

**DEPARTMENT OF COMPUTER SCIENCE
FACULTY OF SCIENCE
A.M.U., ALIGARH**

**Syllabus for Ph.D. Admission Test 2024 -25, Under Visvesvaraya Ph.D Scheme for
Electronics and IT – Phase II**

SECTION-B

Sets, Relations, Functions. Pigeonhole Principle, Inclusion-Exclusion Principle, Equivalence and Partial Orderings, Elementary Counting Techniques, Probability. Measure(s) for information and Mutual information. Computability: Models of computation-Finite Automata, Pushdown Automata, Nondeterminism and NFA. DPDA and PDAs and Languages accepted by these structures. Turing Machines, halting problem, Grammars, Languages, Non-computability and examples of non-computable problems. Compiler: Concepts, phases of compiler. YACC Compiler.

Graph: Definition, walks, paths, trails, connected graphs, regular and bipartite graphs, cycles and circuits. Tree and rooted tree. Spanning trees, Eccentricity of a vertex radius and diameter of a graph. Central Graphs. Centre(s) of a tree. Hamiltonian and Eulerian graphs, Planar graphs.

Propositional (Boolean) Logic, Predicate Logic, Well-formed formulae (WFF), Satisfiability and Tautology. Logic Families: TTL, ECL and C-MOS gates. 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, Addition, subtraction, multiplication and Division, Floating point representation and operations.

Data, Information, Definition of Data Structure, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps, Hashing, inverted lists and multi-lists, B trees and B+ trees.

Programming in C/C++ : Identifiers, datatypes, Control structures. Sequence, selection and iteration(s), arrays, struct, union, string, and pointers. File handling, OOP Concepts.

Database Concepts: E-R diagrams and their transformation to relational design. Normalization-1NF, 2NF, 3NF, BCNF and 4NF. Limitations of 4NF and BCNF. SQL: Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL) commands. Database objects like-Views, indexes, sequences, synonyms, data dictionary.

Big database: Big Data Processing Architectures, Big Data Technologies, Big Data Analysis, Big Data Analytics Software, Big Graph Search.

Soft Computing: Introduction to Soft Computing, Fuzzy Set Theory and Fuzzy logic Systems, Neural Networks, Genetic Algorithms & Modeling, Applications of Soft Computing, Evolutionary Algorithms.

Data Mining: Data Mining Issues, Data Mining Techniques, Data mining Tools, Classification, Clustering, Data Mining Metrics.

Information Retrieval and Web mining: Web Mining, Data mining with unstructured data, Text mining, Tools and Techniques.

Parallel and Distributed Computing: Task partitioning and load balancing in parallel distributed computing, Advanced scheduling methods, dynamic task scheduling, and loop scheduling, Load balancing methods (deterministic and stochastic algorithms, optimality analysis, methods using combinatorial optimization).

Information Systems: Use of Computers in Managerial applications, Technology issues and Data processing in organizations, Information systems, MIS and Decision making, System analysis and design, Internet and Internet-based applications, Advanced concepts of information system: Enterprise Resource Planning, the role of ERP systems in business processes, business intelligence tools.

E-Systems Engineering: Introduction to e-systems engineering, Eliciting Requirements and Analyzing needs, Modeling an Architecting System, Implementation, testing and Evaluation of Systems.

Bioinformatics: Introduction to Bioinformatics: Introduction to Biological Databases: Biological Data bases, Information

Retrieval from Biological Databases, Machine Learning and Bioinformatics: Introduction to various Machine Learning techniques and their applications in Bioinformatics.

E-learning Systems: Model and Architecture of modern e-learning systems, Impact and challenges of e-learning

Software Engineering: Evolution of Software Engineering, Umbrella Activities, Software Project, Object oriented Modeling, Software Design, Software Metrics, Software Testing, Software Security, Software Security Testing Techniques.

Computer Networks: Network Models, Protocols & Protocol Suite, Routing, Congestion Control: QoS, Network Security, Data Communication Concepts and Technologies.

Wireless Sensor Networks: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc Networks (MANETs) and Wireless Sensor Networks (WSN), Enabling technologies for Wireless Sensor Networks, Sensor Node Hardware and Network Architecture, Deployment and Configuration of WSN, Routing and Security in WSN, Data Storage and Manipulation in WSN.

Cloud Computing: Recent trends in cloud computing, Enabling Technologies and System Models for Cloud Computing, Virtualization and load balancing in cloud computing, Game theory and Algorithmic Game theory, Approximation Algorithms.