CSE-2201: Database Management Systems - I

Introduction: General overview and purpose of Database Management Systems (DBMSs), advantages, applications, common features and overall structure of the database. **Data modeling (Relational model):** structure of relational model, key constraints, referential integrity constraints, general constraints, Relational algebra: fundamental, additional and extended operations, aggregate functions, outer joins and database modification using RA. ER model: entity and relationship sets, constraints – key, mapping cardinality and participation constraints, strong and weak entity sets, E-R diagram, class hierarchies, aggregation, conceptual database design with the ER model, converting ER to relational model. **Database application development (SQL):** data definition and data manipulation languages, integrity constraints, basic queries, nested and complex queries, modification of the database, Views: definition, update on views, cursors, Extending DBMS functionality: stored procedures, assertions and triggers, embedded and dynamic SQL, DBMS administration: DBA, users, privileges, security etc. **Relational database design:** Features of good relational design, functional dependency theory - basic concept, uses, closure of a set of FDs, closure of attribute sets, canonical cover, algorithms for FDs, decomposition using FDs & its desirable properties, Normalization: atomic domains and first normal form, BCNF and 3NF, multi-valued dependencies and fourth normal form, decomposition algorithms for different normal forms, database design process.

CSE-2202: Design and Analysis of Algorithms - I

Introduction: Introduction to Algorithms, role of algorithms in computing with respect to state of the art researches. **Complexity Analysis and Recurrence Relation:** Asymptotic notations, growth of a function, methods to solve recurrence relation- Substitution method, Recursion tree method, Master method. **Graph Traversal:** Review of Breadth first search (BFS), Depth first search (DFS), Topological Sort, Strongly Connected Components, Euler Path, Articulation Point, Bridge, Bi-connected Components. **Shortest Path Algorithms:** Dijkstra's Shortest Path Algorithm, Bellman –Ford algorithm and negative cycle detection, Floyd-Warshall all pair shortest path algorithm, shortest path in Directed Acyclic Graph. **Divide & Conquer (DC):** Counting Inversion using merge sort, closest pair of points, finding Ak mod M using DC method, Finding median (in general k-th smallest element) in a set using DC in expected linear time. **Greedy Algorithms:** Elements and properties of Greedy algorithms, fractional knapsack, job scheduling with deadline minimum spanning tree: Prim's algorithm and Kruskal's algorithm. **Dynamic Programming:** Basic idea, properties and comparison with Divide & Conquer and Greedy Algorithms, general form of Dynamic Programming and Memorization, coin related problems, Longest Increasing subsequence (LIS), Longest Common Subsequence (LCS), 0/1 Knapsack, Matrix Chain Multiplication, Applications of Dynamic programming. **Network Flow:** Flow Networks, Max-Flow Min-cut theorem, Ford Fulkerson method and its limitation, Edmonds Karp algorithm, Maximum bipartite matching, minimum path cover, edge cover.

CSE-2203: Data and Telecommunication

Introduction: Communication model, data communication tasks, data communication network standards and organizations. Protocol architecture, communications between layers, peer to peer communication between remote layers, service access points, service primitives and communication between adjacent layers, encapsulation of PDUs, addition of headers on transmission; removal on reception, segmentation & reassembly by protocol layers. **Physical Layer:** Analog and digital data transmission, spectrum and bandwidth, transmission impairments, data rate and channel capacity. **Transmission Medium:** Characteristics and applications of various types of guided medium. **Wireless Transmission:** Characteristics and applications of wireless transmission-terrestrial and satellite microwave, radio waves, propagation mechanism, free space propagation, land propagation, path loss, slow fading, fast fading, delay spread, inter symbol interference, VSAT. **Digital transmission:** Line coding techniquesNRZ, RZ, Manchester, and differential Manchester encoding, AMI, Block coding, analog to digital conversion based on PCM, delta modulation, etc. **Analog transmission:** ASK, FSK, PSK, QPSK, QAM encodings, AM, PM, FM, etc. **Data Transmission:** Synchronous and asynchronous data transmission techniques. **Multiplexing:** FDM, international FDM carrier standards, synchronous TDM, international TDM carrier standards, statistical time division multiplexing. **Spread Spectrum:** Frequency hopping spread spectrum, direct sequence spread spectrum, code division multiple access. **Data Link Layer:** Error Detection and Correction; parity check, CRC, forward error correction technique, linear block code, hamming code, etc. **Data Link Control:** Line configurations, flow control and error control techniques- sliding window, stop and wait ARQ, selective reject ARQ and HDLC protocols.

CSE-2204: Computer Architecture and Organization

Micro-computer organization and its basic components: Carry Look Ahead adders, Carry Save adder, Multipliers (e.g. Booth's algorithm), Divider, Fixed and Floating point (IEEE754) number representations, Finite State Machine (FSM) representation. **Basic Accumulator based CPU:** Organization, instruction set, programming considerations, RISC & CISC Processors- Instruction Sets, addressing Modes. **Introduction to the Basic MIPS:** Instruction Set. **Fixed Point ALUs:** Combinational and Sequential ALUs, ALU Expansion. **Floating Point Arithmetic circuits:** Pipelined Processing, Systolic Arrays, resolving structural, data, control, and name hazards; analyzing processor performance, Memory mapping(e.g. RAM, cache); Non-blocking cache memories; memory protection, translation and virtualization, synchronization, consistency and coherence, direct-mapped and associative caches; write-through and write-back caches, pipelined caches, analyzing memory performance. **Processor Architecture:** Super-scalar execution, Out-of-order execution, register renaming, memory disambiguation, branch prediction, speculative execution; multithreaded, VLIW, and SIMD processors. **Hardwired and Microprogrammed Control Design.** Buses, bus arbitration, I/O control, interrupts and direct memory access, virtual memory mapping and addressing.

CSE-2205: Introduction to Mechatronics

Introduction: Definition and applications of Mechatronics, relationship amongst different disciplines. **Basics of Electronics:** Fundamental concepts of circuits and electrics. **Basics of Mechanical Engineering:** Fundamental concepts of Mechanics, measurement systems, control systems, mechanical design, discrete linear systems. **Sensors and Transducers:** Sensors for displacement, proximity, motion, sound, light, temperature, fluid Level and flow, force, etc. **Actuation Systems:** Basics of pneumatic and hydraulic systems, mechanical actuation systems, electrical actuation systems, servos. **System Models and Controllers:** Fundamentals of electrical, mechanical, fluid and thermal systems, electromechanical systems, process controllers, control modes, PID and digital controllers, velocity, adaptive, digital logic, microprocessor control. **Programmable Logic Controllers:** Fundamentals of PLCs, mnemonics and timers, relays and counters, master and jump control, data control, analog I/O control. **Design of Mechatronics Systems:** Steps of mechatronics system design, possible design solutions, case study.