

**Course Structure FOR
Choice Based Credit System of
B.Sc. (Computer Science) Program with effect from 2020-21
School of Science, UPRTOU, Prayagraj**

Semester	Course Code	Title of Paper	Credits	Max. Marks
I	UGCS -101	Computer Fundamental & PC Software	2	100
	UGCS -101P	Practical Work	2	100
II	UGCS -102	C Programming	2	100
	UGCS -102P	Practical Work	2	100
III	UGCS -103	Data Structures	2	100
	UGCS -103P	Practical Work	2	100
	Skill Enhancement Course			
	SBSCS-01	Discrete Mathematics	4	100
IV	UGCS -104	Introduction to Database Management System	2	100
	UGCS -104P	Practical Work	2	100
V	Discipline Centric Elective Course			
	DCECS -105	Computer Network	2	100
	DCECS -106	Operating System	2	100
	DCECS -107P	Practical Work based on 106	2	100
VI	Discipline Centric Elective Course			
	DCECS -108	C++ and Object Oriented Programming	2	100
	DCECS -109	Software Engineering	2	100
	DCECS -110P	Practical Work based on 108	2	100
Total Credit/Max. Marks			32	1500

UGCS-102 C Programming

Block 1: Introduction to algorithms and program design

Unit 1: Introduction to Algorithms

Problem solving techniques, Algorithm

Unit 2: Pseudo-codes and Flowcharts

Tools of Algorithm, Pseudo codes, Flowchart

Unit 3: Program design principles

Introduction to computer programming, Program design principles, Programming techniques, Program Errors

Block 2: Introduction to the 'C' programming language

Unit 1: Introduction

History of C Language, Structure of a 'C' program, Creating and Executing a 'C' program,

Unit 2: Data Types in 'C'

Character Set of 'C' language, Trigraph characters, Tokens, Identifiers, Keywords, Constants, Data types, Variables

Unit 3: Storage Classes

Scope and lifetime of variable, Storage classes, Automatic storage class, Register storage class, Static storage class, External storage class

Unit 4: Input and Output Functions

Reading a single character, Writing a single character, Formatted Input-Output, Formatted Input, Formatted Output

Block 3: Operator and Control Structures

Unit 1: Operators and Expressions

Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment and decrement operators, Conditional operators, Bitwise operators, Special operators, Operator Precedence and Associativity, lvalue and rvalue, Type casting: Promotion and Demotion of variable types

Unit 2: Decision Structures in 'C'

if statement, if else statement, nested if ... else statement, switch statement, goto statement

Unit 3: Loop Structures in 'C'

for statement, while statement, do while statement, break statement, continue statement

Unit 4: Arrays

One dimensional array, Two dimensional array, Multidimensional arrays, Strings, String handling functions, Character functions

Block 4: Advanced Features of C

Unit 1: Pointers

Pointers and Address (&) operator, Pointer declaration and Initialization, Indirection operator, Pointer Arithmetic, Arrays and Pointers, Character strings and Pointers, Array of Pointers, Pointer to Pointer

Unit 2: Functions

Functions, user-defined functions, categories of function, returning non-integer values, function arguments, recursion, arrays as function arguments

Unit 3: Structures, Unions, enum and typedef

Structure definition, Structures within structures, Structures as function arguments, Pointers to structures, Unions, Enumerated data type, Type definition

Unit 4: File and Memory Management in 'C'

Files, File Pointer Variable, Opening a file, Reading and writing to files, File Status Functions, Random Access to files, Command Line Arguments, Memory management

Unit 5: Preprocessor Directives and Error reporting

Macro directives, Conditional directives, Control directives, Error reporting

BLOCK - 1**UNIT 1: Introduction to data structure**

Algorithm, Basic criteria for algorithms, Data type, Data structure, Data representation, linear and non linear data structure.

UNIT 2: Basics of algorithm

Algorithm, Basics of complexity of algorithm

UNIT 3: Array

Definition, Representation of array, Single and multi-dimensional array, address calculation (one dimensional, two dimensional, multidimensional), sparse matrices

BLOCK - 2**UNIT 4: Stack**

Definition, Operations on stacks, Array representation and implementation of stack; infix, prefix and postfix representation of expression and evaluation multiple stacks, Application of stacks.

UNIT 5: Recursion

Recursive definition and processes, some named problems of recursion, principle of recursion: designing recursive algorithm, how recursion works, tail recursion.

UNIT 6: Queue

Definition, operation on queues, circular queue, dequeue, priority queue, Application of queue.

BLOCK 3**UNIT 7: Linked List**

Representation and implementation of single linked list, Operations in the singly linked list, stack and queue as a linked list, circularly linked list, doubly linked list, circularly doubly linked list, Application of linked list: polynomial representation and addition, garbage collection

UNIT 8: Tree

Basic terminology, binary tree, binary tree representation, complete binary tree, extended binary tree, array and linked list representations, traversing binary tree, threaded binary tree, binary search tree, Operations on BST, AVL tree, Operations on AVL tree, B-tree Insertion and deletion in B tree.

UNIT 9: Graph

Basic terminology Graph representation Depth first search, breadth first search, topological sort, connected components, spanning tree, minimum cost spanning tree, Kruskal's and prim's algorithm, Shortest path algorithms: Bellman Ford Algorithm, Dijkstra's algorithm, Floyd-Warshall algorithm.

BLOCK - 4**UNIT 10: Searching and sorting**

Sequential search, binary search, comparison and analysis, Selection sort, Bubble sort, Insertion sort, Heap sort, Quick Sort, Merge sort, Shell sort, radix sort.

UNIT 11: Hashing

Hash table, hash function, collision resolution strategies, hash table implementation.

UNIT 12: File Structure

Terminology, File organization, Sequential files, Direct File organization, Indexed Sequential file organization.

BLOCK - 1**UNIT 1: Overview of database management**

Introduction, Traditional oriented approach, Three view of data, The three level architecture of DBMS, DDL, DML, data model schemas and instances, Advantage and disadvantage of database management system.

UNIT 2: Database Models and implementation

Introduction, file management system, entity relationship model, the hierarchical model, network model. the relational model.

UNIT 3: Entity relationship model

ER model concept, notations of ER diagram, mapping constraints, keys, concept of super key, candidate key, primary key, verbalization, aggregation reduction of ER diagram to tables, extended ER model, relationship of higher degree.

BLOCK - 2**UNIT 4: Relational Model**

Concept, Formal definition of a relation, entirety. constraint, entity indigntiy, referential integrity, keys constraints, domain constraint, relational algebra relational calculus.

UNIT 5: SQL

Characteristic of SQL, Advantage of SQL, SQL data types, SQL commands, SQL operators, insertion, update and delete operations, joins, unions intersection, minus, views, queries and sub queries, aggregate function, cursor in SQL.

UNIT 6: Database Design

Conceptual, logical and physical design, Functional dependencies, normal form, first, second, third, BCNF, multi-valued dependencies, fourth normal form, join dependencies, fifth normal form, inclusion dependencies, lossless join decomposition, normalization using FD, MVD and JDs.

BLOCK - 3**UNIT 7: File Organization**

Introduction, file organization, sequential file organization, index-sequential file organization, direct file organization, multi key file organization.

UNIT 8: Transaction Processing Concept

Transaction system, testing of serializability, serializability of schedules, conflict and view serializable schedule, recoverability, recovery from transaction failure, Joe based recovery, checkpoints, deadlock handling, concept of concurrency.

Block 1: Computer Network Basics and Services**Unit 1: Introduction to Computer Network**

Computer networks, Network Hardware—Local Area networks, Metropolitan Area networks,, Wide Area networks, Wireless networks, Internetworks, Network Software: Protocol Hierarchies,

Unit 2: OSI and TCP/IP Model

Design and Issue for layers, Interfaces and services, Connection oriented and Connection less Services. OSI reference model, and its Evolution, TCP/IP model.

Unit 3: The Physical Layer:

Physical Layer, Transmission media, twisted pair, Base band and Broadband coaxial cable, Fiber optics, unguided media.

Unit 4: ISDN and Switching Techniques:

MODEM, ISDN services, Switching Message, Packet Circuit switching TDM, and FDM, ATM, X.25.

Block 2: Link Layer Issues and Access Protocols**Unit 5: Data Link Layer:**

Data Link Layer, Error detection and Correction, Protocols: Simplex Stop and wait protocols, One bit sliding window protocol, Using Go-Back N. Flow control, Sliding Window Protocol, Channel Allocation Problem,

Unit 6: Multiple Access Protocol: ALOHA, CSMA protocol, Collision Free protocol, Polling, FDM, TDM,

Unit 7: The Medium Access Sub Layer:

Framing, Static and Dynamic Channel Allocation in LANs and MANs, IEEE Standard 802.3, and Ethernet IEEE standard 802.4 and token Ring, IEEE Standard 802.5, Token Bus,

Unit 8: Network devices:

Hub, Bridges, Switch, Gateways, Routers.

Block 3: IP Addressing and Routing Issues**Unit 9: IP Protocol and Addressing:**

Network layer design issue, IP Protocol, IP Addresses, subnets,

Unit 10: Connection Management:

Internetworking, connectionless and connection oriented services, tunneling, Fragmentation, Firewall, Internet Controls Protocols.

Unit 11: Routing in Network Layer:

Routing Algorithm, shortest path routing, Flooding, Flow-based routing, Broadcast routing, Congestion Control Algorithm, Congestion control and prevention policies;

Block 4: Transport, Session, Presentation and Application Layer**Unit 12: Transport layer:**

Transport layer connection management, flow control, error control, congestion control, Establishing and releasing a connection, TCP service Model, TCP protocol

Unit 13: Session and Presentation Layer:

Introduction to cryptography and data compression

Unit 14: The Application Layer:

Network Security, Domain Name System, Email: Architecture and Services, Message formats, Message transfer.

UNIT 1: Introduction

Basic definitions, Batch processing, Multi-programming. Time sharing, multiprocessing; Structure and Functions of Operating System

UNIT 2: Process and thread

Process, Process states, State Transitions, Process Control Block, Context Switching, concept of thread, comparison between process and thread, Thread model, thread usage, implementing thread in kernel and user space.

UNIT 3: Process Scheduling

Scheduler, Scheduling criteria, Preemptive and non-preemptive scheduling, Process Scheduling, Process scheduling algorithms.

UNIT 4: Concurrent Process

Process Interaction, Shared Data and Critical Section, Mutual Exclusion, Synchronization, Classical Problems of Synchronization, Semaphores, Monitors.

BLOCK - 2**UNIT 5: Deadlock**

Concept of deadlock, necessary condition for deadlock, resource allocation graph, deadlock prevention, deadlock avoidance, Banker's algorithm, Deadlock detection, deadlock recovery.

UNIT 6: Memory management

Address Binding, Dynamic Loading and Linking Concepts, Logical and Physical Addresses Contiguous and non-contiguous memory allocation, Paging, Segmentation, Virtual Memory, Demand Paging, Page fault, Page replacement algorithms, thrashing.

UNIT 7: Secondary memory management:

Free Space management, Disk Structure, Disk Scheduling, Formatting, Swap space Management.

UNIT 7: Case Study of UNIX

SBSCS-01**Discrete Mathematics****Block—01: Language of Mathematics and its application**

Unit-01: Mathematical Logic: statements, operations, truth values, tautology and quantifiers.

Unit 02: Arguments: Rule of Detachment, Validity of a compound statement by using Truth Table, Validity using Simplification Methods, Validity using Rules of Inference, Invalidity of an Argument, Indirect Method of proof and Proof by Counter-Example.

Unit – 03: Boolean Algebra: Boolean Algebra, Principle of Duality, Isomorphic Boolean Algebras, Boolean Algebra as Lattices, Boolean Functions, Disjunctive Normal Form, Conjunctive Normal Form, Minimization of Boolean Functions (Karnaugh Map)

Unit – 04: Switching circuits and logical Circuits : Switching Circuits, Simplification of circuit, Non-Series Parallel Circuits, Relay Circuits, Logic Circuits

Block – 02: Set theory and its application

Unit-01: Set theory: sets, Subsets, Operations on Sets, Complementation, Intersection and Union, Laws Relating Operations, Distributive Laws and De Morgan's Laws.

Unit -02: Relation: Relation, binary relations in a Set, Domain and Range of a Relation, Total number of Distinct Relations, Relations as Sets of Ordered Pairs, Types of Relations, Composition of Relations, Equivalence relation in a set, Partition of a Set, Equivalence Class and Quotient set of a set.

Unit – 03: Partitions and Distributions: Equivalence Relations, Equivalence Classes, Properties of Equivalence Classes, Quotient set and Partition.

Unit – 04: Function: Functions, Direct and Inverse image, Inverse Functions, Operations on Functions, Composite of functions, Types of Functions and Connection between Equivalence relation and mapping.

Block – 03: Counting Process

Unit-01: Mathematical Induction: Principle of Mathematical Induction, Second Principle of Induction and Well ordering property.

Unit -02: Combinatorics: Basic counting principles, Principle of Disjunctive counting, Principle of Sequential counting and Ordered and Unordered Partitions.

Unit – 03: Permutation

Unit – 04: Combination

Block – 04: Probability theory and application

Unit-01: Binomial theorem: Binomial theorem, General term in a binomial expansion, Middle term in a binomial expansion and Binomial expansion for rational exponents.

Unit -02: Probability: Definition of Probability, Addition law for counting and Product law for counting.

Unit – 03: General Counting methods: General Counting method is the extension part of counting process. It discusses Sum and Product Rules and The Pigeonhole Principle.

Unit – 04: The Inclusion- Exclusion Principle: inclusion-exclusion principle, Alternative form of the inclusion-exclusion principle and Onto Functions.

UGCS-108

Object oriented programming with C++

BLOCK - 1

UNIT 1: Principles of object oriented programming

Object oriented programming paradigm, Comparison with procedural programming, Basic concepts of object oriented programming, benefits of OOP, object oriented Languages, advantage of C++.

UNIT 2: Object Orient Programming System

Class, inheritance, abstraction, encapsulation and information hiding, polymorphism, overloading.

UNIT 3: Advanced concept

Dynamism (Dynamic typing., dynamic binding, late binding, dynamic loading). Structuring programs, reusability, organizing object oriented project,

BLOCK - 2

UNIT 5: Overview of C++

Tokens, keywords, identifiers and constants basic data types, user-defined and derived Data types, type compatibility, reference, variables type Casting, operator precedence, control structures, structure, function.

UNIT 6: Classes and objects

Class specification, class objects, accessing class members, scope resolution operator, data hiding, empty classes, Pointers within a class, passing objects as arguments, returning objects from functions, friend Functions and friend classes, constant parameters and member functions, structures and Classes, static members.

UNIT 7: Object initialization and cleanup

Constructors destructor, constructor overloading. order of construction and destruction, Constructors with default arguments, nameless objects, dynamic initialization through Constructors, constructors with dynamic operations, constant objects and constructor, static Data members with constructors and destructors, nested classes.

BLOCK - 3

UNIT 8: Operator overloading and type conversion

Defining operator overloading, overloading unary operators, overloading binary operators, overloading binary operators using friends, manipulation of strings using Operators, rules for overloading operators. type conversions.

UNIT 9: Inheritance: extending classes

Deriving derived classes, single multilevel, multiple, hierarchical, hybrid inheritance, Constructors & destructors in derived classes, constructors invocation and data members Initialization, virtual base classes, abstract classes, delegation.

BLOCK- 4

UNIT 10: Pointers, virtual functions and polymorphism

Pointers to objects, this pointer. pointers to derived classes, virtual functions, Implementation of run-time polymorphism, pure virtual functions.

UNIT 11: Working with files

Classes for file stream operations. opening and closing a file, file pointers and their Manipulations, sequential input and output operations, error handling during file Operations, command line arguments.

UNIT 12: Object Oriented Modeling

Need of object oriented Modeling, Simulation of real life problems using OOP concept: Example, Representation of problem using object and class diagrams at design level.

UGCS-109 Software Engineering

UNIT-I Software Engineering Fundamentals: Definition of Software, Software characteristics, Software Applications. Software Process: Software Process Models - Waterfall model, prototyping model, spiral model, incremental model, concurrent development model. Project management Concepts: The Management Spectrum - The People, The Product The Process, The Project.

UNIT-II Software Process and Project Metrics : Measures , Metrics and Indicators , Software measurement Size -Oriented Metrics , Function - Oriented Metrics , Extended Function point metrics Software Project Planning : Project Planning Objectives , Software Project Estimation , Decomposition Techniques - Problem Based Estimation Process Based Estimation ,Empirical Estimation Models- The COCOMO Model Risk Analysis and Management: Software risks, Risk identification, Risk Projection, Risk Refinement, Risk Mitigation , Monitoring and Management.

UNIT-III Software Quality Assurance: Basic concepts- Quality, Quality Control, Quality Assurance, Cost of Quality , Software Quality Assurance (SQA) , Formal Technical Review Software Configuration Management: Baselines , Software Configuration Items, The SCM Process, Version Control, Change Control, Configuration Audit, Status Reporting. Analysis Concepts and Principles: Requirements Elicitation for Software, Analysis Principles. The Information Domain, Modeling, Partitioning, Essential and Implementation Views, Specification: Specification Principles, Representation, The Software Requirement Specification (SRS)

UNIT-IV Design Concepts and Principles: Design Principles, Design Concepts — Abstraction, Refinement, Modularity, Software Architecture, Control Hierarchy, Structural Partitioning, Data Structure. Software Procedure, Structure, Information Hiding, Effective Modular Design- Cohesion, Coupling Software Testing: Testing Objectives & principles, Unit Testing, Integration Testing (Top Down Integration , Bottom. Up Integration, Regression Testing, Smoke Testing), Validation Testing (Alpha and Beta Testing), System Testing (Recovery Testing, Security Testing, Stress Testing, Performance Testing).

UNIT-V Reengineering: Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering CASE Tools: What is CASE, Building Blocks of CASE, A Taxonomy of CASE Tools, Integrated CASE Environments, The integration Architecture, The CASE Repository.