Nepal Rastra Bank
Syllabus for
Assistant Director (IT)

Open Competition

Stages of Examination

1. **First Stage:** Written Examination   **Full Marks: 300**

Paper	Subject	Full marks	Pass marks	Types of questions	Time
Paper I	Information Technology – I	100	40	**Objective* & Subjective**	**Total 3 hrs**: 30 min. for Objective and 2 hrs. 30 min. for Subjective
Paper II	Information Technology - II	100	40		**Total 3 hrs**: 30 min. for Objective and 2 hrs. 30 min. for Subjective
Paper III	Current Developments in IT Sector and Emerging Technologies	100	40		**Total 3 hrs**: 30 min. for Objective and 2 hrs. 30 min. for Subjective

*0.2 marks will be deducted for each incorrect answer

2. **Second Stage:** a) Practical   **Full Marks: 50**   **Pass Marks: 25**

                    b) Interview   **Full Marks: 40**

Remarks:

1. In written examination, questions shall be asked in English.
2. Examinee shall use English language in answer.
3. Theoretical, practical and analytical questions will be asked.
4. During the first stage written examinations, subjective question paper will be distributed only after collecting objective answer sheets (candidates have to submit the answer sheets within the allocated time period for objective exam).
5. Candidates shall write their answers of MCQs, short questions and long questions on separate answer sheets.
6. The candidates selected from the written examination will be called for the second stage.
7. This syllabus would be applicable from November 1, 2021.

Paper I
Information Technology – I

There shall be 30 multiple-choice questions, 8 short-answer questions and 3 long-answer questions with 1, 5 and 10 marks each respectively. Subjective exam will be conducted immediately after the submission of objective answer sheets by the candidates within allocated time period. Candidates are required to answer all of them.

1. **Computer Architecture & Organization and Microprocessors**
    1.1. Basic Structures: Sequential Circuits, Design Procedure, State Diagram, and State Table, Von Neumann / Harvard Architecture, RISC/CISC Architecture, SISD, SIMD, MISD, MIMD, Addressing Methods and Programs, Representation of Data, Arithmetic Operations, Basic Operational Concepts, Bus Structures, Instruction, Cycle and Excitation Cycle
    1.2. Processing Unit: Instruction Formats, Arithmetic and Logical Instruction, Addressing Modes and Formats
    1.3. Input Output Organization: I/O programming, Memory Mapped I/O, Basic Interrupt System, DMA
    1.4. Computer Arithmetic: Arithmetic and Logic Unit, Integer Arithmetic and Representation, Floating-Point Arithmetic
    1.5. Memory Systems: Internal Memory, Cache Memory, Direct Memory Access, External Memory

1.6. CPU Structure and Function: Processor and Register Organization, Power PC Processor

1.7. 808X and Intel Microprocessors: Programming and Interfacing, Microinstruction Sequencing and Execution

2. **Digital Logic Design**

2.1. Introduction

2.2. Digital Logic: Basic, Exclusive and Universal Gates, Positive and Negative Logics

2.3. Combinational Logic Circuits: Boolean Algebra, K-Map, Minterms and Maxterms, SOP and POS

2.4. Data Processing Circuits: Adders and Subtractors, Multiplexer and Demultiplexer, Encoders and Decoders, Parity Generators and Checkers, Comparators, ROM and PLDs

2.5. Arithmetic Circuits: Binary Addition, Subtraction, Signed- and Unsigned Numbers

2.6. Flip-flops: Latches and Flip-flops, SR, D, T and JK Flip-flops, Flip-flop Conversion, Characteristic Equations, Excitation Tables, Master-slave Flip-flops

2.7. Registers: Different Types of Flip-flops, SISO, SIPO, PISO, PIPO

2.8. Counters: Synchronous Counters, Asynchronous Counters, Up/Down Counters, Modulus Counters, Decade Counters, Digital Clock

2.9. Sequential Machines: Synchronous Machines with Single and Multiple Serial Inputs, Synchronous Machines Design using Different types of Flip-flops, Asynchronous Machine Design Examples

2.10. Digital Integrated Circuits: BJT and MOSFET as the Switches, RTL and DTL Circuits, TTL Circuits, Integrated Injection Logics (I2L), Emitter-Coupled Logic (ECL), MOS and CMOS Logics, Bi-MOS Logic Circuits

3. **Operating Systems**

3.1. Definition, Development and Functions of Operating System (OS), Functional Architecture of OS, Types of OS, Network and distributed OS

3.2. Processes and Threads: Symmetric Multiprocessing, Micro-kernels, Concurrency, Mutual Exclusion and Synchronization, Inter Process Communications, Semaphores. Features of Process Scheduling; List the features of Inter-Process Communication and Deadlock scheduling

3.3. Disk Allocation and Scheduling Methods, Basic Memory Management strategies, Virtual Memory Management Techniques, Define a Process and features of the Process Management System

3.4. Concepts of Parallel and Distributed Processing, Identify Security Threats to Operating Systems, authentication and access authorization, system flaws and attacks, trusted system

3.5. 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, Interrupt handling

3.6. Distributed Systems: Distributed Message passing, RPC, Client/Server Computing, Cluster computing

4. **Database Management System and Design**

4.1. Introduction, A Database Model, Relational Database Model, Integrity, RDBMS

4.2. SQL and Embedded SQL

4.3. Writing Basic SQL queries (DDL, DML, DCL)

4.4. SQL middleware basics: SQL API, Open SQL Gateway

4.5. Restricting and Sorting Data

4.6. Sub Queries, Manipulating Data and Creating &Managing Tables

4.7. Creating Views and Controlling User Access

4.8. Using Set Operators, Date time Function

4.9. Relational Database Design, ER Diagram, Keys (primary, foreign, candidate, alternate keys)

4.10. Normalizations (1NF, 2NF, 3NF, BCNF, 4NF) and functional dependencies

4.11. Basic Concept of major RDBMS products (MSSQL, Oracle, MariaDB etc.)

4.12. Concept of Time series DB

4.13. Fundamentals of database servers, functions, procedures, triggers and rules

4.14. Transaction Management and Concurrency Control: Concurrent execution of the user

4.15. programs, transactions, Concurrency control techniques

4.16. Crash Recovery: Types of failure, Recovery techniques

4.17. Query Processing and Optimization

4.18. Indexing: Hash based indexing, Tree based indexing

4.19. Distributed Database Systems and Object-oriented database system

4.20. Data Mining and Data Warehousing

4.21. Security Management System

5. **Computer Networks**

5.1. Definition, OSI & TCP/IP reference model, Topologies, Client/Server Model & Peer2Peer Model

5.2. Network Components: Repeater, Hub, Bridge, Switch, and Router

5.3. Link Layer: Services, Flow and Error Control, error detection and correction, multiple access protocols (ALOHA, Slotted ALOHA), 802.3 Ethernet CSMA/CD, Token Bus, Token Ring, FDDI, Protocols: PPP, HDLC, Virtual circuit switching: Frame relay, ATM, X.25, MPLS

5.4. Network Layer: services, datagram and virtual circuits, routing principles and algorithms, Internet Protocols (IPv4/v6) header format, IPv4/v6 addressing and sub-netting, VLSM, CIDR,   ICMPv4/v6 error/information messages, Routing: interior/exterior routing, unicast/multicast routing, adaptive/non-adaptive routing. Routing protocols: RIP, OSPF, BGP, IS-IS

5.5. Transport Layer: Services, multiplexing and De-multiplexing, UDP, TCP, flow control, TCP sliding window, principles of congestion control, TCP congestion control, Open/close loop congestion control, Leaky bucket & Token Bucket algorithm, overview of socket programming, TCP/UDP Sockets

5.6. Upper layers: Application, presentation and session layer functionalizes, principles of WWW, DNS, DHCP, FTP, email protocols: SMTP/PoP/IMAP, PGP

5.7. Network management: Server concepts-Proxy/web/DNS servers, IP interconnection, Tier ISP architecture, VoIP, FoIP, remote login (telnet, ssh), Traffic monitoring (MRTG, bandwidth, throughput, latency/delay)

5.8. Advanced Data Storage Techniques: Network Attached Storage, Storage Area Networks

5.9. Introduction to Latest networking: Software-Defined Networking, Software-Defined IPv6 (SoDIP6) Network, IPv6 network migration methods, SDN migration methods, IoT, WSN, NGN

6. Distributed System

6.1. Client server computing concepts: Building blocks, the state of distributed client server infrastructure

6.2. Fundamental models of Distributed system, distributed object based communications: RPC/RMI, CORBA

6.3. Synchronization is Distributed System (DS), physical/logical clocks (Cristian, Lamport, Vector clocks), Distributed Mutual Exclusion, Election in DS

6.4. Replication and Fault Tolerant, Recovery approach in DS, Distributed file system (SUN-NFS, HDFS)

6.5. Distributed transaction and concurrency control methods, Distributed deadlock

7. **Cryptography and Network Security**
   7.1. Introduction to Cryptography: Security attacks, conventional encryption model, simplified DES
   7.2. Block Cypher principle
   7.3. Principles of Public-Key Cryptosystems: RSA algorithm, Diffie-Hellman Key exchange, Number Theory-Prime and Relatively Prime Numbers
   7.4. Message Authentication and Hash function
   7.5. Digital Signature and authentication protocols: Digital signatures, Digital signature standards, authentication protocols
   7.6. Network Security: Authentication applications – Kerberos, electronic mail security
   7.7. Web security: Web security requirements, secure sockets layer and transport layer security, secure electronic transaction
   7.8. Intruders and Viruses related threats
   7.9. Firewall design principles, DMZ, masquerading, proxy firewall, NATing
   7.10. Information security and Audit, introduction to Certified Information Systems Auditor (CISA), Service Organization Control (SOC) 2 certification
   7.11. Introduction to Blockchain technology, security in cloud/fog/edge computing

Chapter/ Unit	Multiple Choice Questions (MCQ)	Short Questions	Long Questions
1	4	1	1
2	4	1	
3	4	1	1
4	6	1	
5	4	1	1
6	4	1	
7	4	2 (One question from Unit 7.1-7.5 and another one question from Unit 7.6-7.10)	
No. of questions	30	8	3
Marks	30×1=30	8×5=40	3×10=30
		Total 100	

Paper II
Information Technology – II

There shall be 30 multiple-choice questions, 8 short-answer questions and 3 long-answer questions with 1, 5 and 10 marks each respectively. Subjective exam will be conducted immediately after the submission of objective answer sheets by the candidates within allocated time period. Candidates are required to answer all of them.

1. **Programming Language**
   1.1. Overview of Programming Language: History, Programming Paradigms, The role of Language translates in the Programming Process
   1.2. Fundamental Issues in Language Design
   1.3. Virtual Machines, Code Generation, Loop Optimization
   1.4. Concept of Procedural Programming, Structural Programming, Object-Oriented Programming
   1.5. Fundamentals of C/C++ programming
   1.6. Java Programming for Declaration, Modularity and Storage Management Software Development

2. **Data Structure and Algorithms**
   2.1. Fundamental of Data Structures, Abstract Data types
   2.2. Stacks, Queues, Lists, Linked Lists
   2.3. Trees: Traversal, Implementations, Binary Trees, Binary Search Trees, Balanced Search Trees, AVL Trees
   2.4. Indexing Methods. Hashing Trees, Suffix Trees
   2.5. Time and space complexity, Bog O' Notation
   2.6. Analysis of Simple Recursive and Non-recursive Algorithms
   2.7. Searching, Merging and Sorting, Divide-and-Conquer, Dynamic Programming, Greedy Methods, Backtracking
   2.8. Graph algorithms: Depth-First Search and Breadth-first Search, Shortest Path Problems, Minimum Spanning Trees, Directed Acyclic Graphs

3. **Discrete Mathematics**
   3.1. Propositional Logic
   3.2. Predicate Logic and Quantification
   3.3. Methods of Proof
   3.4. Sets and Functions

3.5. Arithmetic Algorithms

3.6. Growth of Functions

3.7. Computational Complexity of Algorithms

3.8. Integer properties and Matrices

3.9. Mathematical Induction

3.10. Recursion

3.11. Sequences and Summations

3.12. Program Correctness

3.13. Graphs and its Applications

3.14. Trees and its Applications

3.15. Languages and Grammars

3.16. Finite-State Machines

3.17. Automata and Language Recognition

3.18. Turing Machines

4. **Compiler Design**

4.1. The Structure of a Compiler

4.2. Lexical Analysis, Syntax analysis, semantic analysis

4.3. Top down Parsing/ Bottom up Parsing

4.4. Syntax Directed Translation

4.5. Types and Type Checking

4.6. Run-Time Storage Administration

4.7. Intermediate Code generation, code generator, code optimization

4.8. Architecture and recent development on compilers

5. **System Analysis and Design**

5.1. Definition of the System, System Owner, System User, System Designers and system Builders, System Analysts, Variations on the System Analyst title, System development life Cycle

5.2. Prototyping: Spiral, Waterfall, Rapid Application Development (RAD), Joint Application Development (JAD)

5.3. System Design Environment: Concept formulations

5.4. Requirements analysis: Representing System Analysis Model, Requirement Model, Design Model

5.5. Fundamentals of Object oriented system analysis and design

5.6. Entity Relationship Diagram (E-R Diagram), Context Diagram, Data Flow Diagrams (DFDs), UML diagrams

6. **Software Engineering Principles**
    6.1.   Software process: The software lifecycle models, risk-driven approaches
    6.2.   Software Project management: Relationship to lifecycle, project planning, project control, project organization, risk management, cost models, configuration management, version control, quality assurance, metrics
    6.3.   Software requirements: Requirements analysis, requirements solicitation, analysis tools, requirements definition, requirements specification, static and dynamic specifications, requirements review
    6.4.   Software design: Design for reuse, design for change, design notations, design evaluation and validation
    6.5.   Software Project Implementation: Programming standards and procedures, modularity, data abstraction, static analysis, unit testing, integration testing, regression testing, tools for testing, fault tolerance
    6.6.   Software Maintenance: The maintenance problem, the nature of maintenance, planning for maintenance
    6.7.   Tools and environments for software engineering, role of programming paradigm, process maturity and Improvement, ISO standards, SEI-CMM, CASE tools

7. **MIS and Web Engineering**
    7.1.   Information Systems, Client-Server Computing
    7.2.   Information system architecture, Control of Information system
    7.3.   Web engine architecture
    7.4.   Database Design issues, Data Mining, Data Warehousing
    7.5.   Knowledge Management, The strategic use of Information Technology
    7.6.   Work Process Redesign (Reengineering) with Information Technology, Enterprise Resources Planning Systems, and Global Information Technology issues
    7.7.   Software Supported Demonstrations including advanced Spreadsheet topics Software Component Based Systems (CBSE)
    7.8.   Multimedia communications and applications
    7.9.   Object-Oriented Programming with COMS & DECOMS
    7.10. Group Decision Support Systems
    7.11. Basics of Website Design, HTML, DHTML, XML

8. **Computer Graphics**
    8.1.   Graphics concepts
    8.2.   Input devices and techniques
    8.3.   Basic raster graphics algorithms and primitives

8.4. Scan conversion

8.5. Graphics hardware

8.6. 2D geometrical transformations and viewing

8.7. 3D geometry and viewing

8.8. Hierarchical modeling

8.9. Projections

8.10. Hidden surface removal

8.11. Shading and Rendering, Phong Shading, Gaurad Shading

Chapter/Unit	Multiple Choice Questions(MCQ)	Short Questions	Long Questions
1	4	1	1
2	4	1	
3	4	1	
4	3	1	
5	4	1	1
6	4	1	1
7	4	1	
8	3	1	
No. of questions	30	8	3
Marks	30×1=30	8×5=40	3×10=30
Total 100			

Paper III

Current Developments in IT Sector and Emerging Technologies

There shall be 30 multiple-choice questions, 8 short-answer questions and 3 long-answer questions with 1, 5 and 10 marks each respectively. Subjective exam will be conducted immediately after the submission of objective answer sheets by the candidates within allocated time period. Candidates are required to answer all of them.

1. **IT in Central Bank (Nepal Rastra Bank) and Nepalese Banking Sector**
   1.1. History of Central Bank
   1.2. History of IT in Nepalese Banking Sector
   1.3. Uses of Computers and Software Development
   1.4. Use of IT in Nepalese Banking Sector
   1.5. IT risks in Banking Sector and management of these risks
   1.6. Information System Audit of Banks

2. **Relevant Acts, Policies and Guidelines**
   2.1. NRB Act, 2058
   2.2. Electronic Transaction Act, 2063
   2.3. ICT Policy, 2072
   2.4. Broadband Policy, 2071
   2.5. Satellite Policy, 2077
   2.6. NRB IT Guidelines, 2012

3. **E-Commerce Technology**
   3.1. Introduction to E-Commerce and M-Commerce
   3.2. Electronic Commerce Strategies
   3.3. Electronic Commerce Security Issues
   3.4. Success Models of E-Governance
   3.5. E-Business: B2B, B2C, B2E, C2C, G2G, G2C
   3.6. Principles of Electronic Payment, Strategies & Systems
   3.7. E-marketing, Reverse Engineering
   3.8. E-Banking, EDI Methods, SWIFT
   3.9. Encryption and Decryption Methods, XML, Layout Managers, Event Model

4. **E-Governance**
   4.1. History of e-Governance development
   4.2. e-Governance working principles, Models of e-Governance

4.3. G2G e-Governance; Governance to Business (G2B); Development of G2B Governance

4.4. Global trading environment & adoption of e-Governance

4.5. E-Government life cycle

4.6. Online service delivery and electronic service delivery

4.7. Infrastructure use in e-Governance

4.8. Electronic funds transfer, e-payment gateways, Electronic payment system (EPS)

4.9. Mobile Governance

5. **Artificial Intelligence and Machine Learning**

5.1. Introduction

5.2. Problem Decomposition and Planning

5.3. Logic and Reasoning

5.4. Natural Language Processing and ANN

5.5. Machine Learning and pattern recognition

6. **Cloud Computing**

6.1. Basics of Cloud Computing, Characteristics

6.2. Cloud, Fog, Edge computing comparisons, Cloud Federation

6.3. Data Storage and Security in the Cloud

6.4. Virtualization: virtual machines and container technologies

6.5. Ubiquitous Clouds and the Internet of Things

6.6. Future of Cloud Computing, Federated learning

7. **Development in Virtual Currency**

7.1. History

7.2. Development

7.3. Models

7.4. Risks and Benefits

7.5. Prospects, Challenges

8. **Internet and Network Programming**

8.1. Common Gateway Interface (CGI) application

8.2. Input to CGI: environment variables, accessing from input

8.3. Output from CGI: CGI and response headers

8.4. Forms and CGI: Sending data to the server using HTML tags

8.5. Unix/internet domain socket, Socket Address Structure, Socket system call

8.6. Introduction to JAVA: JAVA evolution, JAVA history, JAVA features, Difference between JAVA and C/C++, Simple JAVA program, JAVA program structure, JAVA Statements

9. Cyber Security and Ethics
9.1. Introduction, Security Technologies
9.2. Information Security and Cryptography
9.3. Legal Issues in Cyber Crime
9.4. Ethics in Cybersecurity & Cyber Law
9.5. Professional and Ethical Responsibilities
9.6. Risks and Liabilities of Computer-Based Systems

10. Overview of FinTech, RegTech and SupTech
10.1. Key technologies of FinTech, API, AI, ML, IoT, Big data analytics, distributed laser technology, smart contracts, cryptography, biometrics
10.2. Areas of RegTech, Identity management and control, risk management, Regulatory reporting, transaction monitoring, Financial market trading
10.3. SupTech supports, Data input, Data pull, Real time access, Reporting utilities, intelligence gathering, data quality management

Chapter/Unit	Multiple Choice Questions(MCQ)	Short Questions	Long Questions
1	3	1	
2	3	1	
3	3		1
4	3	1	
5	3	1	1
6	3	1	
7	3	1	
8	3	1	1
9	3		
10	3	1	
No. of questions	30	8	3
Marks	30×1=30	8×5=40	3×10=30
Total 100			

Second Stage: Practical

Full Marks: 50   Pass Marks: 25

 Time: 1 hour 30 minutes

S.N.	Topics	Number of Questions	Marks
1.	OS (MS Windows) a. Basic Configuration b. Issues and problem resolution c. User/file rights Management	1	10x1=10
2.	Networking a. IP/Subnet/Routing/Gateway concepts. b. Connectivity troubleshooting c. Cisco Device configurations i. IP and Routing ii. VLAN and Switching d. Basic Access control and security	1	10x1=10
3.	Database a. Database design with constraints b. SQL	2	10x2=20
4.	Programming a. Database connectivity b. C/Java programming c. XML d. PHP Programming	1	10x1=10