CONTENTS

Session 1: Analysis of Algorithm, Mathematics & Bit Manipulation

- Asymptotic Analysis
- Time and Space Complexity
- Masters Theorem
- Bitwise Operators (Bitwise AND, Bitwise OR, Bitwise XOR, Left Shift, Right Shift, etc)
- **Problems:** GCD and LCM, Iterative Power, Generate Power Set, etc

Session 2: Arrays

- Arrays - Introduction and Advantages
- Types of Arrays
- Operations of Arrays - Searching, Insertion, and Deletion
- Sliding Window Technique
- **Problems**: Largest Element in an Array, Leaders in an Array Problem, Maximum Subarray Sum, etc

Session 3: Linked List

- Introduction to Linked List
- Traversing a Linked List
- Insertion and Deletion of Node in Linked List
- Doubly Linked List and Circular Linked List
- **Problems:** Middle of Linked List, Deleting a Node without accessing Head pointer of Linked List, etc

Session 4: Stack

- Stack - Introduction and Applications
- Stack Operations (e.g. push, pop, etc)
- Array Implementation of Stack
- Linked List Implementation of Stack
- **Problems:** Balanced Parenthesis, Next Greater Element, etc

Session 5: Queue and Deque

- Queue - Introduction and Application
- Implementation of Queue using Array
- Implementation of Queue using Linked List
- Deque - Introduction and Application
- **Problems:** Generate Numbers with Given Digits, First Circular Tour, etc

Session 6: Searching

- Linear Search
- Binary Search - Iterative and Recursive Approach
- Analysis of Binary Search
- Two Pointer Approach
- **Problems:** Index of the first Occurrence in SortedArray, Count 1s in a Sorted Binary Array, Square root of a number, etc

Session 7: Recursion and Backtracking

- Introduction to Recursion
- Writing Base Cases in Recursion
- Tail Recursion
- Introduction to Backtracking
- **Problems:** Print 1 to N Using Recursion, Rope Cutting Problem, Rat in a Maze, etc

Session 8: Sorting

- Overview of the Sorting Algorithm
- Sorting Algorithms e.g. Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort with Analysis
- Stability of Sorting Algorithms
- **Problems:** Minimum Difference in an Array, Chocolate Distribution Problem, etc

Session 9: Matrix and Hashing

- Multidimensional Array
- Passing 2D Arrays as an argument
- Hashing Introduction, applications, and analysis
- Collision Handling
- Hashing Function
- **Problems:** Transpose of a Matrix, Matrix in Snake Pattern, Count Distinct Elements, Frequencies of Array Elements, etc

CONTENTS

Session 10: Strings

- String Introduction
- Overview of Pattern Searching Algorithm
- Naive and Improved Naive Pattern Searching
- Rabin Karp Algorithm
- KMP Algorithm (Constructing LPS Array and Complete Algorithms)
- **Problems:** Palindrome Check, Reverse words in a string, Anagram Search, etc

Session 11: Tree

- Tree - Introduction and Application
- Introduction to Binary Tree
- Tree Traversal - Inorder, Preorder, and Postorder with Implementation
- Level Order Traversal
- Lowest Common Ancestor of a Binary Tree
- Serialize and Deserialize a Binary Tree
- **Problems:** Height of a Binary Tree, Diameter of a Binary Tree, etc

Session 12: Binary Search Tree

- BST - Introduction and Application
- Search in BST with Implementation
- Insert in BST with Implementation
- Deletion in BST with Implementation
- Self Balancing BST - AVL Tree, Red Black Tree
- **Problems:** Find Kth Smallest in BST, Vertical Sum in Binary Tree, Floor in BST, etc

Session 13: Greedy and Heap

- Introduction to Greedy Algorithm
- Binary Heap - Introduction
- Binary Heap - Insertion, Heapify, and Extract
- Binary Heap - Decrease, Delete and Build Heap
- Heap Sort
- Priority Queue
- **Problems:** Activity Selection Problem, Job Sequencing Problem, Sort K Sorted Arrays, etc

Session 14: Dynamic Programming

- Introduction to Dynamic Programming
- Dynamic Programming Approach vs Greedy Approach
- How to approach a DP Problem
- Memoization and Tabulation methods
- **Problems:** Coin Change Problem, Longest Common Subsequence, Subset Sum Problem, etc

Session 15: Graph

- Introduction to Graph
- Graph Representation(Adjacency List and Matrix)
- Breadth First Search - Introduction and Implementation
- Depth First Search - Introduction and Implementation
- Prims Algorithm - Introduction and Implementation
- Dijkstra Algorithm - Introduction and Implementation
- **Problems:** Bridges in Graph, Detect Cycle in a Directed Graph, etc

Session 16: Graph (Advanced)

- Kruskal's Algorithm
- Bellman-Ford Algorithm
- Ford-Fulkerson Algorithm
- **Problems:** Strongly Connected Components, Find the No. of Islands, etc

Session 17: OS Fundamentals, Process Management, and Synchronization

- Introduction to Operating Systems: Types of OS, Functions, Components
- Key Topics: Differences between major operating systems, Case studies
- Processes: Process states, Process control block (PCB), Process scheduling
- Threads: Multithreading models, User vs. Kernel threads
- CPU Scheduling: Scheduling algorithms (FCFS, SJF, Round Robin, Priority scheduling)
- Process Synchronization: Critical section problem, Semaphores, Mutex

Session 18: Deadlocks, Memory Management, and File Systems

- Deadlocks: Conditions, Detection, Prevention, Avoidance
- Memory Management: Contiguous allocation, Paging, Segmentation
- Virtual Memory: Demand paging, Page replacement algorithms (FIFO, LRU)
- File Systems: File concepts, Access methods, Directory structure
- File System Implementation: Allocation methods, Free space management
- Security and Protection: Access control, Authentication, Encryption

Session 19: Networking Basics, Data Link Layer, and Network Layer

- Introduction to Computer Networks: OSI and TCP/IP models, Network topologies
- Physical Layer: Transmission media, Switching techniques
- Data Link Layer: Framing, Error detection and correction, Flow control
- MAC Protocols: ALOHA, CSMA/CD, CSMA/CA
- Network Layer: Logical addressing (IPv4, IPv6), Subnetting, CIDR
- Routing: Distance vector routing, Link state routing, Path vector routing
- IP Protocols: ARP, RARP, ICMP, DHCP

Session 20: Transport Layer, Application Layer, and Network Security

- Network Devices: Routers, Switches, Gateways
- Transport Layer: TCP/UDP protocols, TCP connection management, Flow control, Congestion control
- Application Layer: DNS, HTTP/HTTPS, FTP, Email protocols (SMTP, POP3, IMAP)
- Network Security: Cryptography basics, SSL/TLS, Firewalls, VPNs
- Wireless Networking: Wi-Fi standards, Cellular networks

Session 21: DBMS Fundamentals and SQL

- Database Concepts: Definition, advantages over file systems
- ER Model: Entities, attributes, relationships, ER diagrams
- Relational Model: Relational schema, primary keys, foreign keys
- SQL Basics: DDL (CREATE, ALTER, DROP), DML (INSERT, UPDATE, DELETE), DQL (SELECT)
- Joins: Inner join, left join, right join, full join

- Functions: Aggregate functions (COUNT, SUM, AVG, MAX, MIN)
- Normalization Concepts: 1NF, 2NF, 3NF

Session 22: Advanced SQL and Transactions

- Views: Creating and managing views
- Indexes: Types of indexes, creating and using indexes
- Stored Procedures and Triggers: Basics of creating and using stored procedures and triggers
- Transaction Management: ACID properties, transaction states
- Recovery Techniques: Log-based recovery, checkpoints

Session 23: Quantitative Aptitude

- Number Systems: Divisibility rules, HCF and LCM
- Arithmetic Operations: Basic operations (addition, subtraction,division)
- Percentages: Calculations, Increase and decrease
- Ratio and Proportion: Simple ratio problems
- Profit and Loss: Cost price, Selling price, Discount

Session 24: Logical Reasoning and Data Interpretation

- Series Completion: Number series, Pattern recognition
- Blood Relations: Family tree
- Coding-Decoding: Letter and number coding
- Puzzles: Seating arrangement, Linear arrangement
- Data Representation: Tables, Bar graphs, Pie charts