Discrete Mathematics and Graph Theory

Unit-1. Sets, Relation and Function:

Operations and Laws of Sets,
Cartesian Products,
Binary Relation,
Partial Ordering Relation,
Equivalence Relation,
Image of a Set,
Sum and Product of Functions,
Bijective functions,
Inverse and Composite Function,
Size of a Set,
Finite and infinite Sets,
Countable and uncountable Sets,
Cantor's diagonal argument and The Power Set theorem,
Schroeder-Bernstein theorem

Unit-2. Principles of Mathematical Induction:

The Well-Ordering Principle,
Recursive definition,
The Division algorithm: Prime Numbers,
The Greatest Common Divisor:
Euclidean Algorithm
The Fundamental Theorem of Arithmetic
Basic counting techniques-inclusion and exclusion,
pigeon-hole principle,
permutation and combination

Unit-3.0 Propositional Logic:

Syntax,
Semantics,
Validity and Satisfiability,
Basic Connectives and Truth Tables,
Logical Equivalence:
The Laws of Logic,
Logical Implication,
Rules of Inference,
The use of Quantifiers

Unit-4.0 Proof Techniques:

Some Terminology,
Proof Methods and Strategies,
Forward Proof
Proof by Contradiction
Proof by Contraposition
Proof of Necessity and Sufficiency

Unit-5.0 Algebraic Structures and Morphism:

Algebraic Structures with one Binary Operation,
Semi Groups,
Monoids,
Groups,
Congruence Relation and Quotient Structures,
Free and Cyclic Monoids and Groups,
Permutation Groups,
Substructures,
Proof by Contraposition,
Proof of Necessity and Sufficiency.
Normal Subgroups,
Algebraic Structures with two Binary Operation,
Rings,
Integral Domain and Fields.
Boolean Algebraand Boolean Ring,
Identities of Boolean Algebra,
Duality, Representation of Boolean Function,
Disjunctive and Conjunctive Normal Form

Unit-6. Graphs and Trees:

Graphs and their properties,
Degree, Connectivity,
Path,
Cycle, Sub Graph,
Isomorphism,
Eulerian and Hamiltonian Walks,
Graph Coloring,
Coloring maps and Planar Graphs,
Coloring Vertices,
Coloring Edges,
List Coloring,
Perfect Graph, definition properties and Example,
rooted trees,
trees and sorting,
weighted trees and prefix codes,
Bi-connected component and Articulation Points,
Shortest distances.

Object Oriented Programming Using Java

Unit-1. OOP Concepts and Java Programming:

Introduction to Java:

History of java,
Java buzzwords,
basics of Java programming,
difference between procedural and object-oriented programming paradigm,
need for OOPs paradigm,
OOPs features,
advantages of oops, JDK, JRE and JVM,
data types,
variables,
operators,
control structures including selection,
looping, java methods,
compilation, and execution of simple program

Unit- 2. Objects, Classes, and Constructors in Java:

Objects and Classes: Basics of objects and classes in java,
declaring objects,
new keyword,
Defining and calling methods in class,
Array of Objects,
Constructors,
Different types of Constructors,
Overloading Methods and Constructors,
Method Binding,
Overriding and Exceptions,
Passing Object as parameters,
returning object,
Static members,
Concept of Access Modifiers (Public, Private, Protected, Default),
this Keyword,
garbage Collection,
finalize() method,
Nested and Inner Classes,
Exploring string class.

Unit- 3.0 Inheritance, Interfaces and Packages:

Inheritance:

Inheritance hierarchies,
Benefits of Inheritance,
super and subclasses,
member access rules,
super keyword,

Preventing inheritance:

final classes and methods,
the object class and its methods

Polymorphism:

Dynamic binding,
method overriding,
abstract classes and methods;

Interface:

Interfaces vs Abstract classes,
defining an interface,
implement interfaces,
accessing implementations through interface references,
extending interface

Packages:

Defining, creating and accessing a package,
understanding CLASSPATH,
importing packages

Unit- 4.0 Exception Handling:

Introduction to error and exception,
Error vs Exception,
Concepts of Exception Handling,
Benefits of exception handling,
exception types,
exception hierarchy,
checked and unchecked exceptions,
Usage of try, catch, throw, throws and finally,
multiple catch clauses,
Nested try statements,
Re throwing exceptions,
creating own exception sub classes.

Unit-5. Introduction to Multithreading:

Differences between multiple processes and multiple threads,
thread states,
creating threads,
interrupting threads,
thread priorities,
synchronizing threads,
inter thread communication

Unit-6. Files, The Collections Framework and Connecting To Database:

Files:

Streams,
byte streams,
character stream,
text input/output,
binary input/output,
random access file operations,
file management using file class;

The Collections Framework (java.util):

Collections overview,
Hierarchy of Collection Framework,
Collection Interfaces,

The Collection classes-

Array List,
Linked List,
Hash Set,
Tree Set,
Priority Queue,
Array Deque;

Connecting to Database:

Connecting to a database,
querying a database and processing the results,
updating data with JDBC.

Digital Electronics

Unit-1. Fundamentals of Digital Systems and logic families:
Digital signals,
digital circuits,
AND, OR, NOT, NAND, NOR and Exclusive-OR operations,
Boolean algebra,
examples of IC gates,
Number systems-
binary,
signed binary,
octal hexadecimal number,
binary arithmetic,
one‟s and two‟s complements arithmetic,
codes,
error detecting and correcting codes,
characteristics of digital lCs,
digital logic families,
TTL,
Schottky TTL and CMOS logic,
interfacing CMOS and TTL,
Tri - state logic

Unit-2. Combinational Digital Circuits:
Standard representation for logic functions K map representation,
simplification of logic functions using K-map,
minimization of logical functions.
Don‟t care conditions,
Multiplexer,
DeMultiplexer/Decoders,
Adders,
Subtractors,
BCD arithmetic,
carry look ahead adder,
serial adder,
ALU,
elementary ALU design,
popular MSI chips,
digital comparator,
parity checker/generator

code converters,
priority encoders,
decoders/drivers for display devices,
Q-M method of function realization

Unit-3. Sequential circuits and systems:

A 1-bit memory, the circuit properties of Bistable latch,
the clocked SR flip flop,
J- K-T and D types flip flops,
applications of flip flops,
shift registers,
applications of shift registers,
serial to parallel converter,
parallel to serial converter,
ring counter,
sequence generator,
ripple (Asynchronous) counters,
synchronous counters,
counters design using flip flops,
special counter IC‟s,
asynchronous sequential counters,
applications of counters

Unit-4. A/D and D/A Converters:

Digital to analog converters:

weighted resistor/converter,
R- 2RLadder D/A converter,
specifications for D/A converters,
examples of D/A converter lCs,
sample and hold circuit,

Analog to digital converters:

quantization and encoding,
parallel comparator A/D converter,
successive approximation A/D converter,
counting A/D converter,
dual slope A/D converter,
A/D converter using Voltage to frequency and voltage to time conversion,
specifications of A/D converters,
example of A/D converter ICs.

Unit-5. Semiconductor memories:

Memory organization and operation,
expanding memory size,
classification and characteristics of memories,
sequential memory,
read only memory (ROM),
read and write memory(RAM),
content addressable memory (CAM),
charge de coupled device memory (CCD),
commonly used memory chips, ROM as a PLD

Unit-6. Programmable logic devices:

Programmable logic array,
Programmable array logic,
complex Programmable logic devices (CPLDS),
Field Programmable Gate Array (FPGA).

Data Structure & Algorithms

Unit-1. Introduction: Basic Terminologies:

Elementary Data Organizations,

Data Structure Operations:

insertion,

deletion,

traversal etc.;

Analysis of an Algorithm,

Asymptotic Notations,

Time-Space trade off

Unit-2. Stacks and Queues:

ADT Stack and its operations:

Algorithms and their complexity analysis,

Applications of Stacks:

Expression Conversion and evaluation – corresponding algorithms and complexity analysis.

ADT queue,

Types of Queue:

Simple Queue,

Circular Queue,

Priority Queue;

Operations on each Type of Queues:

Algorithms and their analysis.

Unit-3. Linked Lists: Singly linked lists:

Representation in memory,

Algorithms of several operations:

Traversing,

Searching,

Insertion into,

Deletion from linked list;

Linked representation of Stack and Queue,

Header nodes,

doubly linked list:

operations on it and algorithmic analysis;

Circular Linked Lists:

all operations their algorithms and the complexity analysis.

Unit-4. Searching, Sorting and Hashing:

Linear Search and Binary Search Techniques and their complexity analysis.

Objective and properties of different sorting algorithms:

Selection Sort,
Bubble Sort,
Insertion Sort,
Quick Sort,
Merge Sort,
Heap Sort;
Performance and Comparison among all the methods,
Hashing

Unit-5.0 Trees:

Basic Tree Terminologies,

Different types of Trees:

Binary Tree,
Threaded Binary Tree,
Binary Search Tree,
AVL Tree;
Tree operations on each of the trees and their algorithms with complexity analysis.
Applications of Binary Trees.
B Tree,

B+ Tree:

definitions,
algorithms and analysis

Unit-6. Graph:

Basic Terminologies and Representations,
Graph search and traversal algorithms and complexity analysis.

Operating Systems

Unit-1. Introduction:

Concept of Operating Systems,
Generations of Operating systems,
Types of Operating Systems,
OS Services,
System Calls,
Structure of an OS Layered,
Monolithic,
Microkernel Operating Systems,
Concept of Virtual Machine.
Case study on UNIX and WINDOWS Operating System

Unit-2.

Processes:

Definition,
Process Relationship,
Different states of a Process,
Process State transitions,
Process Control Block (PCB),
Context switching.

Thread:

Definition,
Various states,
Benefits of threads,
Types of threads,
Concept of multithreads

Process Scheduling:

Foundation and Scheduling objectives,
Types of Schedulers,
Scheduling criteria:
CPU utilization,
Throughput,
Turnaround Time,
Waiting Time,
Response Time;
Scheduling algorithms:
Pre-emptive and Non pre-emptive,
FCFS, SJF, RR

Multiprocessor scheduling:
Real Time scheduling:
RM and EDF.

Unit-3. Inter-process Communication:
Critical Section,
Race Conditions,
Mutual Exclusion,
Hardware Solution,
Strict Alternation,
Peterson‟s Solution,
The Producer - Consumer Problem,
Semaphores,
Event Counters,
Monitors,
Message Passing,
Shared Memory,
Classical IPC Problems:
Reader‟s & Writer Problem,
Dinning Philosopher Problem etc

Unit-4.0 Deadlocks:
Definition,
Necessary and sufficient conditions for Deadlock,
Deadlock Prevention,
Deadlock Avoidance:
Banker‟s algorithm,
Deadlock detection and Recovery

Unit-5.
Memory Management:
Basic concept,
Logical and Physical address map,
Memory allocation:
Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction;
Paging and Segmentation:
Principle of operation – Page allocation – Hardware support for paging,

Protection and sharing,
Advantages and Disadvantages of paging and segmentation.

Virtual Memory:

Basics of Virtual Memory – Hardware and control structures – Locality of reference,
Page fault ,
Working Set ,
Dirty page/Dirty bit – Demand paging,

Page Replacement algorithms:

Optimal, First in First Out (FIFO),
Second Chance (SC),
Not recently used (NRU) and Least Recently used (LRU).

Unit-6.0

File Management:

Concept of File,
Access methods,
File types,
File operation,
Directory structure,
File System structure,
Allocation methods (contiguous, linked, indexed),
Free- space management (bit vector, linked list, grouping)
directory implementation (linear list, hash table),
efficiency and performance.

Disk Management:

Disk structure,
Disk scheduling - FCFS, SSTF, SCAN, C SCAN,
Disk reliability,
Disk formatting,
Boot-block,
Bad blocks

I/O Hardware:

I/O devices,
Device controllers,
Direct memory access,

Principles of I/O Software:

Goals of Interrupt handlers,
Device drivers,
Device independent I/O software
Secondary-Storage Structure