Annexure I

M.Tech. in Computer Science and Engineering

Written Examination Syllabus

Design and Analysis of Algorithms

Unit-I — Algorithm Design paradigms

Motivation, concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Structure of divide-and-conquer algorithms: sets and disjoint sets, Union and Find algorithms, quick sort, Finding the maximum and minimum, Quick Sort, Merge sort, Heap and heap sort.

Unit-II — Greedy Algorithms

Optimal storage on tapes, Knapsack problem, Job sequencing with deadlines, Minimum Spanning trees: Prim's algorithm, Kruskal's algorithm, Huffman codes.

Unit-III — Dynamic programming

Overview, difference between dynamic programming and divide and conquer, Matrix chain multiplication, Traveling salesman Problem, longest Common sequence, 0/1 knapsack.

Unit-IV — Backtracking

Queen Problem, Sum of subsets, graph colouring, Hamiltonian cycles. Branch and bound: LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem, Traveling Salesman Problem.

Unit-V — Computational Complexity

Complexity measures, Polynomial Vs non-polynomial time complexity; NP-hard and NP-complete classes, examples.

Computer Organization

Unit-I — General System Architecture

Stored Program control concept (Von-Neumann architecture principle), Flynn's Classification of computers (SIMD, MISD, MIMD), Structure organization (CPU, Caches, Main memory, Secondary memory unit and I/O), Register Transfer Operation, Micro-operations, Addressing Modes, Operation instruction set (Arithmetic and logical, Data transfer, Control flow), Instruction set format, Instruction Set Architecture (Instruction set based classification of processor i.e., RISC, CISC, RISC vs CISC Comparison).

Unit-II — Processor Design

Arithmetic and logic unit, Stack organization, CPU Architecture types, Accumulator Based- Register, Stack Memory, Register, Detailed data path of a typical register-based CPU, Fetch, Decode, and Execute Cycle.

Unit-III — Computer Arithmetic and Control Design

Addition and Subtraction, Multiplication Algorithms (Booth's Multiplication Algorithm), Division Algorithm, Floating point arithmetic operations.

Control Design: Microprogrammed and Hard-wired control options, Hard-wired design methods, State table method, Multiplier control, CPU control unit. Microprogrammed, Basic concepts, control Memory, Address Sequencing.

Unit-IV Memory Hierarchy & I/O Organization

Memory Hierarchy, need for Memory Hierarchy, locality of reference principle, cache memory, main & secondary, Memory parameters, access cycle time, cost per unit, concept of virtual memory. Programmed, Interrupt driven I/O, Direct Memory Access, Synchronous and asynchronous data transfer.

Unit-V Introduction to Parallelism

Goals of parallelism, Instruction level parallelism, pipelining, super scaling, Processor level parallelism, Multiprocessor system overview.

Operating Systems

Unit-I Introduction

Operating Systems, Definition, Types, Functions, Abstract view of OS, System Structures, System Calls, Virtual Machines, Process Concepts, Threads, Multithreading.

Unit-II Process Management

Process Scheduling, Process Co-ordination, Synchronization, Semaphores, Monitors Hardware, Synchronization, Deadlocks, Methods for Handling Deadlocks.

Unit-III Memory Management

Strategies, Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Page Placement and Replacement Policies

Unit-IV File System

Basic concepts, File System design and Implementation, Case Study: Linux File Systems, Mass Storage Structure, Disk Scheduling, Disk Management, I/O Systems, System Protection and Security.

Unit-V Distributed Systems

Introduction, Distributed operating systems, Distributed file systems, Distributed Synchronization.

Database Management Systems

Unit-I Introduction

Purpose of Database System, Views of data, data models, database management system, three- schema architecture of DBMS, components of DBMS. E/R Model, Conceptual data modelling, motivation, entities, entity types, attributes, relationships, relationship types, E/R diagram notation, examples.

Unit-II Relational Model

Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviours. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL.

Unit-III Database Design

Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF

Unit-IV Transactions

Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo- redo logging and recovery methods.

Unit-V Implementation Techniques

Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

Computer Networks

Unit-I Layered Network Architecture

ISO-OSI Model, TCP/IP, Data Communication Techniques: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Data Modems, Multiplexing Techniques, Frequency Division, Multiplexing Hierarchies, Transmission Media, Error Detection: Parity Check Codes, Cyclic Redundancy Codes.

Unit-II Data Link Protocols

Stop and Wait protocols, Noise free and Noisy Channels, Performance and Efficiency, Sliding Window protocols, MAC Sublayer: The Channel Allocation Problem, Carrier Sense multiple Access Protocols, Collision Free Protocols, FDDI protocol, Distributed Queue Dual Bus (DQDB) protocol, Virtual LAN.

Unit-III Network Layer protocols

Design Issues: Virtual Circuits and Datagrams, Routing Algorithms, Optimality principle, shortest path routing Algorithms, Flooding and Broadcasting, Distance Vector Routing, Link State Routing, Flow Based Routing, Multicast Routing; Flow and Congestion Control: General Principles, Congestion control in datagram subnets, Choke Packets, Load Shedding, Jitter Control, RSVP. Interworking: Bridges, Routers and Gateways, IP packet, IP routing

Unit-IV Transport Layer Protocols

Design Issues, Quality of Services, Introduction to sockets, Connection Management: Addressing, Connection Establishment and Releases, Use of Timers, Flow Control and Buffering, Multiplexing, The internet Transport Protocols: User Datagram protocol UDP/TCP Layering, Segment Format, Checks Sum, Timeout Connection Management.

Unit-V Session Layer Protocol

Dialog Management, Synchronization, OSI Session primitives, Connection Establishment. Introduction to network management: Remote Monitoring Techniques: polling, Traps performance management, Class of service, Quality of service, Security Management, Firewalls.

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