Maharashtra Education Society

Abasaheb Garware College

(Autonomous)

(Affiliated to Savitribai Phule Pune University)

Three Year B.Sc. Degree Program **in Computer Science**

(Faculty of Science and Technology)

Syllabi under NEP

S.Y.B.Sc. (Computer Science)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2024-2025

Structure of the major for Course: B.Sc. (Computer Science)

Major : Computer Science

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of hours
2	III	Core	CS-201-MJ	Data Structures using C		2	30
			CS-202-MJ	Relational Database Management Systems		2	30
			CS-203-MJ	Computer Networks I		2	30
			CS-204-MJP	Computer Science Laboratory		2	4 per batch per week
		OE/GE	OE-201-CS	Basics of Cyber Security		2	30
		VSC	CS-221-VSC	Hardware and Networking		2	30
	IV	Core	CS-251-MJ	Object Oriented Programming using C++		2	30
			CS-252-MJ	Python Programming		2	30
			CS-253-MJ	Computer Networks II		2	30
			CS-254-MJP	Computer Science Laboratory		2	4 per batch per week
		OE/GE	OE-251-CS	Type Setting in LaTeX		1 + 1	15 + 2 per batch per week
		SEC	SEC-251-CS	Fundamentals of Data Science		2	30

Minor : Data Science

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of hours
2	III	Minor	CS-241-MN	Graph Theory		2	30
			CS-242-MNP	Lab course based on Graph Theory		2	4 per batch per week
	IV	Minor	CS-291-MN	Data Representation and Condensation		2	30
			CS-292-MNP	Lab Course based on Data Representation and Condensation		2	4 per batch per week

Minor : Internet of Things (IoT)

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of hours
2	III	Minor	CS-243-MN	Microcontroller Architecture & Programming		2	30
			CS-244-MNP	Lab course based on Microcontroller Architecture & Programming		2	4 per batch per week
	IV	Minor	CS-293-MN	Digital Communication and Networking		2	30
			CS-294-MNP	Practical course based on DigitalCommunication and Networking		2	4 per batch per week

CS-201-MJ Data Structures using C

Lectures: 30 (Credits-2)

Prerequisites:

- Basic knowledge of algorithms and problem solving
- Knowledge of C Programming Language

Course Objectives:

1. To understand analysis of algorithms.
2. To learn different array representation methods and uses.
3. To understand different types of linked list.
4. To learn use of linear data structures like stack and queue.
5. To acquire knowledge of nonlinear data structures, tree and graph.

Learning Outcomes: On completion of this course, students will be able to:

1. Analyze the algorithms on the scale of their performance.
2. Develop searching and sorting techniques to solve real world computing problems.
3. Apply linked list data structure for developing applications.
4. Understand applications of linear data structures like stack and queue.
5. Understand tree and graph operations with its applications.

Unit 1: Introduction to Data Structures and Algorithm Analysis 02

1.1 Introduction
- 1.1.1 Need of Data Structure
- 1.1.2 Data object, Data Structure, Abstract Data Type (ADT)
- 1.1.3 Types of Data Structures

1.2 Algorithm analysis
- 1.2.1 Space complexity, time complexity and examples of algorithms with linear, logarithmic, quadratic time complexities
- 1.2.2 Best, Worst, Average case analysis, Asymptotic notations (Big O, Omega Ω, Theta θ)Problems on time complexity calculation.

Unit 2: Array as a Data Structure 06

2.1 ADT of array, Operations on Arrays

2.2 Applications of Arrays
- 2.2.1 Searching
  - 2.2.1.1 Sequential Search
  - 2.2.1.2 Binary Search
  - 2.2.1.3 Comparison of searching methods
- 2.2.2 Sorting
  - 2.2.2.1 Terminology, Internal, External, Stable, In-place Sorting

2.2.2.2 Comparison Based Sorting methods - Bubble Sort, Insertion Sort
2.2.2.3 Non-Comparison Based Sorting algorithms - Counting Sort
2.2.2.4 Divide and Conquer strategy - Merge Sort, Quick Sort
2.2.2.5 Complexity analysis of sorting methods.

Unit 3: Linked List **06**

3.1 List as a Data Structure, comparison with array.
3.2 Dynamic implementation of Linked List, internal and external pointers
3.3 Types of Linked List
  3.3.1 Singly linked list
  3.3.2 Doubly linked list
  3.3.3 Circular linked list
  3.3.4 Doubly circular linked list
3.4 Operations on Linked List - create, traverse, insert, delete, search, sort, reverse, merge
3.5 Applications of Linked List – Polynomial representation, Addition of two polynomials

Unit 4: Stack **06**

4.1 Introduction
4.2 Implementation of Stack - Static and Dynamic, comparison between the two implementations
4.3 Operations on Stack – init(), push(), pop(), isEmpty(), isFull(), peek()
4.4 Applications of stack
  4.4.1 Function call and recursion
  4.4.2 String reversal, palindrome checking
  4.4.3 Expression types - infix, prefix and postfix, expression conversion and evaluation(implementation of infix to postfix conversion and evaluation of postfix expression)

Unit 5: Queue **06**

5.1 Introduction
5.2 Types of Queue - Linear Queue, Circular Queue, Priority Queue, Double Ended Queue
5.3 Implementation - Static and Dynamic, comparison between the two implementations
5.4 Operations on Queue - init(), enqueue(), dequeue(), isEmpty(), isFull(), peek()
5.5 Applications of queue
  5.5.1 CPU Scheduling in multiprogramming environment

Unit 6: Non-linear data Structures **04**

6.1 Concept of tree and Terminologies

6.2 Concept and types of Binary trees - skewed tree, strictly binary tree, full binary tree, complete binary tree, expression tree, binary search tree, Heap
6.3 Representation of binary tree (dynamic)
6.4 Traversal methods of Binary tree – preorder, inorder, postorder (Recursive implementation)
6.5 Operations on binary search tree - create, insert node, search a value
6.6 Applications of tree
6.7 Concept of graph and terminologies
6.8 Representation of Graph – Adjacency matrix, Adjacency list
6.9 Graph Traversals – Breadth First Search and Depth First Search
6.10 Applications of graph

Reference Books:

1. Classic Data Structures - D. Samanta, Prentice Hall India Pvt. Ltd.
2. Fundamentals of Data Structures in C - Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, 2nd Edition, Universities Press.
3. Data Structures using C and C++ - Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Pearson Education
4. Data Structures: A Pseudo code approach with C, Richard Gilberg, Behrouz A. Forouzan, Cengage Learning.

CS-202-MJ: Relational Database Management Systems

Lectures: 30 (Credits-2)

Prerequisites:

1. Basic Knowledge of RDBMS
2. Knowledge of SQL Queries
3. Basics of relational database design

Course Objectives:

1. To teach procedural extension of SQL
2. To be familiar with the basic issues of transaction processing like concurrency control and recovery
3. To understand data security and its importance

Learning Outcomes: On completion of this course, students will be able to:

1. Use database techniques such as SQL & PL/SQL
2. Understand transaction Management in relational database System.
3. Learn Database Security mechanisms.

Unit 1: Relational Database Design **04**

1.1 Introduction to Relational-Database Design (undesirable properties of a RDB design)

1.2 Concept of Decomposition Desirable Properties of Decomposition (Lossless join, Dependency Preservation)

1.3 Functional Dependencies – Basic concept, closure of set of Functional Dependencies, Closure of Attribute set

1.4 Concept of normalization, Normal Forms (Definition only) (1NF,2NF and 3NF, BCNF), Examples

Unit 2: Relational Database Design Using PLSQL **10**

2.1 Introduction to PLSQL

2.2 PL/PgSqL: Datatypes, Language structure

2.3 Controlling the program flow, conditional statements, loops

2.4 Stored Functions

2.5 Handling Errors and Exceptions

2.6 Cursors

2.7 Triggers

2.8 Views

Unit 3: Transaction Concepts and concurrency control **08**

3.1 Describe a transaction, properties of transaction, state of the transaction.
3.2 Executing transactions concurrently, Anomalies due to Interleaved Execution.
3.3 Schedules, types of schedules, concept of Serializability, Precedence graph for Serializability.
3.4 Ensuring Serializability by locks, different lock modes, 2PL and its variations.
3.5 Concurrency control without Locking - Timestamp Based Concurrency, Thomas Write Rule.
3.6 Deadlock
3.7 Deadlock handling - Deadlock Prevention (wait-die, wound-wait), Deadlock Detection and Recovery (Wait for graph).

Unit 4: Crash Recovery **04**

4.1 Failure classification
4.2 Log based recovery techniques (Deferred and immediate update)
4.3 Checkpoints
4.4 Database backup and recovery from catastrophic failure

Unit 5: Database Integrity and Security Concepts **04**

5.1 Introduction to Database security
5.2 Access Control
5.3 Methods for database security
  5.3.1 Discretionary access control method
  5.3.2 Mandatory access control
5.4 Use of views in security enforcement

Reference Books:

1. Database Management Systems by RaghuRamakrishnan, Mcgraw-hill higher Education publication
2. Database System Concepts by Henry F. Korth, Abraham Silberschatz, Tata McGraw-Hill Education publication
3. Practical Postgresql By Joshua D. Drake, John C Worsley O'Reilly publication

CS-203-MJ: Computer Networks I

Lectures: 30 (Credits-2)

Prerequisites: None

Course Objectives:

1. To provide the fundamental concepts of networking standards and technology.
2. To gain the knowledge of OSI/IP, TCP/IP model and addressing techniques.
3. To learn analog signal and digital signal.
4. To study different techniques for framing, error control, flow control and routing.
5. To learn IP address and the network protocols.

Learning Outcomes: On completion of this course, students will be able to:

1. Analyze the requirements for a given organization and select appropriate network architecture, topologies, transmission mediums and technologies.
2. Understand different network model and addressing techniques.
3. Calculate data rate limits for noisy and noiseless channel.
4. Understand different techniques for framing, error control, flow control and routing.
5. Understand the IPV4 and IPV6 network protocols.

Unit 1: Introduction to Data Communication 04

1.1 Concept, Characteristics and Components of Data communication
1.2 Types of Data flow – Simplex, Half Duplex, Full Duplex
1.3 Computer Networks applications –Business Application, Home Application, Mobiles
1.4 Broadcast and point-to-point networks
1.5 Network Topologies - Bus, Star, Ring, Mesh
1.6 Network Types- LAN, MAN, WAN, PAN, Wireless Networks

Unit 2: Network Models 06

2.1 OSI Model – layered architecture, peer-to-peer processes
2.2 TCP/IP Model – layers and Protocol Suite
2.3 Addressing-Physical, Logical, Port addresses, Specific addresses

Unit 3: Physical Layer 08

3.1 Analog and Digital data, Analog and Digital signals, Digital Signals-Bit rate, Bit length
3.2 Baseband Transmission, Broadband Transmission
3.3 Transmission Impairments– Attenuation, Distortion and Noise
3.4 Data Rate Limits– Noiseless channel: Nyquist's bit rate, noisy channel: Shannon's law
3.5 Performance of the Network Bandwidth, Throughput, Latency (Delay), Bandwidth –Delay Product, Jitters
3.6 Line Coding Characteristics, Line Coding Schemes–Unipolar -NRZ, Polar-NRZ-I, NRZ-L, RZ, Manchester and Differential Manchester

3.7 Transmission Modes, Parallel Transmission and Serial Transmission– Asynchronous, Synchronous and Isochronous

3.8 Switching-Circuit Switching, Message Switching and Packet Switching

Unit 4: Data Link Layer **08**

4.1 Framing – Concept, Methods – Character Count, Flag bytes with Byte Stuffing, Starting and ending Flags with Bit Stuffing

4.2 Elementary data link protocols – For Noiseless channel – Simplex, Stop and wait protocol

4.3 Sliding Window Protocols – 1-bit sliding, Go-Back N and Selective Repeat

4.4 Random Access Protocols – 1-persistent, p-persistent and non-persistent CSMA/CD, CSMA/CA

4.5 Controlled Access - Reservation, Polling and Token Passing

Unit 5: Network Layer **04**

5.1 IPv4 addresses: Address space, Notation, Classful addressing, Classless addressing

5.2 IPv4: Datagram, Fragmentation, checksum, options

5.3 NAT

Reference Books:

1. Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill.
2. Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13-212695-3, Pearson

CS-204-MJP: Computer Science Laboratory

No. of Sessions – 12 (Credits – 2)

Assignments of Data Structures using C:

1. Assignment on array: Matrix operations
2. Searching algorithms
   a. Sequential Search
   b. Binary Search
3. Sorting algorithms
   a. Bubble, Insertion, Selection Sort (any one)
   b. Quick, Merge Sort (any one)
   c. Count sort
4. Operations on Stack (push, pop, peek, isempty(), isfull())
5. Applications of Stack – palindrome, Conversion to postfix and evaluation of postfix (any one)
6. Operations on Queue and Implementation of priority queue
7. Operations on Singly linked list
8. Operations on Doubly linked list

Assignments of Relational Database Management System:

1. Stored Function
   a. A Simple Stored Function
   b. A Stored Function that returns a value
2. Cursors
   a. A Simple Cursor
   b. A Parameterize Cursor
3. Exception Handling
   a. Simple Exception- Raise Notice Level Messages
   b. Simple Exception- Raise Exception Level Messages
4. Triggers
   a. Before Triggers (insert, update, delete) (row level and statement level)
   b. After Triggers (insert, update, delete) (row level and statement level)
5. Views
   a. Creating Views on tables, and writing queries on the views.

OE-201-CS: Basics of Cyber Security

Lectures: 30 (Credits-2)

Prerequisites

1. Fundamentals of computer software and hardware.
2. Basic concepts of operating system and networking.
3. Practical knowledge of internet and use of networks.

Course Objectives:-

1. Identify Key concept and Terminology of Cyber Security.
2. Examine the concept of privacy and its legal protections.
3. Explain the primary concepts involving encryption.
4. Perform basic computer forensics.
5. Describe the social implications of cyber security.
6. Understand the risks and benefits of social networks.

Course Outcomes: **On completion of this course, Student will be able to**

1. Evaluate fundamental cyber security concepts, theories, and strategies as they apply to real world case studies.
2. Explain technical and non-technical security solutions on different types of cyber systems.
3. Assess risks, vulnerabilities, and threats to sample cyber systems.
4. Identify attributes associated with cyber security professionals.

Unit 1: Introduction to Cyber Security **6**

1.1 Overview of Cyber Security
1.2 Internet Governance – Challenges and Constraints
1.3 Cyber Threats: - Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage
1.4 Need for a Comprehensive Cyber Security Policy
1.5 Need for a Nodal Authority
1.6 Need for an International convention on Cyberspace
1.7 Challenges in cyber security

Unit 2: Cyber Security Vulnerabilities and attacks **8**

2.1 Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Threat Actors, Attacks
2.2 Open Access to Organizational Data, Weak Authentication
2.3 Unprotected Broadband communications
2.4 Poor Cyber Security Awareness
2.5 Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management

Unit 3: Securing Web Application, Services and Servers **8**

3.1 Introduction, Basic security for HTTP Applications and Services
3.2 Basic Security for SOAP Services
3.3 Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges

Unit 4: Intrusion Detection and Prevention **8**

4.1 Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider
4.2 Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software
4.3 Network based Intrusion detection Systems, Network based Intrusion Prevention Systems
4.4 Host based Intrusion prevention Systems
4.5 Security Information Management, Network Session Analysis
4.6 System Integrity Validation

Reference Books:

1. Cyber security – Attack and Defense Strategies: 2nd Edition Paperback Yuri Diogenes (Author), Erdal Ozkaya (Author)
2. Cyber Security Basics: Protect your organization … (Paperback) by Franke, Don

CS-221-VSC : Hardware and Networking

Lectures: 30 (Credits-2)

Prerequisites: None

Course Objectives:

1. The Course shall introduce the Networking Concepts and its use in the Information Technology industry.
2. It also elaborates on the protection and security aspects.

Unit 1: Networking Fundamentals 10

1.1 Basics of Networks: - Definition, Need, Applications

1.2 Network Topologies: BUS, STAR, MESH, Hybrid: Definition, Advantages & Disadvantages, Applications

1.3 OSI Reference Model: Diagram, Working & Significance of Each Layer.

1.4 Protocol Basics: Definition, Types of Protocols

1.5 Usage of Various Protocols & Port numbers: TCP/IP, NetBeui, VPN, SNMP, FTP/SMTP/POP/HTTP, SSL/TSL

1.6 Arcnet, Ethernet, MAN, SAN, NAS, Virtual LANs, ATM's:- Definition, Need, Significance, Application

Unit 2: Networking Components (Hardware) 10

2.1 Networking Components (Hardware): Cables & Connectors (Coaxial, UTP/STP, Fiber Optics, Cat(x) Cables)

2.2 Switches (Unmanaged, Smart Web Managed, Full Managed), Hardware/Software Firewall

2.3 Study of UTM, Wireless Routers DSL/ADSL – Latest Examples and Usage

2.4 Advances in Network Applications: Mobile as a Network Client, Types & Application of CCTV

2.5 Network, Types and Application of Access Control Devices

Unit 3: Classification of Servers 10

3.1 Classification of Servers – Latest Versions with Examples and Applications

3.2 Function parameters/arguments (Actual, Formal) Concept of Client Server Technology- Definition, Need, Significance, Application

3.3 Application Server- Definition, Need, Significance, Application

3.4 File/Storage / Print Server- Definition, Need, Significance, Application

3.5 Mail / Web Servers- Definition, Need, Significance, Application

3.6 Data Base Server (Oracle /SQL) Definition, Need, Significance, Application

3.7 Network Video Recorder (NVR) Server- Video Surveillance Store

Reference Books: (All Latest Versions)

1. Cisco Certified Network Associate – BPB Publication

2. Upgrading and Trouble Shooting of Networks by Zackers
3. Computer Networks by Tanen Baum
4. Network Hand Book by Taylor

CS-241-MN: Graph Theory

Lectures: 30 (Credits-2)

Learning Objectives:

1. To introduce basic concepts of Graph Theory.
2. To use appropriate representation(s) of a graph for various applications.
3. To understand and implement important graph theory algorithms which are widely used in data science.
4. To get acquainted with graph database.

Course Outcomes: On completion of this course, student will be able to-

1. Understand the graph, and graph models, terminology of graph
2. Use concepts of Graph theory in data structures.
3. Understand need of unstructured (No-SQL) data base.
4. Familiarize with software like Neo4j.

Unit 1: An Introduction to graph **6**

1.1 Definitions, Basic terminologies and properties of graph, Graph models

1.2 Special types of graphs, basic terminologies, properties

1.3 Some applications of special types of graphs

1.4 Matrix representation and elementary results, Isomorphism of graphs

Unit 2: Connected graph and Trees **10**

2.1 Walk, trail, path, cycle, elementary properties of connectedness

2.2 Cut edge (Bridge), Cut vertex, cut set, vertex connectivity, edge connectivity and properties

2.3 Definition of a tree, basic terminologies, properties

2.4 Binary tree – definition and elementary properties

Unit 3: Graph Algorithms **10**

3.1 BFS, DFS

3.2 Definition of spanning tree, Kruskal's algorithm to find minimal spanning tree

3.3 Prim's algorithm to find minimal spanning tree

3.4 Shortest path problem, Dijkstra's algorithm

Unit 4: Graph Database **4**

4.1 Need of graph database

4.2 Introduction to graph database

4.3 Introduction of Neo4j

Text Book:

Kenneth Rosen, Discrete Mathematics and its applications, Tata McGraw Hill, Seventh Edition.

Unit 1: Chapter 8: Sec. 8.1, 8.2, 8.3
Unit 2: Chapter 8: Sec. 8.4
Unit 3: Chapter 8: Sec. 8.5, 8.6
Unit 4: Chapter 9: Sec. 9.1, 9.2, 9.3, 9.4, 9.5.

Reference Books:

1. John Clark and Derek Holton, A first look at Graph theory, Allied Publishers.
2. Narsingh Deo, Graph Theory with applications to computer science and engineering, Prentice Hall.
3. Douglas B. West, Introduction to Graph Theory, Pearson Education, second edition.

CS-242 – MNP : Lab course based on Graph Theory

No. of Sessions: 12 (Credits 2)

List of Practical

Practical 1: Problems on Unit1.
Practical 2: Problems on Unit 2 (Connected graphs)
Practical 3: Problems on Unit 2 (Trees)
Practical 4: Problems on Unit 3 (DFS, BFS)
Practical 5: Problems on Unit 3 (Prim's algorithm)
Practical 6: Problems on Unit 3 (Kruskal's algorithm).
Practical 7: Problems on Unit 3 (Dijkstra's algorithm)
Practical 8: Miscellaneous Problems.
Practical 9: Python codes for DFS / BFS
Practical 10: Demo of Neo4j

CS-243-MN: Microcontroller Architecture & Programming

Lectures 30 (2 Credits)

Course Objectives:

1. To study the basics of microcontroller IC 8051.
2. To study the Programming of IC 8051.
3. To study the interfacing techniques of microcontroller IC 8051.
4. To design different application circuits using microcontroller IC 8051

Course Outcomes: On completion of the course, student will be able

1. To develop programs for 8051 microcontroller
2. To interface I/O peripherals to 8051 microcontroller
3. To design small microcontroller based projects

Unit 1: Basics of Microcontroller & Intel 8051 architecture **08**

1.1. Introduction to microcontrollers
1.2. Difference between controller and processor
1.3. Architecture of 8051
1.4. Internal block diagram
1.5. Internal RAM organization
1.6. SFRS
1.7. Pin functions of 8051
1.8. I/O port structure & Operation
1.9. External Memory Interface

Unit 2: Programming model of 8051 **10**

2.1 Instruction classification
2.2 Instruction set
2.3 Addressing Modes - Immediate, register, direct, indirect and relative
2.4 Assembler directives (ORG, END)
2.5 Features with examples
2.6 I/O Bit & Byte programming using assembly language for LED and seven segment display (SSD) interfacing
2.7 Introduction to 8051 programming in C

Unit 3: Timer / Counter, Interrupts **07**

3.1 Timer / Counter: TMOD, TCON, SCON, SBUF, PCON Registers
3.2 Timer modes
3.3 Programming for time delay using mode 1 and mode 2
3.4 Interrupts
    3.4.1 Introduction to interrupt
    3.4.2 Interrupt types and their vector addresses
    3.4.3 Interrupt enable register and interrupt priority register (IE, IP)

Unit 4: Interfacing, Serial Communication **05**

4.1 Programming of serial port without interrupt

4.2 Serial Communication - Synchronous and asynchronous serial communication

4.3 Use of timer to select baud rate for serial communication

4.4 Interfacing - ADC, DAC, LED, LCD, stepper motor, DC Motor, SSD, Relay and Buzzer

Reference Books :

1. 8051 microcontroller and Embedded system using assembly and C : Mazidi and McKinley, Pearson publications
2. The 8051 microcontroller – Architecture, programming and applications: K. Uma Rao and Andhe Pallavi, Pearson publications

CS-244-MNP : Lab course based on Microcontroller Architecture & Programming

No of sessions: 12 (2 Credits)

Assignments:

1. Arithmetic programmes using 8051: addition, subtraction, to find largest and smallest number in the given string
2. Interfacing of LED logic
3. Interfacing of LCD (8-bit mode)
4. Interfacing of LCD + keyboard (8-bit mode)
5. Interfacing of 7-segment
6. Interfacing of 7-segment+keyboard
7. Interfacing of DAC 0808
8. Interfacing of ADC 0804
9. Interfacing of DC motor
10. Interfacing of stepper motor
11. Interfacing of relay & buzzer
12. Project equivalent to two experiments

CS-251-MJ : Object Oriented Programming using C++

Lectures: 30 (Credits-2)

Prerequisites: Knowledge of C Programming Language

Course Objectives:

1. To learn principles of Object-Oriented Programming (OOP).
2. To learn operators, type casting, reference variable.
3. To understand concept of functions, default arguments.
4. To acquire the knowledge of function and operator overloading.
5. To learn concept of Inheritance, abstract class.

Learning Outcomes: On completion of this course, students will be able to

1. Understand object-oriented concepts such as data abstraction, encapsulation, inheritance, dynamic binding and polymorphism.
2. Make use of this pointer and access specifiers.
3. Apply new and delete operator.
4. Understand concept of polymorphism.
5. Illustrate concept of inheritance, virtual function, pure virtual function.

Unit 1: Object oriented concepts 02

1.1 Procedure-oriented programming Vs Object-oriented programming
1.2 Classes and objects
1.3 Abstraction
1.4 Inheritance
1.5 Polymorphism
1.6 Encapsulations

Unit 2: Introduction to C++ programming 07

2.1 Features of C++
2.2 Data Types and Operators
2.3 Type casting in C++
2.4 Reference variables, this pointer
2.5 Usage of namespace, Managing Console I/O, Usage of Manipulators
2.6 Access specifiers
2.7 Defining data members and member functions
2.8 Array of objects

Unit 3: Function in C++ 06

3.1 Constructor, types of constructors, Destructor
3.2 Memory allocation (new and delete)
3.3 Call by reference, Return by reference

3.4 Default arguments
3.5 Inline function
3.6 Static class members
3.7 Friend functions

Unit 4: Function and Operator overloading **07**

4.1 Function overloading
4.2 Overloading unary operators and binary operators (with member function and with friend function)
4.3 Overloading insertion and extraction operator

Unit 5: Inheritance **08**

5.1 Inheritance and its types
5.2 Constructor and destructor in derived class
5.3 Virtual base classes and abstract base classes
5.4 Function overriding
5.5 Virtual functions and pure virtual function

Reference Books:

1. Object Oriented Programming (C++) Balaguruswamy, McGraw Hill Education; Seventh edition
2. The Complete Reference C++ by Herbert Schildt, McGraw Hill Education; 4 edition
3. Mastering C++ by Venugopal, T Ravishankar, McGraw Hill Education; 2 edition A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India

CS-252-MJ: Python Programming

Lectures: 30 (Credits-2)

Prerequisites: None

Course Objectives:

1. To introduce programming concepts using python.
2. To use various data structures and control structures python.
3. To learn use of built-in functions, modules and develop user defined functions.
4. To write and execute python programs using OOP.

Learning Outcomes: On completion of this course, students will be able to:

1. Understand basic constructs of programming.
2. Determine the methods to create and develop Python programs by utilizing the data structures like lists, dictionaries, tuples and sets and control structures.
3. Use built-in functions, modules and develop user defined functions for problem solving.
4. To write python programs using OOP for problem solving.

Unit 1: Introduction to Python **03**

1.1 Need, Applications, program structure, interactive mode and script mode

1.2 Python Fundamentals – Keywords, Operators, Variables, Indentation, Comments, Input and Output in Python

Unit 2: Data Handling and Control statements **12**

2.1 Data Types – int, float, complex, boolean, none, string

2.2 String - declaration, manipulation, special operations, escape character, string formatting operator, Raw String, Unicode Strings, built-in String methods.

2.3 List - Concept, creating and accessing elements, updating & deleting elements of list, traversing a list, reverse, built-in List Operators - Concatenation, Repetition, In, Built-in List functions and methods.

2.4 Tuple - Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, Basic tuple operations - Concatenation, Repetition, in, Iteration, Built-in tuple functions, indexing, slicing and matrices.

2.5 Set - Concept, creating and accessing elements, Operations on Sets

2.6 Dictionary - Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions, Built-in Dictionary Methods.

2.7 Conditional Statements - if, if-else, nested if-else

2.8 Loops - for, while, nested loops, loop control statements (break, continue, pass)

Unit 3: Functions and Module **08**

3.1 Definitions and Uses, User defined functions, Function Calls
3.2 Types of functions, Parameters, Return values
3.3 Lambada functions
3.4 Recursion
3.5 Modules - Importing module, Creating & exploring modules, Math module, Pandas, Numpy

Unit 4: Object Oriented Programming **07**

4.1 Overview of OOP (Object Oriented Programming) – Abstraction, Encapsulation, Data Hiding, Inheritance,
4.2 Classes and Objects: Class Definition, Creating Objects, Instances as Arguments, Instances as return values, Built-in Class Attributes,
4.3 Inheritance with types
4.4 Constructor with types
4.5 Method Overriding

Reference Books:

1. An Introduction to Computer Science using Python 3 by Jason Montojo, Jennifer Campbell, Paul Gries, The pragmatic bookshelf-2013
2. James Payne, "Beginning Python": Using Python and Python 3.1, Wrox Publication
3. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python ", Green Tea Press, 2002
4. Introduction to Problem Solving with Python by E balguruswamy, TMH publication-2016
5. Beginning Programming with Python for Dummies Paperback – 2015 by John PaulMueller
6. Object-oriented Programming in Python, MichaelH. Goldwasser, David Letscher, Pearson Prentice Hall-2008
7. Numpy - https://ncert.nic.in/textbook/pdf/keip106.pdf

CS-253-MJ : Computer Networks II

Lectures: 30 (Credits-2)

Prerequisites: Basics of Computer Networks

Course Objectives:

1. To understand reliable and unreliable protocol.
2. To understand different protocols of application layer.
3. To learn and explore cryptographic techniques.
4. To explore the different methods used for Network/INTERNET security.

Learning Outcomes: On completion of this course, students will be able to:

1. Differentiate connection oriented and connection less service.
2. Understand the different protocols of Application layer.
3. Understand, compare and apply cryptographic techniques for data security.
4. Identify information security goals.

Unit 1: Network Layer : IPv6 Address 03

1.1 IPv6 addresses: Structure, address space

1.2 IPv6: packet format, Extension headers

Unit 2: Transport Layer 06

2.1 User Datagram Protocol (UDP) - Datagram Format, Checksum, UDP operations, Use of UDP

2.2 Transmission Control Protocol (TCP) - TCP Services – Process to-Process Communication, Stream Delivery Service- Sending and Receiving Buffers and Segments

2.3 TCP Features – Numbering System, Byte Number, Sequence Number, Acknowledgement Number, Flow Control, Error Control, Congestion Control

2.4 TCP Segment Format

2.5 TCP Vs UDP

Unit 3: Application Layer 08

3.1 Domain Name System (DNS) Name Space, Domain, Name Space, Distribution of Name Space, DNS in the Internet, Resolution

3.2 E-MAIL Architecture, User Agent, Message Transfer Agent-SMTP, Message Access Agent-POP3, IMAP4, Web Based Mail

3.3 File Transfer Protocol (FTP) Communication over control connection, Communication over Data Connection, Anonymous FTP

3.4 WWW Architecture, WEB Documents

3.5 HTTP - HTTP Transaction, Persistent and Non persistent Connection, Proxy Server

Unit 4: Cryptography and Network Security 07

4.1 Need for security

4.2 Principles of Security

- 4.3 Types of Attacks
- 4.4 Cryptography
- 4.5 Plaintext and Cipher Text
- 4.6 Substitution techniques
  - 4.6.1 Caesar Cipher
  - 4.6.2 Mono-alphabetic Cipher
  - 4.6.3 Polygram, Poly alphabetic Substitution
  - 4.6.4 Play fair
  - 4.6.5 Hill Cipher
- 4.7 Transposition techniques
  - 4.7.1 Rail-Fence
  - 4.7.2 Simple Columnar Transposition
- 4.8 Encryption and Decryption
- 4.9 Symmetric and Asymmetric Key Cryptography

Unit 5: Security in the Internet **06**

- 5.1 IPSecurity(IPSec)
  - 5.1.1 Two modes
  - 5.1.2 Two security protocols
  - 5.1.3 Services provided by IPSec
  - 5.1.4 Security association
  - 5.1.5 Internet key exchange
  - 5.1.6 Virtual private network
- 5.2 SSL/TLS
  - 5.2.1 SSL services
  - 5.2.2 Security parameters
  - 5.2.3 Sessions and connections
  - 5.2.4 Four protocols
  - 5.2.5 Transport layer security
- 5.3 PGP
  - 5.3.1 Security parameters
  - 5.3.2 Services
  - 5.3.3 Key rings
  - 5.3.4 PGP Certificates
- 5.4 Firewalls
  - 5.4.1 Packet filter firewall
  - 5.4.2 Proxy firewall

Reference Books:

1. Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill.
2. Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13-212695-3, Pearson

CS-254-MJP Computer Science Laboratory

No. of Sessions : 12 (Credits-2)

C++ Assignments:

1. Class and Objects
2. Functions in C++
3. Operator overloading
4. Inheritance

Python Assignments:

1. Mathematical functions from math, cmath modules.
2. Looping statements such as while, for etc, Tables using while
3. Strings :String operations: + : Concatenation, * : Repetition, String slice
4. Lists: List operations, Use of range function and Accessing list elements, Updating list: addition, removal or updating of elements of a list
5. Tuples: Defining a tuple, Index operator and slice operator, Tuple assignment, Tuple as a return value.
6. Sets: Operations on set
7. Dictionary : creation, updation and all operations
8. Assignement on functions
9. Programs on file handing
10. Programs on classes and objects

OE-251-CS: Type setting in LaTeX

Lectures: 15 (Credit-1)

Prerequisite : None

Course Objectives:

1. To Learn LaTeX from scratch in an easy-to-follow but highly effective way.
2. To get up to the level of professional document writeup, presentation creation and even generating graphics and figures in LaTeX.

Learning Outcomes: On completion of this course, students will be able to:

1. Use LaTeX and all its features in efficient way.
2. Create documents, presentations, graphics in LaTeX

Unit 1: Getting started with LaTeX **5**

1.1 The basic structure of a LaTeX document: documentclass, Title, author, date, and abstract, Commenting within the code

1.2 Formatting: Paper size and margins, Font size and font styles, Font color, Text Formatting, Text alignment, Headers and Footers, Page numbering, creating space using vspace and hspace.

1.3 Sections, subsections and more

1.4 Appendix

1.5 The Verbatim package

1.6 Lists: Enumerated and bullet points

1.7 Referencing: Footnotes and hyperlinks, Label and References

Unit2: Including files, figures and Referencing **10**

2.1 Inserting Tables and Figures: Inserting a picture / figure, Creating a table

2.2 Mathematical notation: Mathematical writing, The equations and align environments, Mathematical symbols and greek letters, Some frequently used mathematical expressions, How to deal with matrices

2.3 Theorems, propositions, definitions

2.4 Input Tex files

2.5 Bibliography: Creating a simple bibliography

Textbooks/ References:

1. https://miktex.org
2. https://www.latexproject.org
3. Introduction to LaTex (Pdf copy of this book will be provided in the class)

Lab Course Based on Typesetting in LaTeX
(Credit-1)

Assignments:

1. Basic tex document containing title, author, date.
2. Tex document including different font styles, font sizes, font color, and font background colors .
3. Create hyper link, Page size, Margin, Header and Footer.
4. Create different simple table in Tex document
5. Complex table with cell merge
6. Writing CV in Tex
7. Creating a Tex document – Forts in Maharashtra / Clean energy / Leaving in global village (yourdocument should include at least 90% of functionalities given in Unit 1)
8. Create mathematical equations in Tex document.
9. Write proof of *given* mathematics theorem in Tex. (Theorem and proof document to be given inthe lab by the instructor. Students are expected to reproduce it as it is.)
10. Write a short report of 4-5 pages on a topic (to be chosen by student).

SEC-251-CS : Fundamental of Data Science

Lectures: 30 (Credits-2)

Prerequisites:

- Problem solving using computers
- Basic mathematics and statistics
- Knowledge of Databases

Course Objectives:

1. To understand reliable and unreliable protocol.
2. To understand different protocols of application layer.
3. To learn and explore cryptographic techniques.
4. To explore the different methods used for Network/INTERNET security.

Learning Outcomes: On completion of this course, students will be able to:

1. Differentiate connection oriented and connection less service.
2. Understand the different protocols of Application layer.
3. Understand, compare, and apply cryptographic techniques for data security.
4. Identify information security goals.

Unit 1: Introduction to data science **04**

1.1 The 3 V's: Volume, Velocity, Variety

1.2 Relevance and Applications of Data Science

1.3 The Data Science Lifecycle

1.4 Types of Data - Structured, semi-structured, Unstructured Data, Problems with unstructured data

1.5 Data sources

1.6 Open Data, Social Media Data, Multimodal Data, standard datasets

1.7 Data Formats - Integers, Floats, Text Data, Text Files, Dense Numerical Arrays, Compressed or Archived Data, CSV Files, JSON Files, XML Files, HTML Files, Tar Files, GZip Files, Zip Files, Image Files: Rasterized, Vectorized, Compressed

Unit 2: Statistical Data Analysis **06**

2.1 Role of statistics in data science

2.2 Descriptive statistics - Measuring the Frequency, Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion: Range, Standard deviation, Variance, Interquartile Range

2.3 Inferential statistics - Hypothesis testing, Multiple hypothesis testing, Parameter Estimation methods, Measuring Data Similarity and Dissimilarity

2.4 Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes, Proximity Measures for Binary Attributes, Dissimilarity of Numeric Data: Euclidean, Manhattan, and Minkowski distances, Proximity Measures for Ordinal Attributes

2.5 Concept of Outlier, types of outliers, outlier detection methods

Unit 3: Data Preprocessing **10**

3.1 Data Objects and Attribute Types: Attribute - Nominal, Binary, Ordinal, Numeric, Discrete versus Continuous Attributes

3.2 Data munging/wrangling operations

3.3 Cleaning Data - Missing Values, Noisy Data (Duplicate Entries, Multiple Entries for a Single Entity, Missing Entries, NULLs, Huge Outliers, Out-of- Date Data, Artificial Entries, Irregular Spacings, Formatting Issues - Irregular between Different Tables/Columns, Extra Whitespace, Irregular Capitalization, Inconsistent Delimiters, Irregular NULL Format, Invalid Characters, Incompatible Datetimes)

3.4 Data Transformation – Rescaling, Normalizing, Binarizing, Standardizing, Label and One Hot Encoding

3.5 Data reduction

3.6 Data discretization

Unit 4: Data Visualization **10**

4.1 Introduction to Exploratory Data Analysis

4.2 Data visualization and visual encoding

4.3 Data visualization libraries

4.4 Basic data visualization tools - Histograms, Bar charts/graphs, Scatter plots, Line charts, Area plots, Pie charts, Donut charts

4.5 Specialized data visualization tools - Boxplots, Bubble plots, Heat map, Dendrogram, Venn diagram, Treemap, 3D scatter plots

Reference Books:

1. Data Science Fundamentals and Practical Approaches, Gypsy Nandi, Rupam Sharma, BPB Publications, 2020.
2. The Data Science Handbook, Field Cady, John Wiley & Sons, Inc, 2017
3. Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann, 2012.
4. A Hands-On Introduction to Data Science, Chirag Shah, University of Washington Cambridge University Press

CS-291-MN: Data Representation and Condensation

Lectures: 30 (Credits-2)

Learning Objectives:

1. To introduce methods in descriptive statistics
2. To explain the concept of descriptive statistics for real data
3. To introduce methods for finding correlation between variables

Unit 1: Introduction **7**

1.1 Raw data, attributes and variables, discrete and continuous variables. Presentation of data using frequency distribution and cumulative frequency distribution

1.2 Graphical Presentation of frequency distribution –histogram, stem and leaf chart, less than and more than type ogive curves

Unit 2: Measures of Central tendency and dispersion **10**

2.1 Measures of Central tendency: Mean, Mode, Median. Examples where each one of these is most appropriate. Partition values: Quartiles, Box-Plot

2.2 Measures of Dispersion: Range, Coefficient of range, Quartile deviation, Coefficient of quartile deviation, Variance, Standard Deviation, Coefficient of Variation

Unit 3: Moments **5**

3.1. Raw and Central moments: definition, computations for ungrouped and grouped data (only up to first four moments)

3.2. Relation between raw and central moments up to fourth order

3.3. Numerical problems related to real life situations

Unit 4: Skewness, Kurtosis and its measures **8**

4.1 Concept of symmetric frequency distribution, skewness, positive and negative skewness Measures of skewness-Pearson's measure, Bowley's measure, $\beta 1$, $\gamma 1$

4.2 Kurtosis of a frequency distribution, types of kurtosis: leptokurtic, platykurtic and mesokurtic, measure of kurtosis ($\beta 2$,$\gamma 2$) based upon moments

4.3 Numerical problems related to real life situations

Text Book:

1. Fundamentals of Applied Statistics, Gupta and Kapoor, S. Chand and Sons, New Delhi, 2014, Fourth Edition

Reference Books:

1. Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1991, Eight Edition
2. An Introductory Statistics, Kennedy and Gentle

CS-292-MNP : Lab course based on Data Representation and Condensation

No. of Sessions: 12 (Credits 2)

Manual problems solving practical

1. Problems based on Unit 1
2. Problems based on Measures of Central Tendency
3. Problems based on Measures of Dispersion.
4. Problems based on moments
5. Problems based on Measures of skewness and kurtosis

Practical using R software / Excel

1. Introduction to Excel / R software
2. Graphical Presentation of frequency distribution – bar graph, stem and leaf chart, ogive curves
3. Measures of Central Tendency
4. Measures of Dispersion.
5. Measures of skewness and kurtosis

CS-293-MN : Digital Communication and Networking

Lectures 30 (Credits 2)

Objectives:

1. To introduce to various aspects of data communication system
2. To introduce to different digital modulation schemes
3. To identify the need of data coding and error detection/correction mechanism.
4. To study bandwidth utilization techniques: multiplexing and spectrum spreading
5. To understand data link layer protocol: Media Access Control

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

1. Define and explain terminologies of data communication
2. Understand the impact and limitations of various digital modulation techniques
3. Acknowledge the need of spread spectrum schemes.
4. Identify functions of data link layer and network layer while accessing communication link
5. Choose appropriate and advanced techniques to build the computer network

Unit 1: Modulation and Demodulation **08**

1.1 Error Handling. Hamming code
1.2 Introduction to modulation and demodulation
1.3 Concept and need of modulation and demodulation
1.4 Digital Modulation techniques
1.5 Pulse Code Modulation (PCM)
1.6 FSK
1.7 QPSK and QAM

Unit 2: Multiplexing, Spectrum Spreading and Media Access Control **06**

2.1 Multiplexing techniques
2.2 Frequency division multiplexing
2.3 Wavelength division multiplexing
2.4 Time division multiplexing

Unit 3: Spectrum Spreading and Media Access Control **08**

3.1 Spread Spectrum techniques
3.2 Frequency hopping Spread Spectrum (FHSS)
3.3 Direct Sequence Spread Spectrum (DSSS)
3.4 Media Access Control (MAC)
3.5 Random Access Protocol - CSMA, CSMA/CD, CSMA/CA
3.6 Controlled Access Protocols - Reservation, Polling, Token passing

Unit 4: Computer Networking **08**

4.1 Introduction to computer networks
4.2 Types of networks - LAN, MAN, WAN, Wireless networks, Switching, Internet,
4.3 Network topology - point to point, Star, Ring, Bus, Mesh, Tree, Daisy Chain, Hybrid
4.4 Network devices - Repeater, Switch, Networking cables, Router, Bridge, Hub, Brouter,
4.5 Gateway. Wired LANs
4.6 Ethernet - Ethernet protocol, standard Ethernet, 100 MBPS Ethernet,
4.7 Gigabit Ethernet, 10Gigabit Ethernet,
4.8 Computer network model - OSI and TCP/IP.

Reference Books:

1. Communication Electronics: Principles and Applications, Frenzel, Tata Mc Graw Hill publication, 5th edition.
2. Data Communication and Networking, Forouzan, Mc Graw Hill publication, 5th edition
3. Computer Networks, Tanenbaum, pHI publication, 5th edition

CS-294-MNP : Lab course based on Digital Communication and Networking

No of sessions: 12(2 credits)

List of Experiments:

1. Study of 3 or 4 Bit Pulse Code Modulation technique
2. Study of Frequency Shift Keying
3. Study of Time Division Multiplexing
4. Study of Frequency Division Multiplexing
5. Study of Error detection and correction by using Hamming Code technique
6. CDMA
7. to 10. Simulation experiments of networking

- https://www.netacad.com/courses/packet-tracer
- https://skillsforall.com/learningcollections/cisco-packet-tracer?courseLang=en-US&utm_source=netacad.com&utm_medium=referral&utm_campaign=packet-tracer&userlogin=0

11. One activity equivalent to 2 practicals