



Bansilal Ramnath Agarwal Charitable Trust's  
**Vishwakarma Institute of Information Technology, Pune-48**  
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

## **Department of Computer Engineering**

### **Ph. D Entrance Test**

### **Paper 2: Computer Engineering**

#### **Examination Scheme**

**Total Marks: 100**

**(Multiple Choice Questions- 2 marks each)**

<b>Unit1: Theory of Computing:</b>
Growth of Functions, Divide-and-Conquer, Probabilistic Analysis and Randomized Algorithms, Heap sort, Quicksort, Sorting in Linear Time, Hash Tables, Binary Search Trees, Red-Black Trees, Dynamic Programming, Greedy Algorithms, B-Trees, Elementary Graph Algorithms, Minimum Spanning Trees, Single-Source Shortest Paths, All-Pairs Shortest Paths, Maximum Flow, Multithreaded Algorithms, Linear Programming, String Matching, NP-Completeness, Finite Automata and Regular Expressions, Properties of Regular Sets, Context Free Grammars, Push down Automata, Properties of Context Free Languages, Turing Machines, Undecidability. Chomsky Hierarchy.
<b>Unit II: Operating Systems</b>
Introduction To Operating System, Operating-System Structures, Process Management: Processes, Threads, CPU Scheduling, Process Synchronization, Deadlocks, Memory Management: Main Memory, Virtual Memory, Storage Management: File-System Interface, File-System Implementation, Mass-Storage Structure, I/O Systems, Protection And Security: Protection, Security, Distributed Systems: Distributed System Structures, Distributed File Systems, Distributed Coordination, Special-Purpose Systems: Real-Time Systems, Multimedia Systems, General Overview Of The System, Introduction To The Kernel, The Buffer Cache, Internal Representation Of Files, System Calls For The File System, The Structure Of Processes, Process Control, Process Scheduling And Time, Memory Management Policies, The I/O Subsystem, Inter process Communication, Multiprocessor Systems, Distributed Unix Systems.
<b>Unit III: Networking</b>
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
<b>Unit IV: DBMS and Information Retrieval</b>

Overview of Database Systems, Introduction to Database Design, The Relational Model, Relational Algebra and Calculus, SQL: Queries, Constraints, Triggers, Database Application Development, Internet Applications, Overview of Storage and Indexing, Storing Data: Disks and Files, Tree-Structured Indexing, Hash-Based Indexing, Overview of Query Evaluation, External Sorting, Evaluating Relational Operators, A Typical Relational Query Optimizer, Overview of Transaction Management, Concurrency Control, Crash Recovery, Schema Refinement and Normal Forms, Physical Database Design and Tuning, Security and Authorization, Parallel and Distributed Databases, Object-Database Systems, Deductive Databases, Data Warehousing and Decision Support, Data Mining, Information Retrieval and XML Data, Spatial Data Management.
<b>Unit V: Computer Architecture</b>
Fundamentals of Quantitative Design and Analysis, Memory Hierarchy Design, Instruction-Level Parallelism and Its Exploitation, Data-Level Parallelism in Vector, SIMD, and GPU Architectures, Thread-Level Parallelism, Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism, Computer Abstractions and Technology, Instructions: Language of the Computer, Arithmetic for Computers, Assessing and Understanding Performance, The Processor: Datapath and Control, Enhancing Performance with Pipelining, Large and Fast: Exploiting Memory Hierarchy, Storage, Networks, and Other Peripherals, Multiprocessors and Clusters.
<b>Unit VI: Programming and Data Structure:</b>
Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
<b>Unit VII: Discrete Mathematics</b>
Propositional and first order logic. Sets, relations, functions, partial orders, and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions. Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition. Calculus: Limits, continuity, and differentiability. Maxima and minima. Mean value theorem. Integration. Probability: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.
<b>Unit VIII: Artificial Intelligence</b>
Artificial Intelligence, Intelligent Agents, Solving Problems by Searching, Beyond Classical Search, Adversarial Search, Constraint Satisfaction Problems, Logical, First- Order Logic, Inference in First-Order Logic, Classical Planning, Planning and Acting in the Real World, Knowledge Representation, Quantifying Uncertainty, Probabilistic Reasoning, Probabilistic Reasoning over Time, Making Simple Decisions, Making Complex Decisions, Learning from Examples, Knowledge in Learning, Learning Probabilistic Models, Reinforcement Learning, Natural Language Processing, Natural Language for Communication, Perception, Robotics, Philosophical Foundations, AI: The Present and Future.
<b>Unit IX: Programming Languages and Translators</b>
Introduction to Programming Languages, Language Description: Syntactic Structure, Statements:

Structured Programming, Types: Data Representation, Procedure Activations, Groupings of Data and Operations, Object-Oriented Programming, Elements of Functional Programming, Functional Programming in a Typed Language, Functional Programming with Lists, Logic Programming, An Introduction to Concurrent Programming, Semantic Methods, Static Types and the Lambda Calculus, Introduction to Compiling, A Simple One-Pass Compiler, Lexical Analysis, Syntax Analysis, Syntax Directed Translation, Type Checking, Run-Time Environments, Intermediate Code Generation, Code Generation, Code Optimization, Linking and Loading, Architectural Issues, Object Files, Storage Allocation, Symbol Management, Libraries, Relocation, Loading and Overlays, Shared Libraries, Dynamic Linking and Loading, Advanced Techniques, Introduction to System Software, Assemblers, Loaders and Linkers, Macro Processors, Compilers, Operating Systems, Other System Software, Software Engineering Issues.

**B.O.S. Chairman**  
**Department of Computer Engineering**