

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Syllabus for PhD Program Entrance Examinations

Module 1 - RESEARCH METHODOLOGY

Types of Research - Research Process - Research Problem - Research Objectives - Research Hypotheses - Types of Research hypothesis - Research Design: Exploratory research Design, Conclusive research Design, Descriptive Research Design, Experimental research design - Features of good research design - Statement of the problem - Measurement and Scaling –Types of Scale - Types of Data - Data Collection Methods - Construction of Questionnaire – Sampling - Statistical Analysis – Univariate Analysis - Bivariate Analysis - Multivariate Analysis - Research Report - Types of research reports - Mechanics of writing Research Report - Research Publications - Plagiarism, Impact Factor, Citation Database - Ethics in Research.

Module 2: MATHEMATICS

Probability and Statistics: Probability, conditional probability, Baye's theorem, means, median, mode, moments, standard deviation. Random variables, Uniform, Binomial, Poisson, normal distributions, Correlation and regression, Sampling and Tests of significance.

Linear Algebra and Transformation Techniques: Linear vector space, determinants, matrices, eigen values, eigen vectors, elements of complex analysis, transformation techniques.

Calculus: Linear ordinary differential equations (ODEs), variation of parameters, Sturm-Liouville problem. Partial differential equations (PDEs).

Discrete Mathematics: Sets, relations and functions, algebra of matrices and determinants, algebraic structures, Boolean algebra and applications.

Module 3: DIGITAL LOGIC, COMPUTER ORGANIZATION AND ARCHITECTURE

Boolean algebra and Minimization of Boolean functions, Flip-flops-types, Race condition and comparison. Design of combinational and sequential circuits. Representation of Integers: Octal, Hex, Decimal, and Binary. 2's complement and 1's complement arithmetic. Floating point representation. Combinational Circuit Design, Sequential Circuit Design. Hardwired and Micro-programmed processor design, Instruction formats, Addressing modes, memory types and organizations, interfacing peripheral devices, Interrupts.

Module 4: PROGRAMMING, DATA STRUCTURES AND ALGORITHMS

Programming in C- Fundamentals- Functions- Arrays- Pointers- Structures- Unions, Recursion, Data Structures - stacks, queues, linked lists, trees, binary search trees, binary heaps, AVL trees, Graphs, Sets, Tables. Files- Sequential, Direct, index-sequential and relative files. Hashing, Inverted lists and multi-lists, Searching, sorting, hashing. Asymptotic notations – big oh, omega and theta, time and space complexity. Algorithm design techniques: Divide and Conquer, greedy, dynamic programming, Backtracking, Branch and Bound. Lower bound theory, nondeterministic algorithm, non-deterministic programming constructs. NP-hard and NP-complete problems.

Module 5: OPERATING SYSTEMS, COMPUTER NETWORKS

Operating Systems: Basic concepts, processes, threads, inter-process communication, concurrency and synchronization. Deadlock, CPU and I/O scheduling. Memory management and virtual memory. File systems, I/O systems.

Computer Networks: Concept of layering: OSI and TCP/IP Protocol Stacks; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4; Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

Module 6: THEORY OF COMPUTATION

Regular languages and finite automata, context free languages and push down automata, recursively enumerable sets and Turing machines, undecidability.

Module 7: DATABASE SYSTEMS, SOFTWARE ENGINEERING

Database Systems: Database and DBMS, ER model, DDL, DML, JOINS, Nested Sub queries, Integrity Constraints, Normalization, RAID, Indexing, Transaction, ACID Properties, Serializability, Concurrency Control, Failure Classification.

Software Engineering: Requirement and Feasibility, Analysis, Data Flow Diagrams, Process Specifications, Input/ Output Design, Process Life Cycle, Planning and Managing the Project, Software Architecture and Design Patterns, Software Reliability and Advanced Testing Techniques, Implementation, Maintenance, Aspect Oriented Programming.

