# B. Tech. in COMPUTER SCIENCE & ENGINEERING / COMPUTER SCIENCE / COMPUTER ENGINEERING

## Syllabus of Paper – 1

**DIGITAL SYSTEM DESIGN**

Binary Systems**:**Introduction to Number Systems and conversions. Arithmetic with numbersystems, Signed and unsigned number systems and their arithmetic. Binary Codes. Boolean Algebra & Logic Gates:Boolean Functions and their Complements, Standard forms &Canonical Forms, Digital logic gates, Gate level Minimization,Karnaugh maps, Digital Circuits using Basic and Universal Gates. Combinational Logic Circuits**:**Analysis and Design of combinational circuit, Code Converters,Adders and its types, Subtractors, Multiplier, Magnitude Comparator, Decoders and Encoders, Multiplexers and Demultiplexers. Sequential Logic Circuits**:**Latches (SR Latch, D Latch), Flip Flops (D Flip Flop, JK Flip Flop, TFlip Flop), Characteristic Tables, Characteristic Equations. .Design and Analysis of Clocked Sequential Circuits (State Equations, State Tables, State Diagrams), Designing Asynchronous and Synchronous Counters. Registers: Simple registers, Registers with parallel Load, Shift Registers, Serial to parallelConvertors. Universal Shift Register. Introduction to Memories and Programmable Logic:Random Access memory, types of ROM,Memory decoding, address and data bus, Sequential Memory, Cache Memory, Programmable Logic Arrays, memory Hierarchy in terms of capacity and access time., PLA, PAL.

**DISCRETE STRUCTURES**

Sets and Propositions: Mathematical induction, The Principle of Inclusion and Exclusion, Proposition, Theory of inference, Predicate Calculus, Methods of proof, Permutations and Combinations, Relations and Functions: properties of binary relations, Closure of relations, Warshall's algorithm, Equivalence relations Partial ordering relations and lattices, Chains and antichains, Functions, Composition of Functions, Invertible Functions, Recursive Functions, Pigeonhole principle, Graphs: representation of Graphs, operations on graphs, paths and circuits, graph traversals, shortest path in weighted graphs, Eulerian paths and circuits, Hamiltonian paths and circuits, Travelling sales persons problem, Planar graphs, Graph Coloring, Application of Graphs, Tress and Cut-Sets: Rooted trees, Binary search trees, Spanning trees, Minimum spanning trees, Kruskal's Algorithm, Prims Algorithm, Transport Network, Modelling Computation: Languages, Phase structure and grammars, Types of grammars and Languages, Finite state machines, Discrete Numeric functions and Generating Functions, Recurrence relations and recursive algorithms, Linear recurrence relations, Solving Recurrence Relations by Generating Functions, Divide and conquer algorithms, Groups and rings: groups and subgroups, Cosets and Lagrange's theorem, Codes and Group codes, Boolean Algebras: Lattices and algebraic systems, Principle of duality, Distributive and complemented lattices, Boolean functions and Boolean expressions, Simplification of logic expressions using Karnaugh Map, Simplification of logic expressions using Quine-McClusky method, Propositional Calculus, Design and Implementation of Digital Networks, Switching Circuits.

**DATA STRUCTURES & ALGORITHMS**

Data types, Abstract data types, Various Data Structures, storage structure, Algorithm and its properties. Time complexity & Space complexity, Asymptotic notations (Big oh, Big Omega, Theta notations). Array, multi-dimensional array. Efficient storage of sparse matrix. String.

Linked list and their representation in memory. One way Linked List, two way Linked list, Circular Linked list, header linked list. Efficient storage of sparse matrix using linked list. Application of linked list. Introduction to Stack and Queue. Application of stack and queue. Double ended queue and its application. Priority Queue and its application. Introduction to nonlinear data structures such as tree, and graph. Linked list representation of tree. Tree traversal. Binary Tree. Construction of binary tree from given traversal sequences. Binary search Tree, expression Tree, AVL Tree, M-way search Tree. Representation of graph. Adjacency Matrix, Adjacency list. Minimum spanning tree. Shortest path algorithms. Graph Traversal: BFS, DFS and their applications. Sorting Techniques: Bubble sort, Quick sort, selection sort, Heap sort, insertion sort, merge sort, radix sort & efficiency considerations. Searching Techniques: Sequential search, Index sequential search, Binary search, Interpolation Search, Tree Searching, and Fibonacci Search.

**FORMAL LANGUAGES AND AUTOMATA THEORY**

Introduction to Automaton. Finite Automata and Regular Expressions: Deterministic and nondeterministic finite automata, regular expressions, Two way finite automata, finite automata with output: Mealy and Moore machines; Properties of Regular Sets: Pumping lemma, closure properties, decision algorithm, MyHill-Nerode theorem and minimization of finite automata; Context-Free Grammars (CFG): CFGs, derivation trees, simplification, Chomsky normal forms, Greibach normal forms; Pushdown Automata(PDA): Definitions, relationship between PDA and context free languages; Properties of Context-Free Languages: Pumping lemma, closure properties, decision algorithm; Turing Machines: The Turing machine model, computable languages and functions, techniques for Turing machine construction, modification of Turing machines, church's hypothesis, Turing machines as enumerators; Un-decidability: properties of recursive and recursively enumerable languages, universal Turing machines, rice's theorem, post correspondence problem; Chomsky Hierarchy: regular grammars, unrestricted grammars, context sensitive languages, relations between classes of languages. P, NP, NP-complete, and NP Hard class of problems.

**COMPUTER ORGANISATION & ARCHITECTURE**

Overview of Computer Architecture and Organization: Contrast between computer architecture and organization; Fundamentals of computer architecture: Organization of Von Neumann machine; Instruction format; execution cycle; Instruction types and addressing modes; Computer Arithmetic: representation of integers and real numbers; algorithm for carrying out common integer and floating-point operation; Memory system organization and architecture: Memory system hierarchy; main memory organization; cache memory; virtual memory; Interfacing and Communication: I/O fundamentals; I/O techniques; Interrupt; memory system design and Interfacing; Buses; Device subsystem: External storage system; RAID architecture; Control Unit Design: Instruction sequencing, Instruction interpretation, control memory, Hardwired Control, Micro programmed Control, Micro programmed Computers. I/O organization: Bus control, Serial I/O (study of Asynchronous and synchronous modes, USART & VART), Parallel Data transfer: (Program controlled: Asynchronous, synchronous & Interrupt driven modes, DMA mode, interrupt controller and DMA controller). Organization of CPU: Single Vs multiple data path; ISA; Control unit; Instruction pipelining; Trends in computer architecture: CISC, RISC, VLIW, Introduction to ILP; Pipeline Hazards: Structural, data and control; Reducing the effects of hazards.

**DESIGN AND ANALYSIS OF ALGORITHMS**

Review of Data Structures. Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – Asymptotic Notations and its properties – Mathematical analysis for Recursive and Non-recursive algorithms. Algorithmic Techniques: Algorithm design strategies, divide and conquer, merge sort, quick sort and its performance analysis, randomized quick sort, Strassen's matrix multiplication; Greedy method and its applications, knapsack problem; Dynamic programming and its performance analysis, optimal binary search trees, 0/1 knapsack problem; Traveling salesman problem; Backtracking, n-queens problem, graph colouring, Hamiltonian cycles, knapsack problem; Branch and bound examples, 15-puzzle problem, 0/1 knapsack, traveling salesman. Graph Algorithms: DFS and BFS, spanning trees, biconnectivity; Minimum cost spanning trees: Kruskal's, Prim's and Sollin's algorithms; Path finding and shortest path algorithms;Topological sorting; Bipartite graphs. Infeasibility: P and NP-classes, NP-hard problems,reduction. Parallel Algorithms: Data and control parallelism, embedding of problem graphs into processor graphs, parallel algorithms for matrix multiplication. Other Algorithms: Number theoretic algorithms, string matching algorithms, approximation algorithms, randomized algorithms.

**DATABASE ENGINEERING**

Introduction to Database systems:Data Independence, Data Models, levels of abstraction, structure of DBMS, Relational Model, Relational Languages, Query Languages: Relational Algebra, Relational Calculus, SQL, QUEL, QBE, Integrity constraints, Aggregate operators, Embedded and Dynamic SQL. Database design: E-R Model, Functional dependencies, decomposition, normalization, multivalued dependencies. File Organization: Storage, Buffer management, Disk Management, File organizationtechniques, Indexing. Query optimization: Query processing on various operations, Translating SQL queries,estimating the cost. Concurrency control and recovery: transaction, schedules, Lock based concurrency, Lockmanagement, Concurrency control without locking, Crash recovery- log, check pointing, media recoveries. Advanced topics: Database Security, Distributed databases design, Object Oriented databasedesign & its implementation.

# Syllabus of Paper - 2

**DATA COMMUNICATION**

Data transmission fundamentals: historical overview; time/frequency representation of datasignals; elements of a communications link; definition of key terms; factors affecting system design, Standards & Protocols, OSI reference model, TCP/IP protocol suite. Binary and multi-level signaling: information transfer rate; calculation of channel capacity; bandwidth efficiency, Baseband data transmission: the problem of inter symbol interference;Achieving a Nyquist channel response; recovery of symbols from noise; bit error rate performance for baseband data systems, Error detection and correction; Band pass digital modulation: binary modulation schemes (eg ASK, FSK, PSK); multi-leveldigital modulation (e.g. M-ary ASK, M-ary FSK, M-ary PSK, QAM), MODEMSource coding; channel coding; block coding; convolutional coding; combined coding and modulation, Multi-user digital modulation techniques such as frequency division multiple access (FDMA); time division multiple access (TDMA); code division multiple access (CDMA); combined multiple access systems.

**OBJECT-ORIENTED SYSTEM DESIGN**

Systems development life cycle (SDLC), information system project identification and initiation, feasibility analysis, requirement determination, requirement elicitation techniques, requirement analysis strategies, use case analysis, elements of a use case, process modeling, data flow diagrams, elements of data flow diagrams, creating data flow diagrams, data modeling, entity relationship diagram (ERD), elements of ERD, data dictionary and metadata, creating an ERD, validating an ERD, architecture design, elements of an architecture design, transition from requirements to design, system acquisition strategies, user interface design, navigation design, input design, output design, program design, moving from logical to physical process models, designing programs, structure chart, program specification, data storage design, data storage formats, Object -Oriented systems development life cycle: Software development process, building high quality software, use- case driven approach, Unified modeling language: Static and dynamic models, UML diagrams, UML class diagrams, use-case diagrams, UML dynamic modeling, packages, UML extensibility and UML meta model, basic characteristics of object-oriented systems, Object Basics, objects, classes, attributes, object behaviour and methods, encapsulation and information hiding, class hierarchy, polymorphism, object relationships and associations, aggregations and object containment, case study, object identity, persistence.

**MICROPROCESSORS & MICROCONTROLLERS**

Overview of 8085 microprocessors; signals, pins, and assembly language programming. Overview of 8086 microprocessors; signals, pins, and assembly language programming. Interfacing with RAMs, ROMs along with the explanation of timing diagrams. Interfacing with peripheral ICs like 8255, 8254, 8279, 8259, 8259, etc. Interfacing with keyboards, LEDs, LCDs, ADCs, and DACs etc. Architecture of 8087, interfacing with 8086. Data types, instructions and programming. Overview of 8051, 8096 microcontrollers; assembly language programming. Interfacing with microcontroller. Introduction high end processors.

**COMPILER DESIGN**

Introduction and overview of the compilation process, Model of a compiler, translators, interpreters, assemblers. Compilation of simple expressions and statements, Organization of a compiler, Compiler design tools, Computer architecture vs. compiler design; Lexical analyser (scanner); DFA; NFA; Context-Free Grammar. Syntax analysis, parsing: Top-Down and Bottom Up parsing, general parsing strategies. Brute-force approach, recursive descent parser and algorithms, simple LL(1) grammar, LL(1) with null and without null rules grammars, Bottom-up parsing- Handle of a right sentential form, Shift-reduce parsers, operator precedence parsing, LR, SLR, canonical LR and LALR grammar and parsers; Symbol Table contents, organization and Management. Syntax-directed translation schemes, intermediates code generation, translation schemes for programming language constructs. Code Optimization, Code Generation, Error Handling.

**OPERATING SYSTEMS**

Introduction: review of computer organization, operating system structures, system calls,system programs, virtual machine; Process: Process concept, Process scheduling, Operations on processes, Cooperating processes, Inter-Process-Communication (IPC), Communication in client-server systems; Case study: IPC in Linux; Threads, Multi-threading models, Thread issues. CPU Scheduling: Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Real time scheduling, Algorithm evaluation, Case Study: Process Scheduling in Linux; Process synchronization: The critical section problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock; Memory Management: Background, Swapping, Contiguous memory allocation, Paging, Segmentation, Segmentation with paging, Virtual memory: Background, Demand Paging, Process Creation, Page replacement, Allocation of frames, Thrashing, Case Study: Memory management in Linux. File System Interface**:**File Concept, Access methods, Directory Structure, File systemmounting, Protection, File system implementation, Directory implementation, Allocation methods, Free space management, Efficiency and Performance, Recovery, Log-structured file systems, Case Study: File system in Linux; I/O Systems: I/O hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance; Mass Storage Structure: Disk Scheduling, Disk Management, Swap space management, RAID, stable storage, tertiary storage, Case Study: I/O in Linux; Security & Protection: Breaches, Solutions, mechanisms, Inside Attacks, outside attacks.

**COMPUTER NETWORKS**

Network fundamentals: protocols and standards; reference models; the significance of layered network architectures; connections and connectionless protocols, Physical links and interfaces: modems and modem standards; LAN characteristics and concepts; interconnection of LANs; WAN characteristics and concepts, Link layer aspects, synchronous and asynchronous transmission; Framing, Error detection and correction, Sliding window protocols; MAC Layer; network layer aspects, addressing, connection Vs connectionless, Routing Algorithms, internetworking; transport layer aspects, reliable transport connections, Internet Protocol (IP); naming and addressing; routing; the Transmission Control Protocol (TCP); application and management protocols, Exploring Internet services: the dial-in end-user; the direct connection user; the Internet Service Provider; the global Internet, Emerging technologies over the Internet, such as IPv6 and ATM for a multimedia network; Internet Telephone.

**SOFTWARE ENGINEERING**

Software Life Cycle Models, Managing software projects, Project management concepts, Software process and Project metrics, Software Project Planning, Risk Analysis and Management, Project scheduling and tracking, Software Quality Assurance, Software Configuration Management. Conventional methods for software engineering, System Engineering, Requirements Analysis and Specifications, Analysis Modeling, Design Concepts and principles, Architectural design, User Interface Design, Component level Design, Software Testing Techniques, Software testing Strategies, Software Reliability, Technical metrics for software, CASE tools, Software Maintenance, Software Reusability. Object-Oriented software engineering: Object-Oriented concepts and principles, Object-Oriented analysis, Object-Oriented Design, and Object-Oriented testing, Technical metrics for Object-Oriented Systems, Special topics in Software Engineering. Emerging trends in software engineering.

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