

## **SYLLABUS FOR PhD ENTRANCE EXAMINATION -2023**

### **PhD in Computer Science and Engineering**

#### **Part A**

Section 1: Digital Logic Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Section 2: Computer Organization and Architecture Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Section 3: Programming and Data Structures Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Section 4: Algorithms Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.

Section 5: Theory of Computation Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.

Section 6: Compiler Design Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.

Section 7: Operating System Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Section 8: Databases ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Section 9: Computer Networks Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

REFERENCES Algorithms: Introduction to Algorithms by Rivest, Cormen, Stein, Leiserson, MIT Press

Operating System: "Operating System Concepts" by Galvin, Silberschatz. WILEY Publishers

Theory of Computation: "Introduction to Automata Theory, Languages and Computation" by Hopcroft, Ullman. Pearson Education

Computer Networks: "Computer Networking: A top-down approach" by Kurose-Ross. Pearson Education

"Computer Networks" by Tanenbaum, Prentice Hall

Computer Organisation: "Computer Organisation" by Carl Hamacher. McGraw Hill

Programming:

"Computer Systems: A Programmer's Perspective", Randal E. Prentice Hall "Java: The Complete Reference, 8th Edition", Herbert Schildt. McGraw Hill

Database Systems: "Database System Concepts" by Korth. McGraw Hill

Compiler Design: "Principles of Compiler Design" by Aho and Ullman. Narosa Publishing House

Digital Logic: "Digital Logic and Design" by Morris Mano. Pearson Education, Prentice Hall

Software Engineering: "Software Engineering: A Practitioner's Approach" by Pressman. Prentice Hall

## **PART – B**

### **RESEARCH METHODOLOGY**

**Research and Types of research:** Meaning of Research- Objectives of Research- Motivation in Research. Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Research Process. Criteria of good Research.

**Research Formulation** – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

**Data Collection** and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Modeling, Mathematical Models for research, Sampling Methods- Data processing and Analysis strategies. Data Analysis with Statistical Packages – Hypothesis-testing, Generalization-and-Interpretation.

**Interpretation and report writing** - Techniques of interpretation - Structure and components of

scientific reports - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis

**Reference Books:**

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.
2. Kothari, C.R., 1990. *Research Methodology: Methods and Techniques*. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, Ess Ess Publications. 2 volumes.
4. Anderson, T. W., *An Introduction to Multivariate Statistical Analysis*, Wiley Eastern Pvt., Ltd., New Delhi
5. Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, Ess Ess Publications. 2 volumes.
6. Trochim, W.M.K., 2005. *Research Methods: the concise knowledge base*, Atomic Dog Publishing. 270p.
7. Fink, A., 2009. *Conducting Research Literature Reviews: From the Internet to Paper*. Sage Publications

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