

## नेपाली सेना

### प्रा.उ.से. कम्प्युटर ईन्जिनियर (खुला) पदको लिखित परीक्षाको पाठ्यक्रम

समय : २ घण्टा ३० मिनेट

पुर्णाङ्क : १००

उत्तीर्णाङ्क : ४०

यो पाठ्यक्रम नेपाली सेनाको विभिन्न ईकाईहरूमा रिक्त रहेको प्रा.उ.से.कम्प्युटर ईन्जिनियर (खुला) पदका उम्मेदवार छनौट परीक्षाको लागि निर्धारण गरिएको हो । लिखित परीक्षामा सरिक हुने उम्मेदवारहरूको पेशा सम्बन्धि विषयलाई आधारमानी प्रश्नहरू सोधिने छ ।

(क) लिखित परीक्षाको माध्यम नेपाली/अंग्रेजी वा दुवै भाषा हुनेछ ।

(ख) लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र अर्को चरणको परीक्षामा सम्मिलित गराईने छ ।

(ग) प्रश्न पत्र निर्माण गर्दा पाठ्यक्रममा समावेश भएका सबै विषयहरूलाई समेटिनेछ ।

(घ) नेपाली सेनाको आवश्यकता तथा विविध परिस्थितमा नेपाली सेना अनुकूल हुने गरी उल्लेखित विवरणहरूमा हेरफेर हुन सक्नेछ ।

(ङ) पाठ्यक्रमको रूपरेखा देहायमा उल्लेख गरे अनुसार हुनेछ ।

(च) पाठ्यक्रम लागु मिति २०७३/१/१२ गते ।

विषय	पुर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली		प्रश्न संख्या X अङ्क	समय
पेशा सम्बन्धी	१००	४०	वस्तुगत (Objective)	बहुवैकल्पिक प्रश्न (MCQs)	४० प्रश्न X १ अङ्क = ४०	२ घण्टा ३० मिनेट
			विषयगत (Subjective)	छोटो उत्तर	६ प्रश्न X ५ अङ्क = ३०	
				लामो उत्तर	३ प्रश्न X १० अङ्क = ३०	

पेशा सम्बन्धी विषयको पाठ्यक्रम

**(SYLLABUS FOR COMPUTER ENGINEER)**

**1. Software and Hardware Procurement**

- 1.1 Software and Hardware Cost Estimation
- 1.2 Specification Development (Desktop, Laptop, UPS, Server, Imaging Devices, Baggage Scanner)
- 1.3 Bid Document Preparation, Procurement Types (Cost Based, Quality Based)
- 1.4 Procurement of Goods; Format of Bidding Document
- 1.5 Procurement of Consulting Service( Steps, Risks ), Software Procurement, Format of Bidding Document
- 1.6 Outsourcing Annual Maintenance Contract (AMC) of Hardware and its risk factor
- 1.7 In-house Software Development vs. Software Outsourcing
- 1.8 e-Procurement (bolpatra.gov.np)
- 1.9 Integrity, Ethics and Confidentiality
- 1.10 Post Delivery Inspection (PDI)
- 1.11 Post Procurement Issues

**2. Operating Systems**

- 2.1 **OS Fundamentals:** Definition of OS, Functions of OS, Components of OS, Types of Operating System, Application Software vs System Software, LINUX vs. UNIX, Primary, Extended and Logical Partition
- 2.2 **Principle of Concurrency:** Mutual Exclusion, Critical Region, Race Condition, Solution to Race Condition (Disabling Interrupts, Lock Variables, Strict Alteration, Petersons Solution, Lock Based Approach, Priority Inversion, sleep and wakeup), Semaphore and mutex, Monitors , Classical Problems of Synchronization: Readers-Writers Problem, Producer Consumer Problem, Dining Philosopher problem
- 2.3 **Process Management:** Program vs. Process, Process Life Cycle, User Bound and I/O bound process, Process Control Block, Context Switching, Concept of Multiprogramming, Concept of Threads, User level and Kernel level Threads, Process vs. Threads
- 2.4 **Process Scheduling:** Concept of Process Scheduling: FCFS, SPN, SRT, Round Robin, Multi level feedback
- 2.5 **Deadlock:** Definition, Detection, Avoidance, Prevention and Recovery examples, Livelock, Two phase locking, Starvation
- 2.6 **Memory Management:** Memory hierarchy, Storage Placement Policies: First Fit, Best Fit, Worst Fit, Fixed Partitioning and Variable Partitioning memory management, Virtual Memory, Paging, Demand Paging, Memory Protection and Sharing, Limit Register, Swapping, Segmentation, Paging and Segmentation Combined, Concept of Thrashing, Page Replacement Algorithms, Overlays, TLBs
- 2.7 **Input/output:** Block Devices and Character Devices, Concept of Device Driver and Controller, Synchronous vs. Asynchronous Transfer, Disk Scheduling Algorithms, RAID, Hard Drive Reliability, MTBF, File Organization
- 2.8 **Security:** Security breaches, Types of Attacks, Security Policy and Access Control, Basics of Cryptography, Protection Mechanisms, Authentication, OS Design Considerations For Security, Access Control Lists And OS Support

### 3. Computer Organization and Architecture

- 3.1 **Computer Organization Fundamentals:** Instruction Cycle, Execution Cycle, CPU Bus Structure, Codes, Microoperations (Arithmetic, Logic and Shift), Von Neumann/Harvard Architecture, Gray Code, Error Detection
- 3.2 **CPU:** CPU Design and Accumulator Logic, RISC vs. CISC, One address and two address instruction, Instruction Format, Addressing modes
- 3.3 **Control Unit:** Control Memory: Addressing sequencing, Microinstruction Format, Symbolic Microinstructions, Symbolic Micro program, Control Unit Operation, Design of control unit, Hardwired control, Microprogrammed Control
- 3.4 **Pipeline and Vector processing:** Pipelining, Parallel processing, Arithmetic Pipeline, Instruction Pipeline, RISC pipeline, Vector processing, Array processing
- 3.5 **Computer Arithmetic:** Addition algorithm, Subtraction algorithm, Multiplication algorithm, Division algorithms, Logical operation
- 3.6 **Memory:** Cache memory principles, Elements of Cache design, Cache size, Mapping function, Replacement algorithm, Write policy, Number of caches
- 3.7 **Input-Output organization:** Peripheral devices, Input-output interface, Modes of transfer (Programmed I/O, Interrupt-driven I/O, Direct Memory access, I/O processor, Data Communication processor)

### 4. Computer Networks

- 4.1 OSI model vs TCP/IP model; Half and Full Duplex Ethernet, Straight-Through, Crossover and Rolled Cabling, Wireless Networking (802.11 a,b,c,d,e,g), Spanning Tree Protocol , ARP, RARP
- 4.2 **Data Link Layer:** Collision Domain, Broadcast Domain, CSMA/CD Protocol, persistent and non-persistent CSMA, Sliding Window Protocol, Hamming Distance and Hamming Codes, Computing Checksum, CRC Code, Unipolar, Polar and bipolar line encoding types, Flow and Error Control Mechanisms ( Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ ), Token Ring, FDDI Operation , Shannon Theory, Nyquist Bit Rate, SNR, PCM
- 4.3 **Virtual LANS(VLAN):** VLAN Basics, Static and Dynamic VLANS, Identifying VLANs, VLAN Trunking Protocol(VTP), Configuring VLANs
- 4.4 **TCP and IP:** Three Way TCP Handshakes; Hierarchical IP addressing Scheme, Public and Private IP address, IP Address Classes, CIDR, Introduction to NAT, Broadcast Addresses, IP subnetting and variable length subnet masks, Integrating IPV4 and IPV6 networking Environments
- 4.5 **Routing:** Routing Basics, IP Routing Process, Distance-Vector Routing Protocols and Link State Routing Protocols, Routing Information Protocol(RIP), Interior gateway Routing Protocol (IGRP), Enhanced IGRP, Open Shortest Path First Routing, BGP Protocol, Dijkstras and Bellman Ford Routing Algorithm Exercises
- 4.6 **Transport Layer:** UDP, TCP, Principles of Congestion Control, Token Bucket and Leaky Bucket, multiplexing and demultiplexing, Circuit Switching vs Packet Switching

- 4.7 **Application Layer:** DHCP and DNS Operations, Cookies Operation, Web Caching, FTP, E-mail, POP3, IMAP Socket Programming, IPSec
- 4.8 Digital Signature and Digital Certificate, HSM, Root Server and CA server, Calculations based on RSA Algorithm; Electronic Payment Gateway and e-Payment Transaction Steps, Credit Card Operation Steps; IPS, IDS, Firewalls, Hacking and Viruses
- 4.9 Distributed System, Cluster based system, Grid Based System; Concept of traffic analyzer: MRTG, PRTG, SNMP, Packet tracer, Wireshark

## 5. Information and IT/IS Security

- 5.1 Network Infrastructure Security: LAN, Client/Server, Wireless, Internet Threats and Security; Authentication and Authorization; Infrastructure Operation and Architecture Review; Technical Testing (Router, Switch, Wireless Testing)
- 5.2 Endpoint Risks and Threats, Web and Email Controls, Data Loss Prevention, Malware Detection and Quarantine, SPAM, Phishing and E-mail fraud, Patch Management and Enforcement, Data Loss Prevention Testing
- 5.3 Secure Remote Access: VPN, Remote Access Threats and Risks, Testing Authentication, IPsec, SSL, Site-to-Site and Mobile user access control testing
- 5.4 Access Control: Access Control Threats and Risks, Access Control Operational and Architecture Review, Posture Assessment Testing, Types of Access Control, General Controls vs Application Controls, IT Application Controls Audit, IT Audit, Internal Controls and CMMI
- 5.5 Perimeter Intrusion Prevention: Perimeter Threats & Risk; Perimeter Operations & Architecture Review, Auditing Firewalls and IPS, Testing IPS and Firewall Rule
- 5.6 The Process of Auditing Information System: Importance of a strong IT Audit Function; Reviewing Compliance with ISO Standards; Auditing IT Security and Privacy; Auditing Identity and Access Management Processes ;Auditing Electronic Document Retention and Archival Processes; Auditing a VPN Installation; Auditing Business Continuity Management Processes; IT Audit in SOA Environments
- 5.7 Auditing Information Security Management Framework, Auditing Logical Access, Investigation Techniques, Techniques for Testing Security, Auditing Network Infrastructure Security, Environmental Exposures and Controls, Physical Access Exposures and Controls, Auditing Cloud Applications
- 5.8 Auditing Tools and Techniques: Security Testing Frameworks; OSSTMM, ISSAF, NIST 800-115, OWASP; Security Auditing Tools: Service Mapping Tools (NMap, Hping) and other CAATS Software; Vulnerability Assessment Tools: Nessus, RedSeal SRM; Packet Capture Tools: Tcpdump, Wireshark/Tshark; Penetration Testing Tools: Core Impact, Metasploit, BackTrack; Security Governance Frameworks (COSO, COBIT, ITIL)
- 5.9 Disaster Recovery and Business Continuity Planning : DRP and SLA, Auditing BCP, BCP vs BPCP vs DRP, BCP Lifecycle phases and BCP Policy, Incident Management, BCP Development and Testing, BCP Review, Business Impact Analysis(BIA checklist), Loss Calculation, Risk vs Threat vs Vulnerability, Risk bases Auditing,

Quantitative Risk Analysis Techniques; COSO ERM; Change Management vs Change Control vs Configuration Management

- 5.10 ITIL Service Management Best Practices: ITIL Service Management Best Practices, ITIL Service Strategies Component, ITIL Service Design, ITIL Service Transition Management Processes, ITIL Service Operation Processes
- 5.11 Security Standards, Procedures and Guidelines (ISO 27000 Series of Standards, NIST, NSA, DISA, SANS, ISACA, Center for Internet Security, Cisco Security Best Practices); Security Audit Checklist; Infrastructure Threats (Unauthorized Access, Denial of Service, Traffic Capture, Layer 2 Threats, Network Service Threats)
- 5.12 Role, Duty and Responsibilities of Quality Auditors; QA Reviews of IT Audit Functioning; Auditing Information System Acquisition, Development, Implementation, Operations, Maintenance and Support

## **6. Data Structure and Algorithms**

- 6.1 Stack and Queue: Stack operation, Evaluation of Infix, Postfix and Prefix expressions; Operations in queue (Enqueue and Dequeue), Linear and circular queue, Priority queue
- 6.2 List and Linked List: Static and dynamic list, Array implementation of lists, Queues as list, Operations in linked list, Linked stacks and queues, Doubly linked lists and its application, Principle of recursion, TOH and Fibonacci sequence, Applications of recursion
- 6.3 Trees: Operation in Binary tree, Tree search, insertion/deletions, Tree traversals (pre-order, post-order and in-order), Height, level and depth of a tree, AVL balanced trees and Balancing algorithm, The Huffman algorithm, B-Tree, Red Black Tree
- 6.4 Sorting: Types of sorting: internal and external, Insertion and selection sort, Exchange sort, Merge and Redix sort, Shell sort, Heap sort as a priority queue, Big 'O' notation and Efficiency of sorting
- 6.5 Searching: Sequential, Binary and Tree search, General search tree, Hashing, Hash function and hash table, Collision resolution technique, Asymptotic notations:  $\Theta$ ,  $O$ ,  $o$ , notations and their properties
- 6.6 Graphs: Transitive closure, Warshall's algorithm, Graphs type, Graph traversal and Spanning forest, Depth First Traversal and Breadth First Traversal, Topological sorting: Depth first, Breadth first topological sorting, Minimum spanning trees, Prim's, Kruskal's and Round-Robin algorithms, Shortest-path algorithm, Greedy algorithm, Dijkstra's Algorithm

## **7. Database Management Systems**

- 7.1 DBMS Fundamentals: Data Vs Information, RDBMS vs. OODBMS, Data Models, Data Abstraction and Data Independence, 3-level Architecture (ANSI/APARC Architecture), DBA, Distributed Database, Object oriented, deductive, spatial, temporal and constraint database management systems, Concepts of DDL, DML and DCL
- 7.2 Entity Relationship Model and Enhanced Entity Relationship development with Case Studies, ER-to-Relational Mapping

- 7.3 SQL Queries: Join (Left and Right Join), Subquery, View, Function and Stored Procedure Examples, Primary Key Constraints, Referential Integrity Constraints (on cascade update, on cascade delete)
- 7.4 Normalization (1NF, 2NF, 3NF, BCNF, 4NF, 5NF) Examples, Functional Dependency, Multi-valued and Join Dependency, Trivial and non-trivial FDs, closure of a set of FDs, attribute closure FDs, irreducible set of FDs, Transitivity, Reflexivity and Augmentation properties of FDs
- 7.5 Transaction and Concurrency Control: Transaction ACID Properties, Concurrent Executions, Serializability Concept, Two-phase locking, Timestamp-based protocols, commit protocols, Lock Granularity, Time stamp ordering multi version concurrency control, Deadlock handling, Failure Classification, Log-based Recovery, Check Pointing, Shadow Paging, Recovery and Atomicity, Recovery Techniques (WAL), Transaction Rollback and Roll forward
- 7.6 Query Cost Estimation, Query Optimization (steps), Query Decomposition, Performance Tuning
- 7.7 Indexing: Hash based indexing and tree based indexing
- 7.8 Data Mining and Data Warehousing
- 7.9 Database Security, Performance Tuning, Concept of Big Data, NoSQL, Hadoop

## **8. Software Engineering**

- 8.1 SDLC Phases; Prototyping, Incremental vs. Iterative model, RUP/USDP Phases; Spiral Model, Software Types: Program vs Software; TPS, MIS, DSS, EIS, ERP, CRM, SRM; Map Reduce and Hadoop Systems
- 8.2 Software Analysis: Requirement analysis techniques and tools; Requirement Engineering and SRS; Functional and Non-Functional Requirement; Feasibility Study and its types; Decision Table and Decision Tree
- 8.3 Software Estimation: Basic COCOMO, Intermediate COCOMO, Complete COCOMO, Halstead's Complexity Metrics
- 8.4 Software Design: Logical vs Physical Design ;UML Diagrams: Use Case Diagram, Class Diagram, Communication Diagram, State Chart Diagram, Sequence Diagram; Activity Diagram; Structure Chart, Qualified Association in Class Diagram DFD( Level-0,1,2); Software Coupling and Cohesion and its Types; User Interface Design: Wireframe Diagrams
- 8.5 Software Development: Software frameworks and CASE tools
- 8.6 Software Testing: Black Box, White Box, Gray Box, Unit, Integration Testing, Regression Testing, Software Fault Tolerance
- 8.7 Software maintenance types, Reverse Engineering; Refactoring and Restructuring
- 8.8 Software Quality: Software Quality Assurance process ;Verification vs Validation; Software Inspection; Clean Room Software Engineering, Software Reviews and FTR; Statistical software quality assurance; Software reliability; ISO Standards; CMMI model
- 8.9 Software Issues: Social, Legal and Ethical Issues; Business Process Engineering and Re-Engineering; Concept of Big Data
- 8.10 Software Configuration Management: Main software configuration management (SCM) concepts, SCM repository; SCM process; Change Management; Version and release management

## 9. Cloud Computing and Virtualization Technologies

- 9.1 Grid Computing, Clustering, Cloud Computing and its Benefits, Business Driver of Cloud Computing, Cloud Characteristics, Restful Services
- 9.2 **Cloud Service Models:** Infrastructure as a Service, Platform as a Service, Software as a Service
- 9.3 **Cloud Deployment Models:** Public, Private and Hybrid Clouds
- 9.4 **Cloud Security Threats:** Traffic Eavesdropping, Malicious Intermediary, Denial of Service, Virtualization Attack, Insufficient Authorization, Virtualization Attacks, Flawed Implementation
- 9.5 Cloud Storage Devices, Load Balancing, SLA Monitoring, Creating Centralized Logging Strategy
- 9.6 **Blade Server and Virtualization:** Benefits of Blades in Virtualization; Blade Architecture, Ethernet and Fiber Channel in Blade Server Systems, Virtualization Types (Server Virtualization, Storage Virtualization, I/O Virtualization, Network Virtualization), Server Virtualization Types, Managing Virtual Server Environments, Things to consider while doing Virtualization, Types of Storage Virtualization
- 9.7 **Clustering and Blades:** Clustering Concepts, Types of Clustering Solutions( High Availability Clusters, Load Balancing Clusters, HPC Clusters, Grid Clusters)
- 9.8 **Assessing Blade System Hardware Considerations:** CPU, Memory, I/O, Storage Consideration, Blade Server and Chassis Features, Additional Power Issues( Insufficient Power, Power Supply Features, DC Power), Host Based Adapters(HBAs), Hypervisors
- 9.9 Virtualization Software Selection (VMware, Citrix, Microsoft Solution for Virtualization); Blade System Vendors, Blade Features Matrix, Virtualization Features Matrix

## 10. Digital Logic

- 10.1 Fundamentals: Coding Types(ASCII Code, BCD, Excess-3 Code, Gray Code), NOT,OR,XOR,AND,NOT,NAND, AND-OR-INVERT Gate, Positive and Negative Logic, SOP and POS methods, Truth Table to Karnaugh Map, Karnaugh Simplifications, Don't care Conditions
- 10.2 Digital Circuits: Multiplexers, Demultiplexers, Decoder, BCD-to-Decimal Decoders, Seven-Segment Decoders, Encoders , Parity Generators and Checkers, Magnitude Comparators, Sequential vs. Combinational Circuits, Half Adder, Full Adder, Half Sub tractor, Full Sub tractor
- 10.3 Flip Flops and Registers : RS Flip Flops, Gated Flip Flops, Edge-Triggered RS Flip-Flops, Edge-Triggered D Flip-Flops, Edge Triggered JK Flip Flops, JK Master Slave Flip Flops, Registers( SISO,SIPO,SISO,PISO,PIPO), Shift Registers
- 10.4 Counter: Synchronous vs. Asynchronous Counter, Decade counter, Modulo-n Counter, Counter Design
- 10.5 Sequential Machine Design: State Diagrams, Transition Tables, Use of flip-flops in realizing the models, Flow tables, excitation maps

## 11. Fundamentals of Electrical and Electronic Systems

- 11.1 Electrical Fundamental: Basic Circuit Theory, Mesh Analysis and Nodal Analysis, R-L-C Circuit, Bode Diagram, Magnitude and Phase Response, two-port networks
- 11.2 Electronics Fundamentals: Kirchhoff's law, Superposition theorem; Thevenin's theorem; Norton's theorem, Zener diode, rectifier-half wave, full wave (center tapped, bridge), Zener regulated power supply, BJT configuration and biasing, small and large signal model, MOSFET as logic circuits, Waveform generator using op-amp for Square wave, Triangular wave Wien bridge oscillator for sinusoidal waveform
- 11.3 Fundamentals of Electrical Machine: Hysteresis with DC and AC excitation, Hysteresis Loss and Eddy Current Loss, Faraday's Law of Electromagnetic Induction, Statically and Dynamically Induced EMF, Losses in a transformer, EMF Equation, Performance Characteristics of D.C. motors, Three Phase Synchronous Motor, Double Field Revolving Theory
- 11.4 Fundamental of Semiconductor Devices: Basic Single-Stage BJT Amplifier Configurations (C-B, C-E, C-C), Transistor as a Switch – Cutoff and Saturation, A General Large-Signal Model for the BJT: The Ebers-Moll Model, Classification of Output Stages, Op Amp-RC Oscillator Circuits, Integrated Circuit Voltage Regulator, Bandgap Voltage Reference, a Constant Current Diodes, Transistor Series Regulators

## 12. Data Communication

- 12.1 **Communication Fundamentals:** Analog and Digital Data Communication System; Transmission Impairments (Attenuation, Noise, Distortion); Periodic and Non-periodic Signals, Deterministic and Random Signals, Energy and Power Signals, Continuous Time and Discrete Time Signals; Unit Impulse Function and Unit Step Function; Data Rate Limits: Nyquist Bit Rate for Noiseless Channel, Shannon Capacity for Noisy Channel; Performance of Channel: Bandwidth, Throughput, Latency, Jitter, Bit Error Rate (BER)
- 12.2 **Data Encoding and Modulation:** Types of Analog Modulation: Amplitude Modulation, Frequency Modulation and Phase Modulation; Pulse Modulation System: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM); Pulse Code Modulation (PCM); Line Coding Schemes: NRZ, RZ, Manchester, AMI; Block Coding, Scrambling; Digital Modulation: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM)
- 12.3 **Information Theory and Coding :** Introduction to Information Theory, Average Information, Source Coding – Huffman Coding, Error Detection and Correction Codes, Hamming Distance, Linear Block Coding, Cyclic Codes, CRC, Convolution Codes

## 13. Smart Card Technologies

- 13.1 Magnetic Stripe Card, Contact vs Contactless Smart Card, Smart Card Processor and Memory Types, Benefits of combining Biometric and Smart Card Technology



- 13.2 Smart Card Standards: ICAO Doc 9303 Part 3 , CWA 14641, Intergraf Certifications, ISO 9001,ISO 14001, ISO 27001,PKS#15, EAL 4+ Certification, ISO/IEC 7816-4, ISO/IEC 7816-8 Commands, ISO 19794- 1,2,3,4
- 13.3 Smart Card Security Consideration: Smart Card Security Features, FIPS 140-2 standard levels, HSM
- 13.4 Smart Card Personalization: Below Surface Laser Engraving, Personalization Machine Types
- 13.5 Smart Card Operating System: JCOP vsMultos; On-Card Applications; SAM Card
- 13.6 Smart Card Material: Polycarbonate, Plastic, Composite, PVC
- 13.7 Components of Smart Card Based System: CMS, AMS, KMS, PKI, TMS, MATG, Card Issuance System; Enrollment System: Mobile Enrollment vs Fixed Enrollment Stations ; Biometric Verification vs Demographic Verification; e-Service Infrastructure ( G2G, G2B, G2C Services) , e-Service Gate; Live Enrollment System in National ID, Passport and Voter Registration
- 13.8 AFIS: NIST Finger Print Evaluation Report, Match on Card(MoC Features), WSQ Image Format, MINEX, NFIQ Scores, Securing AFIS System
- 13.9 Smart Card Application: Payment, Identification and Transports, Healthcare, GPS based vs RFID based Vehicle Tracking System and Embossed Vehicle Number Plate System; MRP vs e-Passport
- 13.10 Comparison of Smart Card Vendor Technologies and Vendors

#### **14. Theory of Computation**

- 14.1 BNF, Languages, Grammars
- 14.2 DFA, NDFA, regular expressions, regular grammars
- 14.3 Closure, Pigeonhole principle
- 14.4 CFGs, Pushdown Automata
- 14.5 Turing Machines
- 14.6 The Chomsky hierarchy, Undecidable problems
- 14.7 Complexity Theory, P and NP

#### **15. Fundamentals of Object Oriented Frameworks**

- 15.1 **Object Technologies Fundamentals:** Dependency Injection Types: Constructor based; Setter Method Based; Lookup Method Based; Identifying application objects and their dependencies, Creating POJO classes corresponding to identified application objects, Creating an instance of IOC Container, Access application objects from IOC Container, Managing Container: Resource Location Paths in Application Context; Declarative usage of Application Contexts, Splitting Container Definitions into Multiple Files; Spring Expression Language (SpEL) for accessing Bean Properties( XML based and Annotation based approach); Autowiring dependencies by type, Constructor, name, default/no; make beans un-available for auto-wiring, auto-wiring limitations
- 15.2 **Mastering MVC Architecture:** MVC using Dispatcher and Controller, Web Application Context; Request Handling Workflow Steps; Basic Layout of Spring MVC Web Application

- 15.3 **Handling Forms and Complex URL Mapping:** Customize validation messages, Custom annotations etc; Getting a submitted form value using a controller method argument; Setting a forms default values using a model object; Saving form data in an object automatically; Using text area, text, password, hidden fields, select field, checkbox, radio buttons, form validation using annotations
- 15.4 **Data Access and Object Relational Mapping:** Spring with JDBC, Hibernate/MyBatis, Data Caching, Securing Methods; Object Relational Mapping: Hibernate, MyBatis, JDO, Apache OJB, Top Link, Cayenne, JSR-220 Persistence; Creating a DAO class, Calling a DAO method from a controller class, saving/retrieving list of objects, updating/deleting object, retrieving incomplete database modifications using transactions
- 15.5 **Object Frameworks for Social Media:** Creating a test Facebook App and test users, Connecting to Facebook, Retrieving user's profiles, Retrieving list of friends of Facebook user, Posting a Facebook status update, Posting a link to Facebook, Posting a custom object to Facebook; Create a Twitter App, Retrieving user's Profile, Retrieving the tweets, posting a tweet, Sending Private message to a user.

## 16. Reasoning

- 16.1 Analytical and logical reasoning
- 16.2 Quantitative Test

This section covers the examinee's reasoning aptitude as well as the presence of mind. Reasoning is to be done by reading a passage and answering the multiple choices Question whereas quantitative test is carried out by solving the mathematical problem (Which needs no advanced level mathematical background?)

यस पेशा सम्बन्धी विषयको पाठ्यक्रमका एकाईहरूबाट सोधिने प्रश्नहरूको संख्या निम्नानुसार हुनेछ ।

एकाई नं. (Unit No.)	अङ्कभार (Weightage)	बहुवैकल्पिक प्रश्न (MCQs) को संख्या	छोटो उत्तर प्रश्नको संख्या	लामो उत्तर प्रश्नको संख्या
१	३०	१०	६ प्रश्न X ५ अङ्क	३ प्रश्न X १० अङ्क
२				
३				
४				
५	३०	१०		
६				
७				
८				
९	२५	१०		
१०				
११				
१२				
१३	१५	१०		
१४				
१५				
१६				
<b>जम्मा</b>	<b>१००</b>	४० प्रश्न X १ अङ्क = ४० अङ्क	६ प्रश्न X ५ अङ्क = ३० अङ्क	३ प्रश्न X १० अङ्क = ३० अङ्क