विविध सेवा, अधिकृत सातौं तह, कम्प्युटर इञ्जिनियर पदका खुला तथा अन्तर सेवा प्रतियोगितात्मक परीक्षाको

द्वितीय पत्र (Paper II) : Technical Subject

Section A- 25

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 demultiplexing, 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

2. **Computer Architecture & organization and micro-processors**
   2.1 Basic Structures : sequential circuits, design procedure, state table and state diagram, von Neumann / Harvard architecture, RISC/CISC architecture
   2.2 Addressing Methods and Programs, representation of data, arithmetic operations, basic operational concepts, bus structures, instruction, cycle and excitation cycle.
   2.3 Processing Unit: instruction formats, arithmetic and logical instruction.
   2.4 addressing modes
   2.5 Input Output Organization : I/O programming , memory mapped I/O, basic interrupt system, DMA
   2.6 Arithmetic
   2.7 Memory Systems
   2.8 808X and Intel microprocessors: programming and interfacing

3. **Digital Design**
   3.1 Digital and Analog Systems. Number Systems.
   3.2 Logic Elements
   3.3 Combinational Logic Circuits
   3.4 Sequential Logic
   3.5 Arithmetic Circuits
   3.6 MSI Logic circuits
   3.7 Counters and Registers
   3.8 IC logic families
   3.9 Interfacing with Analog Devices
   3.10 Memory Devices

4. **Basic Electrical & Electronics**
   4.1 **Electrical**
       4.1.1 Basic Circuit Theory
       4.1.2 AC circuit Fundamentals
       4.1.3 Magnetic circuits and Transformers
       4.1.4 Transient Analysis, Filters

4.2 **Electronics**

    4.2.1 Semiconductors, Diodes and Diode Circuits, Transistors,

    4.2.2 Transistor modeling

    4.2.3 Biasing and Amplification

    4.2.4 Small Signal amplifiers and frequency response

    4.2.5 Large signal amplifiers, feedback amplifiers and Oscillators

    4.2.6 Operational amplifiers

5. **Principles of Electronic Communications**

    5.1 Block Diagram of analog/ digital communication system

    5.2 Analog and Digital modulation techniques

    5.3 Fundamentals of Error Detection and Correction

    5.4 Performance evaluation of analog and digital communication systems: SNR and BER

Section B- 25

6. **Structured and object oriented programming**

    6.1 Data types, ADT

    6.2 Operators, variables and assignments, control structures

    6.3 Procedure/function

    6.4 Class definitions, encapsulation, inheritance, object composition, polymorphism

    6.5 Pattern and framework

7. **Data structures**

    7.1 General concepts : Abstract data Type, Time and space analysis of algorithms, Big oh and theta notations, Average, best and worst case analysis

    7.2 Linear data structures

    7.3 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

    7.4 Algorithm design techniques: Greedy methods, Priority queue search, Exhaustive search, Divide and conquer, Dynamic programming, Recursion

    7.5 Hashing

    7.6 Graphs and digraphs

    7.7 Sorting

8. **Software Engineering principles (System analysis & design)**

    8.1 Software process: The software lifecycle models, risk-driven approaches

    8.2 Software Project management: Relationship to lifecycle, project planning, project control, project organization, risk management, cost models, configuration management, version control, quality assurance, metrics

    8.3 Software requirements: Requirements analysis, requirements solicitation, analysis tools, requirements definition, requirements specification, static and dynamic specifications, requirements review.

    8.4 Software design: Design for reuse, design for change, design notations, design evaluation and validation

    8.5 Implementation: Programming standards and procedures, modularity, data abstraction, static analysis, unit testing, integration testing, regression testing, tools for testing, fault tolerance

    8.6 Maintenance: The maintenance problem, the nature of maintenance, planning for maintenance

    8.7 SE issues: Formal methods, tools and environments for software engineering, role of programming paradigm, process maturity and Improvement, ISO standards, SEI-CMM, CASE tools

9. **Database Management System**
   9.1 Introduction : The relational model, ER model , SQL, Functional dependency and relational database design, File structure
   9.2 Transaction Management and Concurrency Control: Concurrent execution of the user programs, transactions, Concurrency control techniques
   9.3 Crash Recovery : types of failure, Recovery techniques
   9.4 Query Processing and Optimization
   9.5 Indexing : Hash based indexing, Tree based indexing
   9.6 Distributed Database Systems and Object oriented database system
   9.7 Data Mining and Data Warehousing
   9.8 Security Management System

10. **Operating System**
    10.1 Processes and Threads: Symmetric Multiprocessing, Micro-kernels, Concurrency, Mutual Exclusion and Synchronization, Deadlock
    10.2 Scheduling
    10.3 Memory Management
    10.4 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
    10.5 Distributed Systems: Distributed Message passing, RPC, Client/Server Computing, Clusters
    10.6 Security : Authentication and Access Authorization, System Flaws and Attacks, Trusted system

Section C- 20

11. **Artificial Intelligence**
    11.1 Search
    11.2 Natural Language Processing
    11.3 Game Playing
    11.4 Learning
    11.5 Automated reasoning
    11.6 Planning
    11.7 Vision and Robotics

12. **Theory of Computation**
    12.1 BNF, Languages, grammars
    12.2 DFA and NDFA, regular expressions, regular grammars
    12.3 Closure, homomorphism
    12.4 Pigeonhole principle, pumping lemma
    12.5 CFGs, Parsing and ambiguity, Pushdown automata, NPDAs & CFGs
    12.6 Pumping lemma
    12.7 Turing machines
    12.8 Recursively enumerable languages   Unrestricted grammars
    12.9 The Chomsky hierarchy, Undecidable problems, Church's Thesis
    12.10 Complexity Theory, P and NP

13. **Compiler design**
    13.1 The Structure of a Compiler
    13.2 Lexical Analyzer
    13.3 Top down Parsing/ Bottom up Parsing
    13.4 Syntax Directed Translation
    13.5 Types and Type Checking
    13.6 Run-Time Storage Administration

       13.7   Intermediate Code generation
       13.8   Data-Flow Analysis and Code Optimizations
       13.9   Architecture and recent development on compilers

14.   **Computer Graphics**
       14.1   Graphics concepts
       14.2   Input devices and techniques
       14.3   Basic raster graphics algorithms and primitives
       14.4   Scan conversion
       14.5   Graphics hardware
       14.6   2D geometrical transformations and viewing
       14.7   3D geometry and viewing
       14.8   Hierarchical modeling
       14.9   Projections
       14.10 Hidden surface removal
       14.11 Shading and rendering

15.   **Emerging Technology and Electives**
       15.1   Modeling and simulation
       15.2   Parallel and distributed computing
       15.3   High speed networks
       15.4   Artificial Neural Network and Computer Vision
       15.5   Adaptive web technology
       15.6   Software Architecture
       15.7   Distributed Object technology (ORB, DCOM)
       15.8   Speech signal processing
       15.9   Cryptography and network security
       15.10 E-commerce
       15.11 Software project management
       15.12 Embedded systems
       15.13 Image processing
       15.14 Multimedia
       15.15 Expert system
       15.16 GIS/ Remote sensing/ GPS

Section D- 30

16.   This section consists of 2 (two) sub-sections i.e. Technical Writing and Case study.

       16.1   **Technical Writing (1 question Carrying 10 marks)**
             This section may ask the examinee to write technical proposal on given specification, essay, views/critics etc. The topic must be related to computer technology or the matter related therewith and examinee should be encouraged to put his/her own views and reasoning rather than facts/information.

       16.2   **Case Study (1 question Carrying 20 marks)**
             This section is dedicated to the analysis and design of a software system. Examinee should be given a scenario of existing system and asked to analyze and design it following one particular paradigm. This section should include the various domain of knowledge in one platform (for e.g. A case study may incorporate questions from Software Engineering and Database management and Operating system domains).

विविध सेवाका समूह/उपसमूह, अधिकृत सातौं तहका पदमा प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरुलाई मात्र लिइने सामूहिक परीक्षण **(Group Test)** को लागि

सामूहिक छलफल **(Group Discussion)**

यस प्रयोजनका लागि गरिने परीक्षण १० पूर्णाङ्ग र ३० मिनेट अवधिको हुनेछ जुन नेता विहिन सामूहिक छलफल (Leaderless Group Discussion) का रुपमा अवलम्बन गरिन छ । दिइएका प्रश्न वा Topic का विषयमा पालैपालोसँग निर्दिष्ट समय भित्र समूह वीच छलफल गद प्रत्येक उम्मेदवारले व्यक्तिगत प्रस्तुति (Individual Presentation) गर्नु पर्नेछ । यस परीक्षणमा मूल्याङ्कनका लागि ३ जना भन्दा बढीको समिति रहनेछ ।