

Subject: Information Technology (IT)

Level: Section Officer, Third Class

1. Computer Networks

- 1.1 Protocol stack, switching
- 1.2 Link Layer: services, error detection and correction, multiple access protocols, LAN addressing and ARP (Address Resolution Protocol), Ethernet, CSMA/CD multiple access protocol, Hubs, Bridges, and Switches, Wireless LANs, PPP (Point to Point Protocol), Wide area protocols
- 1.3 Network Layer: services, datagram and virtual circuits, routing principles and algorithms, Internet Protocol (IP), IP addressing, IP transport, fragmentation and assembly, ICMP (Internet Control Message Protocol), routing on the internet, RIP (Routing Information Protocol), OSPF (Open Shortest Path First), router internals, IPv6
- 1.4 Transport Layer: principles, multiplexing and de-multiplexing, UDP, TCP, flow control, principles of congestion control, TCP congestion control
- 1.5 Application Layer: Web and Web caching, FTP (File Transfer Protocol), Electronic mail, DNS (Domain Name Service), socket programming
- 1.6 Distributed system, Clusters, Network Security, Disaster Recovery, Data Storage Techniques: Clustering, NAS, SAN

2. Structured and object oriented programming

- 2.1 Data types, ADT
- 2.2 Operators, variables and assignments, control structures, Procedure/function
- 2.3 Class definitions, encapsulation, inheritance, object composition, Polymorphism
- 2.4 Pattern and framework
- 2.5 Programming with C, C++, Java

3. Artificial Intelligence

- 3.1 Search
- 3.2 Natural Language Processing
- 3.3 Game Playing
- 3.4 Learning
- 3.5 Automated reasoning
- 3.6 Planning
- 3.7 Vision and Robotics

4. Data Structures and Algorithms

- 4.1 General concepts: Abstract data types, Time and space analysis of algorithms, Big Oh and theta notations, Average, best and worst case analysis
- 4.2 Linear data structures: Lists, Linked Lists, Stacks, Queues, Priority Queue
- 4.3 Trees: General and binary trees, Representations and traversals, Binary search trees, balancing trees, AVL trees, 2-3 trees, red-black trees, self-adjusting trees, Splay Trees
- 4.4 Algorithm design techniques: Greedy methods, Priority queue search, Exhaustive search, Divide and conquer, Dynamic programming, Backtracking and Recursion
- 4.5 Indexing Methods: Hashing Trees, Suffix Trees
- 4.6 Graph algorithms: Depth-first Search and Breadth-first Search, Shortest Path Problems, Minimum Spanning Trees, Directed Acyclic Graphs.
- 4.7 Searching, Merging and Sorting

5. Computer Architecture and organization and micro-processors

- 5.1 Basic Structures: sequential circuits, design procedure, state table and state diagram, Von Neumann / Harvard architecture, RISC/CISC architecture
- 5.2 Addressing Methods and Programs, representation of data, arithmetic operations, basic operational concepts, bus structures, instruction cycle and excitation cycle
- 5.3 Processing Unit: instruction formats, arithmetic and logical instruction
- 5.4 Addressing modes
- 5.5 Input Output Organization: I/O programming, memory mapped I/O, basic interrupt system, DMA
- 5.6 Memory Systems
- 5.7 808X and Intel microprocessors: programming and interfacing

6. Digital Design

- 6.1 Digital and Analog Systems. Number Systems
- 6.2 Logic Elements
- 6.3 Combinational Logic Circuits
- 6.4 Sequential Logic
- 6.5 Arithmetic Circuits
- 6.6 MSI Logic Circuits
- 6.7 Counters and Registers
- 6.8 IC logic families
- 6.9 Interfacing with Analog Devices
- 6.10 Memory Devices

7. Software Engineering Principles (System analysis and design)

- 7.1 Software process: Software Process models, risk-driven approaches
- 7.2 Software Project Management: Relationship to lifecycle, project planning, project control, project organization, risk management, cost models, configuration management, version control, quality assurance, metrics
- 7.3 Software requirements: Requirements analysis, requirements solicitation, analysis tools, requirements definition, requirements specification, static and dynamic specifications, requirements review.
- 7.4 Software design: Design for reuse, design for change, design notations, design evaluation and validation, Software Architecture, Context diagram and DFD, Object Modeling: Object-Oriented Concept, Object Structure, Object Feature, Class and Object, Use Case Diagram, State Diagram, Event Flow Diagram
- 7.5 Implementation: Programming standards and procedures, modularity, data abstraction, static analysis, unit testing, integration testing, regression testing, tools for testing, fault tolerance.
- 7.6 Maintenance: The maintenance problem, the nature of maintenance, planning for maintenance
- 7.7 SE issues: Formal methods, tools and environments for software engineering, role of programming paradigm, process maturity and Improvement, ISO standards, SEI-CMM, CASE tools

8. Database Management System and Database Design

- 8.1 Introduction: The relational model, ER model, SQL, Functional dependency and relational database design, File structure
- 8.2 Transaction Management and Concurrency Control: Concurrent execution of the user programs, transactions, Concurrency control techniques
- 8.3 Crash Recovery: Types of failure, Recovery techniques

- 8.4 Query Processing and Optimization
- 8.5 Indexing: Hash based indexing, Tree based indexing
- 8.6 Distributed Database Systems and Object oriented database system
- 8.7 Data Mining and Data Warehousing
- 8.8 Security Management System
- 8.9 SQL and Embedded SQL, Writing Basic SQL SELECT Statements, Restricting and Sorting data, Single Row Functions, Displaying Data from Multiple Tables, Aggregation of Data Using Group Functions, Sub Queries, Manipulating Data and Creating & Managing Tables, Creating Views and Controlling User Access,
- 8.10 Database Design: Logical Design, Conceptual Design, Mapping Conceptual to Logical, Pragmatic issues, Physical Design, Integrity and Correctness, Relational Algebra, Relational Calculus. Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF, DKNF, Database Design with major RDBMS products: Oracle, Sybase, DB2, SQL Server.

9. Operating System

- 9.1 Processing and Threads: Symmetric Multiprocessing, Micro-kernels, Concurrency, Mutual Exclusion and Synchronization, Deadlock
- 9.2 Scheduling
- 9.3 Memory Management
- 9.4 Input Output and Files: I/O devices and its organization, Principles of I/O software and hardware, Disks, Files and directories organization, File System Implementation
- 9.5 Distributed Systems: Distributed Message passing, RPC, Client/Server Computing, Clusters
- 9.6 Security: Authentication and Access Authorization, System Flaws and Attacks, Trusted System
- 9.7 Common Operating Systems: MS-DOS, Windows Family of Products, Unix Family of Products, Linux Family of Products, Windows Networking, Windows Architecture, Linux Architecture, Troubleshooting Windows, & Linux, Managing Network Printing, Managing Hard Disks and Partitions, Monitoring and Troubleshooting Windows, Users, Groups and Permission on Linux and Windows.

10. Theory of Computation

- 10.1 BNF, Languages, Grammars
- 10.2 DFA and NDFAs, regular expressions, regular grammars
- 10.3 Closure, homomorphism
- 10.4 Pigeonhole principle, pumping lemma
- 10.5 CFGs, Parsing and ambiguity, Pushdown automata, NPDAs & CFGs
- 10.6 Pumping lemma
- 10.7 Turing machines
- 10.8 Recursively enumerable languages, unrestricted grammars
- 10.9 The Chomsky hierarchy, Undecidable problems, Church's Thesis
- 10.10 Complexity Theory, P and NP

11. Compiler Design

- 11.1 The Structure of a Compiler
- 11.2 Lexical Analyzer
- 11.3 Top down Parsing/Bottom up Parsing
- 11.4 Syntax Directed Translation
- 11.5 Types and Type Checking
- 11.6 Run-Time Storage Administration
- 11.7 Intermediate Code Generation
- 11.8 Data-Flow Analysis and Code Optimizations
- 11.9 Architecture and recent development on compilers

12. Computer Graphics

- 12.1 Graphics Concepts
- 12.2 Input devices and techniques
- 12.3 Basic raster graphics algorithms and primitives
- 12.4 Scan conversion
- 12.5 Graphics hardware
- 12.6 2D geometrical transformations and viewing
- 12.7 3D geometry and viewing
- 12.8 Hierarchical modeling
- 12.9 Projections
- 12.10 Hidden surface removal
- 12.11 Shading and rendering

13. Principles of Electronics Communications

- 13.1 Block Diagram of analog/digital communication system
- 13.2 Analog and Digital modulation techniques
- 13.3 Fundamentals of Error Detection and Correction
- 13.4 Performance evaluation of analog and digital communication systems: SNR and BER

14. IT in Nepal and Emerging Technologies

- 14.1 History of IT in Nepal
- 14.2 ICT Policy, 2072 B.S.,
- 14.3 Electronic Transaction Act, 2063 B.S.
- 14.4 Simulation and Modeling
- 14.5 Cryptography, Digital Signature
- 14.6 Artificial Neural Network and Computer Vision
- 14.7 Speech signal processing
- 14.8 Adaptive web technology
- 14.9 E-commerce, e-Governance
- 14.10 Multimedia, Image processing
- 14.11 GIS, Remote sensing, GPS

The End