
| CO4 |  |  |  |  |  |  | H |  |  |  |  |  |
| CO5 | H |  |  | L |  |  |  |  | M |  |  |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. “Compilers: Principles, Techniques and Tools” by Alfred V Aho and Ravi Sethi
2. Compiler Design, Oxford University, Muneeswaran, November 2012.

**Reference Books**

1. “Engineering a Compiler” by Keith D Cooper and Linda Torczon
2. “Compiler Design in C” by Allen I Holob
3. “Elements of Compiler Design” by Meduna

**Course Name: Theory of Computation**

**Course Code: MCA252**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
| 3 | 1 | 0 | 4 |

**Course Objective**

1. To introduce the mathematical foundations of computation including automata theory.
2. To understand the concept of formal languages and grammars and the notions of algorithm, decidability, complexity, and computability.
3. To enhance/develop students' ability to understand and conduct mathematical proofs for computation and algorithms.
4. To enhance the ability to understand the concept of Regular Expression Formalism.
5. To be able to describe formation of Turing machine by Grammars.

Syllabus

Unit I

**Introduction**: Basic Concepts, Sets, Relations, Graphs, Languages, Mathematical Finite State Machines FSM: Concept of Basic Machine Induction,, Finite State Machine, Finite Automata,

Deterministic Finite Automata, Non-deterministic Finite Automata, Equivalence of NFA and DFA, NFA with є-Transitions, Equivalence of NFA and NFA with є-Transitions, Equivalence of DFA and NFA with є-Transitions, Finite Automata with Output, Equivalence of Moore and Mealy Machines, FSM Equivalence, DFA Minimization

**Unit II**

**Regular Expression:**  Formalism, Examples of Regular Expressions, Equivalence of Regular Expressions and Finite Automata, DFA to Regular Expression Conversion, Regular Sets and their Closure Properties, Pumping Lemma for Regular Languages, Decision Algorithms for Regular Sets, Applications of Regular Expressions and Finite Automata.

**Unit III**

**Turing Machine:** Elements of a Turing Machine, Turing Machine Formalism, Instantaneous Description, Transition Graph for Turing Machine, Complexity of a Turing   
Machine, Composite and Iterative Turing Machines, Universal Turing Machine, Multi-tape Turing Machine, Multi-stack Turing Machine, Multi-track Turing Machine, Solvable, Semi-solvable, and Unsolvable Problems, Halting Recursively Enumerable and Recursive Languages, Functions, Linear Problem Bounded Automata.

**Unit IV**

**Grammar:** Constituents of Grammar, Formal Definition of Grammar, Grammar Notations, Derivation Process, Derivation Tree, Context-free Languages, Ambiguous Context-free Grammar, Simplification of Context-free Grammar, Normal Forms, Chomsky Hierarchy, Equivalence of Right-linear and Left-linear Grammars ,Equivalence of Regular Grammars and Finite Automata Pumping Lemma for Context-free Languages, Kuroda Normal Form, Dyck Language, Derivation Graph, Applications of Context-free Grammar, Backus–Naur Form

**Unit V**

**Automata:** Elements of a PDM, Pushdown Automata, Finite Automata vs PDAPDA Accepting CFLs, DPDA vs NPDA, Equivalence of CFG and PDA, Closure Properties of CFLs, Additional PDA Examples. Parsing, Bottom-up Parsing, Working of a Bottom-up Parser, Automatic Construction of Bottom-up Parser.

**Course Outcomes (COs):**

**On successful completion of this course, the learner will be able to**

CO1: Students are able to understand basic terms TOC and FSM.

CO2: Enhance the knowledge Regular Expression and its fundamentals.

CO3: Determine formation of Turing machine by Grammars.

CO4: Students will be able to understand the different-2 types of grammars

CO5: Students will be able to describe the PDA, Parsing, Bottom-up Parsing.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  | H |  |  |  |  | H | M |  |  |  |
| CO2 |  |  |  | H |  | H |  |  |  | L |  |  |
| CO3 |  |  |  |  |  |  |  |  |  |  |  | M |
| CO4 |  |  |  | M |  |  |  | H |  |  |  |  |
| CO5 |  | H |  |  |  |  | M |  | H |  | M |  |

H = Highly Related; M = Medium; L = Low

**Text Books**

1. Vivek Kulkarni ''Theory of Computation" , Oxford University Press. 2013
2. Peter Linz, “An Introduction to Formal Languages and Automata”, (5e),Jones & Bartlett Learning, 2011.

**Reference Books:**

1. John C Martin, “Introduction to Languages and the Theory of Computation”, (3e), McGraw Hill, 2007.
2. J E Hopcroft, Rajeev Motwani& Jeffrey D Ullman, “Introduction to Automata Theory, Languages and Computation”, (3e), Pearson Education, 2006.
3. K. L. P. Mishra, N. Chandrashekharan, “Theory of Computer Science”, (3e),PHI publications, 2007.

**Course Name: Robotics Process Automation**

**Course Code: MCA253**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
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**Syllabus**

**Unit-1**

Programming Basics & Recap:- Programming Concepts Basics, Understanding the application, Basic Web Concepts,Protocols,EmailClients,DataStructures,DataTables,Algorithms,Software.

Processes, Software Design, SDLC:- Programming Concepts Basics – 2 Scripting,.Net Framework,.Net ,Fundamentals, XML, Control structures and functions, XML, HTML, CSS, Variables & Arguments.

RPA Basics:- History of Automation, What is RPA,RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated, Types of Bots, Workloads which can be automated.

**Unit- II**

RPA Advanced Concepts :Standardization of processes, RPA Development methodologies, Difference from SDLC, Robotic control flow architecture, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks& Challenges with RPA,RPA and emerging ecosystem

Installation :Installing Studio community edition, The User Interface, Keyboard Shortcuts, About Updating, About Automation Projects, Introduction to Automation Debugging, Managing Activation Packages, Reusing Automations Library, Installing the Chrome Extension,

Installing the Firefox Extension, Connecting your project to a source control system, Activities Guide

Variables :Managing Variables, Naming Best Practices, The Variables Panel, Generic Value Variables, Text Variables, True or False Variables, Number Variables, Array Variables, Date and Time Variables, Data Table Variables, Managing Arguments, Naming Best Practices, The Arguments Panel, Using Arguments, About Imported Namespaces, Importing New Namespaces

**Unit-III**

Control Flow :Control Flow Introduction, If Else Statements, Loops, Advanced Control Flow, Sequences, Flowcharts ,About Control Flow, Control Flow Activities, The Assign Activity, The Delay Activity, The Do While Activity, The If Activity, The Switch Activity, The While Activity, The For Each Activity, The Break Activity

Data Manipulation :Data Manipulation Introduction, Scalar variables, collections and Tables, Text Manipulation, Data Manipulation, Gathering and Assembling Data.

Recording and Advanced UI Interaction :Recording Introduction, Basic and Desktop Recording, Web Recording, Input/Output Methods, Screen Scraping, Data Scraping, Scraping advanced techniques. Selectors: Selectors, Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge.

**Unit-IV**

Advanced Automation concepts and techniques: Image, Text & Advanced Citrix Automation: Introduction to Image & Text ,Automation, Image based automation, Keyboard based automation, I nformation Retrieval ,Advanced Citrix Automation challenges, BestPractices,Using tab for Images, Starting Apps.

Excel Data Tables &PDF :Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting Data from PDF, Extracting a single piece of data, Anchors, Using anchors in PDF

Email Automation :Email Automation, Incoming Email automation, Sending Email automation

Exceptional Handling & Best Practices

Debugging and Exception Handling :Debugging Tools ,Strategies for solving issues ,Catching errors

Project Organization: What is project organization, Best practices, Avoiding pitfalls, Invoke Activity

**Unit-V**

Introduction to Orchestrator: Orchestrator: Tenants, Authentication, Users, Roles, Robots, Environments, Queues &Transactions, Schedules.

Emerging and Future Trends in IT: Emerging and Future Trends in IT: Artificial Intelligence, Machine Learning, Agent awareness, Natural Language Processing, Computer Vision

Capstone Project: Real life case studies which can be used to apply the concepts learnt during the course. The projects shall test student’s skills right from process transformation and documentation to the design and development of the actual robot.

**COURSE OBJECTIVE:**

1. To understand Basic Programming concepts and the underlying logic/structure

2. To describe RPA, where it can be applied and how it’s implemented

3. To describe the different types of variables, Control Flow and data manipulation techniques

4. To Understand Image, Text and Data Tables Automation

5. To describe automation to Email and various types of Exceptions and strategies to handle

**COURSE OUTCOMES:**

After the completion of the course the student will be able to

CO1 Students will be able to understand Basic Programming concepts and theunderlying logic/structure

CO2 Students will learn to describe RPA, where it can be applied and how itsimplemented

CO3 Students will be able to describe different types of variables, Control Flowand data manipulation techniques.

CO4 Students will be able to identify and understand Image, Text and DataTables Automation

CO5 Students will be able to describe automation to Email and various types ofExceptions and strategies to handle

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 |  | H |  |  |  | L |  |  |  |  | H |  |
| CO2 |  |  |  | H |  |  |  |  |  | M |  |  |
| CO3 | H |  |  |  |  |  |  | M |  |  |  | M |
| CO4 |  |  |  | H |  |  |  |  |  |  |  |  |
| CO5 |  | M |  |  | H |  |  |  | M |  |  |  |

H = Highly Related; M = Medium; L = Low

**Course Name: Advance Computer Architecture**

**Course Code: MCA254**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**Course Objective:**

1. To describe the operation of modern and high performance computers.
2. To undertake performance comparisons of modern and high performance computers.
3. To improve the performance of applications on modern and high performance computers.
4. To development of software to solve computationally intensive problems.
5. To enhance teamwork and leadership skills through the project.

**Syllabus**

**Unit I**

**Introduction to Advanced Computer Architecture and Parallel Processing:**  Four Decades of Computing, Flynn’s Taxonomy of Computer Architecture, SIMD Architecture, MIMD Architecture, Interconnection Networks

**Unit II**

**Performance Analysis of Multiprocessor Architecture:** Computational Models, an Argument for Parallel Architectures, Interconnection Networks Performance Issues, Scalability of Parallel Architectures

**Unit III**

**Instruction Set and Addressing Modes:** Pipelining, Categories of Instructions: General Instruction Format, General Addressing Modes, Program Control, An Example: the M68000 Addressing Modes, Instruction Set of MIPS Processor, Link to Subroutines, Three Instruction Formats, Three Ways of Branch/Jump Addressing, Three Addressing Modes for Operands, CISC vs. RISC

**Unit IV**

**Memory And I/O Cache Performance** – Reducing cache miss penalty and miss rate – Reducing hit time Main memory and performance – Memory technology. Types of storage devices –Buses – RAID – Reliability, availability and dependability – I/O performance measures designing an I/O system.

**Unit V**

**Multi-Core Architectures** Software and hardware multithreading – SMT and CMP architectures – Design issues –Case studies – Intel Multi-core architecture – SUN CMP architecture – heterogenous multi-core processors – case study: IBM Cell Processor.

**Course Outcomes (COs):**

**Upon successful completion of this subject students should be able to:**

CO1: Know the fundamental aspects of computer architecture design and analysis

CO2: Understand design, pipelining, instruction set, out-of-order execution, caches (memory hierarchies).

CO4: Understand virtual memory, storage systems, and simulation techniques

CO3: Know about computer performance, instruction set architecture design and implementation.

CO5: Know about Multi-Core Architectures, Software and hardware multithreading

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  |  | M |  |  |  |  | M |  |  |  |
| CO2 |  |  |  | H |  |  |  |  |  | L |  |  |
| CO3 |  |  |  |  |  | M |  |  |  |  |  | M |
| CO4 |  |  |  | M |  |  |  | H |  |  |  |  |
| CO5 | H |  | L |  |  |  | M |  |  |  | M |  |

H = Highly Related; M = Medium; L = Low

**Text Books:**

1. “Advanced Computer Architecture for Parallel Processing (Mcgraw Hill Series in Electrical and Computer Engineering)” by Kai Hwang
2. “Advanced Computer Architecture for Parallel Processing”, Wiley, Hesham El-Rewini and Mostafa Abd-El-Barr

**Reference Books**

1. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture :Ahardware/software approach” , Morgan Kaufmann /Elsevier Publishers, 1999.
2. “Computer Architecture and Parallel Processing” by Bharat Bhushan Agarwal and Sumit Prakash Tayal.
3. “Parallel Computers – Architecture and Programming” by Rajaraman V
4. Kai Hwang and Zhi.WeiXu, “Scalable Parallel Computing”, Tata McGraw Hill, NewDelhi, 2003.

**Course Code: MCA255**

**Course Name: Agile Software development**

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| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **C** |
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**Course Objectives:**

1. To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
2. To provide a good understanding of software design and a set of software technologies and APIs.
3. To do a detailed examination and demonstration of agile development and testing techniques.
4. To understand the benefits and pitfalls of working in an agile team.
5. To understand agile development and testing.

**UNIT I**

**Agile Methodology:-** Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

**UNIT II**

**Agile Processes**: - Lean Production – SCRUM, Crystal, Feature Driven Development- Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

**UNIT III**

**Agility And Knowledge Management:-** Agile Information Systems – Agile Decision Making – Earl‗S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

**UNIT IV**

**Agility and Requirements Engineering:-** Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

**UNIT V**

**Agility and Quality Assurance: -** Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Test Driven Development – Agile Approach in Global Software Development.

**Course Outcomes:**

**Upon completion of the course, the students will be able to:**

CO1 Realize the importance of interacting with business stakeholders in determining the requirements for a software system

CO2 Perform iterative software development processes: how to plan them, how to execute them.

CO3 Point out the impact of social aspects on software development success.

CO4 Develop techniques and tools for improving team collaboration and software quality.

CO5 Perform Software process improvement as an ongoing task for development teams and show how agile approaches can be scaled up to the enterprise level.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  |  |  |  |  |  |  | M |  |  |  |
| CO2 |  | M |  |  |  |  | L |  |  |  | M |  |
| CO3 |  | H | H |  |  |  |  |  |  |  |  | M |
| CO4 |  |  |  |  |  | M |  | H |  |  |  |  |
| CO5 | H |  |  | M |  | H |  | H |  | H |  | H |

H = Highly Related; M = Medium; L = Low

**Text Books:**

1. David J. Anderson and Eli Schragenheim, ―Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. Hazza and Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.

**REFERENCES:**

1. Craig Larman, ―Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004.
2. Kevin C. Desouza, ―Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

**Course Name: Introduction to Blockchain**

**Course Code: MCA256**

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| --- | --- | --- | --- |
| **L (Hr.)** | **T/P (Hr.)** | **Pr (Hr.)** | **Credits** |
|  |  |  |  |

**SYLLABUS**

**Unit I: Basics:**

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance,Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. •Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, ZeroKnowledge Proof.

**Unit II: Blockchain:**

Introduction, Advantage over conventional distributed database, Blockchain Network, MiningMechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee,Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Privateand Public blockchain.

**Unit III: Distributed Consensus:**

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, SybilAttack, Energy utilization and alternate.

**Unit IV: Cryptocurrency:**

History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum -Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

**Unit V: Cryptocurrency Regulation:**

Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market andGlobal Economy.

Applications: Internet of Things, Medical Record Management System, Domain Name Serviceand future of Blockchain

.

**Tutorial & Practical:** Naive Blockchain construction, Memory Hard algorithm –Hashcashimplementation, Direct Acyclic Graph, Play with Go-ethereum, Smart Contract Construction,Toy application using Blockchain, Mining puzzles

**Text Book**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, PrincetonUniversity Press (July 19, 2016).

**Reference Books**

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies

2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System

3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellowpaper.2014.

4. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereumsmart contracts

**COURSE OBJECTIVES**

1. Define clearly what blockchain technology is

2. Describe the intrinsic value of leading cryptocurrencies, Bitcoin and Ethereum

3. Identify current issues that exist concerning cryptocurrency

4. Explain the idea of distributed consensus

5. Evaluate security, privacy, and efficiency of a given blockchain system

**COURSE OUTCOMES**

By the end of the course, students will be able to

CO1. Understand how blockchain systems (mainly Bitcoin and Ethereum) work,

CO2. To securely interact with them,

CO3. Design, build, and deploy smart contracts and distributed applications,

CO4. Integrate ideas from blockchain technology into their own projects.

CO5.Understand and program a smart contract on the Ethereum test network

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcome** | **Program Outcome** | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | H |  |  |  |  |  |  |  | M |  |  |  |
| CO2 | H |  | M |  |  |  |  |  |  |  |  | M |
| CO3 |  |  |  | M |  |  |  |  |  | M |  |  |
| CO4 |  |  |  |  |  |  | H |  |  |  |  |  |
| CO5 |  | M |  |  | M |  |  | H |  |  |  |  |

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