Department of Computer Applications

SYLLABUS FOR Ph.D ENTRANCE EXAMINATION

**Part A**

# Section 1: Computer Organization and Architecture

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

**Computer Organization:** 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 2: Programming Languages

**Programming in C:** Elementary Data Types; Tokens, Identifiers, Data Types, Sequence Control, Subprogram Control, Arrays, Structures, Union, String, Pointers, Functions, File Handling, Command Line Arguments, Preprocessors

**Programming in C++ :** Class, Object, Instantiation, Inheritance, Encapsulation, Abstract Class, Polymorphism, Tokens, Identifiers, Variables and Constants; Data types, Operators, Control statements, Functions Parameter Passing, Virtual Functions;

**Programming in Java:** The Java Virtual Machine, Data types, Conditional and looping Statements, Arrays, Methods and functions, Constructors, Overloading methods, Garbage collection, Packages

# Section 3: Data Structures and Algorithms

**Data Structures:** Arrays, Stacks, Queues, Linked Lists, Trees, Forests, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, B Tree, B+ Tree, B\* Tree, Graphs, Sorting, Searching.

**Algorithms:** Performance Analysis of Algorithms – Time and Space complexities, Divide and Conquer, Dynamic Programming, Greedy Algorithms, Backtracking, Branch and Bound, Breadth-First Search, Depth-First Search, Shortest Path, Minimum Spanning Tree, P and NP Class Problems.

# Section 4: Database Management Systems

**Database System Concepts:** Data Models, Schemas, Architecture, ER Model, Relational Model, Relational Algebra, Relational Calculus. Functional Dependency, Multi valued Dependency, Join Dependency, and Normalization Forms. SQL**:** Types of commands, Constraints, Views, Stored Procedures, Functions, Triggers. Deadlock – Prevention and Avoidance, Heap File Organization, ISAM, Hashing and Indexing

# Section 5: Theory of Computation and Compiler Design

**Theory of Computation:** Regular expressions and finite automata, Context-free grammars and push-down automata, Regular and context-free languages, Turing machines.

**Compiler Design:** Lexical analysis, parsing, syntax-directed translation.

# Section 6: System Software and Operating System

**System Software**: Machine, Assembly and High-Level Languages; Compilers and Interpreters; Loading, Linking and Relocation; Macros, Debuggers

**Operating System**: Processes, threads, inter-process communication, concurrency and synchronization; Multicore Programming, Multithreading Models Deadlock; CPU scheduling; Memory management and virtual memory; File systems

# Section 7: Software Engineering

**Software Engineering:** The Waterfall Model, Incremental Process Models Evolutionary Process Models, Concurrent Models. Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Adaptive Software Development (ASD), Scrum; Requirements Modelling: Requirements Analysis, Scenario-Based Modelling, UML Models, Design Concepts: The Design Process, Design Concepts, the Design Model, Architectural design, and component-level design. Quality management

# Section 8: Data Communication and Computer Networks

**Data Communication:** simplex, half-duplex and full-duplex mode of data transmission, packet switching and circuit switching, Analog and Digital Signals; Noiseless and Noisy Channels; Digital and Analog Transmission; Data Encoding and Modulation Techniques; switching; Flow and error control techniques

**Computer Networks:** Network Hardware, LAN, MAN, WAN, OSI Reference Model, - Protocol IPv4/IPv6, routers and routing algorithms (distance vector, link state); TCP/UDP andsockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Network Security: authentication, basics of public key and private key cryptography

# 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:** “Fundamentals of Database Systems” – Ramez Elmasri and Shamkant B Navathe, Pearson Publications.

“Database Management Systems” – Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill Publications.

**Software Engineering**: Roger S Pressman, “Software Engineering- A Practitioners Approach”, Sixth Edition, Mc Graw Hill publishers.

Lan SommerVille, “Software Engineering”, 8th Edition, Pearson Education, 2009.

**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

**Data Structure**:“Fundamentals of Data Structure in C” – Ellis Horowitz and Sartaj Sahni, University Press.

“Data Structures and Algorithm Analysis in C” - Mark Allen Weiss, Pearson Education.

“Introduction to the Design and Analysis of Algorithms” – Anany Levitin, Pearson Education.

## 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

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