लोक सेवा आयोग

नेपाल विविध सेवा, राजपत्राङ्कित तृतीय श्रेणी, कम्प्युटर इन्जिनियर पदको खुला र आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

पाठ्यक्रमको रुपरेखा :– यस पाठ्यक्रमको आधारमा निम्नानुसार दुई चरणमा परीक्षा लिइने छ :

प्रथम चरण :– लिखित परीक्षा पूर्णाङ्क :– २००

द्वितीय चरण :– अन्तर्वार्ता पूर्णाङ्क :– ३०

प्रथम चरण – लिखित परीक्षा योजना (Examination Scheme)

पत्र	विषय	पूर्णाङ्क	उत्तीर्णाङ्क	परीक्षा प्रणाली	प्रश्न संख्या xअङ्कभार	समय
प्रथम	कम्प्युटर इन्जिनियरिङ्ग सम्बन्धी विषय	१००	४०	वस्तुगत बहुउत्तर (Multiple Choice)	१००X१ = १००	१ घण्टा ३० मिनेट
द्वितीय		१००	४०	विषयगत (Subjective)	८X१० = ८० १X२० = २०	३ घण्टा

द्वितीय चरण

विषय	पूर्णाङ्क	परीक्षा प्रणाली
व्यक्तिगत अन्तर्वार्ता	३०	मौखिक

१. लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुवै हुन सक्नेछ ।

२. पाठ्यक्रमको प्रथम र द्वितीय पत्रको विषयवस्तु एउटै हुनेछ ।

३. प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।

४. प्रथम तथा द्वितीय पत्रका एकाईहरुको प्रश्नसंख्या निम्नानुसार हुनेछ :

प्रथम पत्रका एकाई	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16.1	16.2
प्रश्न संख्या	6	6	3	6	6	5	7	6	6	4	5	3	7	5	5	10	10
द्वितीयपत्रका खण्ड	A					B					C					D	
द्वितीय पत्रका एकाई	1	5	6	13	14	2	4	7	8	9	3	10	11	12	15	Technical Writing	Case Study
प्रतिशत	5	5	4	5	5	5	5	6	5	5	3	4	5	3	5	10	20

४.१ माथि तालिकामा उल्लेख भए अनुसार द्वितीय पत्रका १ देखि १५ सम्मका एकाइहरुवाट ७ (सात) प्रश्नहरु, Technical Writing को १ (एक) प्रश्न र Case Study को २० अङ्कको १ (एक) प्रश्न गरी जम्मा ९ (नौ) प्रश्नहरु सोधिने छन् ।

५. प्रथम पत्रमा वस्तुगत बहुउत्तर (Multiple Choice) प्रश्नहरुको उत्तर सही दिएमा प्रत्येक सही उत्तर बापत १ (एक) अङ्क प्रदान गरिनेछ भने गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अर्थात् ०.२ अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।

६. द्वितीय पत्रको विषयगत प्रश्नका लागि तोकिएका १० अङ्कका प्रश्नहरुको हकमा १० अङ्कको एउटा लामो प्रश्न वा एउटै प्रश्नका दुई वा दुई भन्दा बढी भाग (Two or more parts of a single question) वा एउटा प्रश्न अन्तर्गत दुई वा बढी टिप्पणीहरु (Short notes) सोध्न सकिने छ ।

७. द्वितीय पत्रको पाठ्यक्रमलाई ४ वटा खण्ड/एकाईमा विभाजन गरिएको छ । ४ वटा खण्ड/एकाईको लागि ४ वटै उत्तरपुस्तिका दिइनेछ र परिक्षार्थीले प्रत्येक खण्ड/एकाईका प्रश्नहरुको उत्तर सोही खण्ड/एकाईको उत्तर पुस्तिकामा लेख्नु पर्नेछ ।

८. यस पाठ्यक्रममा जेसुकै लेखिएको भएता पनि पाठ्यक्रममा परेका ऐन, नियमहरु परीक्षाको मिति भन्दा ३ (तीन) महिना अगाडि (संशोधन भएका वा संशोधन भई हटाइएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा रहेको सम्झनु पर्दछ ।

९. प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरुलाई मात्र द्वितीय चरणको अन्तर्वार्तामा सम्मिलित गराइनेछ ।

१०. यस भन्दा अगाडि लागू भएको माथि उल्लिखित समूहको पाठ्यक्रम खारेज गरिएको छ ।

११ पाठ्यक्रम लागू मिति :– २०६२/२/२४ देखि (२०७२/०७/२४ को निर्णय अनुसार सामूहिक परीक्षण समावेश)

प्रथम र द्वितीय पत्र :– कम्प्युटर इञ्जिनियरिङ्ग सम्बन्धी विषय

Section A- 24 %

1. **Computer Networks**

Protocol stack, switching

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

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)

Transport Layer: principles, multiplexing and demultiplexing, UDP, TCP, flow control, principles of congestion control, TCP congestion control

Application Layer : Web and Web caching, FTP (File Transfer Protocol), Electronic mail, DNS (Domain Name Service), socket programming)

Distributed system, Clusters

5. **Computer Architecture & 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 Arithmetic
   - 5.7 Memory Systems
   - 5.8 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

13. **Basic Electrical & Electronics**
   - 13.1 **Electrical**
     - 13.1.1 Basic Circuit Theory
     - 13.1.2 AC circuit Fundamentals
     - 13.1.3 Magnetic circuits and Transformers
     - 13.1.4 Transient Analysis, Filters

13.2 **Electronics**
    13.2.1 Semiconductors, Diodes and Diode Circuits, Transistors,
    13.2.2 Transistor modeling
    13.2.3 Biasing and Amplification
    13.2.4 Small Signal amplifiers and frequency response
    13.2.5 Large signal amplifiers, feedback amplifiers and Oscillators
    13.2.6 Operational amplifiers

14. Principles of Electronic Communications
14.1 Block Diagram of analog/ digital communication system
14.2 Analog and Digital modulation techniques
14.3 Fundamentals of Error Detection and Correction
14.4 Performance evaluation of analog and digital communication systems: SNR and BER

Section B- 26 %

2. Structured and object oriented programming
2.1 Data types, ADT
2.2 Operators, variables and assignments, control structures
2.3 Procedure/function
2.4 Class definitions, encapsulation, inheritance, object composition, Polymorphism
2.5 Pattern and framework

4. Data structures
4.1 General concepts : Abstract data Type, Time and space analysis of algorithms, Big oh and theta notations, Average, best and worst case analysis
4.2 Linear data structures
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, Recursion
4.5 Hashing
4.6 Graphs and digraphs
4.7 Sorting

7. Software Engineering principles(System analysis & design)
7.1 Software process: The software lifecycle 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
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

    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

9. Operating System

    9.1   Processes 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

Section C- 20 %

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

10. Theory of Computation

    10.1   BNF, Languages, grammars

    10.2   DFA and NDFA, 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

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. 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 choice question where as quantitative test is carried out by solving the mathematical problem (which needs no advanced level mathematical background)

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Guidelines for Multiple Choice Questions

1. Total number of MCQ questions : 100
2. Each question carries 1(one) mark.
3. Time allocation for MCQ test: one hour thirty minutes (1hr. 30 minutes)
4. The MCQ must follow the following weight scheme

Subject	Weight (%)	No. of questions
1. Computer Networks	6	6
2. Structured and OO programming	6	6
3. Artificial Intelligence	3	3
4. Data Structure	6	6
5. Computer Architecture/Organization and Microprocessor	6	6
6. Digital Design	5	5
7. Software Engineering Principles (System Analysis/design)	7	7
8. Database Management System	6	6
9. Operating System	6	6
10. Theory of Computation	4	4
11. Compiler Design	5	5
12. Computer Graphics	3	3
13. Basic Electrical and Electronics	7	7
14. Principles of Electronic Communication	5	5
15. Emerging Technology and Electives	5	5
16. Reasoning 16.1 Analytical and Logical Reasoning 16.2 Quantitative test	10 10	10 10

5. Analytical reasoning and logical reasoning comprises of reading passages which is followed by four multiple choice questions for each. The reading passage must be unambiguous and not particular to one field of study.
6. Quantitative test should include general mathematical question (not belonging to advanced level of mathematical studies). Each question must be able to identify the presence of mind of the examinee rather than the depth in the subject matter.

वस्तुगत बहुउत्तर नमूना प्रश्नहरु (Sample Questions)

1. The Constructive Cost Model (COCOMO) helps in identifying
   A. Function point count
   B. Effort
   C. Lines of Codes
   D. Design timeframe
   Correct answer: (B)
2. Which one of the following process scheduling technique is most appropriate for batch jobs for which run time are known in advance?
   A. Round robin scheduling
   B. Priority based scheduling
   C. Multiple queues scheduling
   D. Shortest job first scheduling
   Correct answer: (D)
3. The pumping lemma for context free languages can be used to

A.   prove that a given language is regular
B.   prove that a given language is not context free.
C.   prove that all CFL have a corresponding PDA
D.   prove that a given CFL is inherently ambiguous

Correct answer: (B)

4.   Which of the followings does NOT belong to "Extreme Programming"?
A.   pair programming
B.   heavy documentation
C.   unit-test
D.   user-story

Correct answer: (B)

Sample Questions of Reasoning

Analytical reasoning

A farmer plants only five different kinds of vegetables - beans, corn, kale, peas, and squash. Every year the farmer plants exactly three kinds of vegetables according to the following restrictions:

If the farmer plants corn, he also plants beans. If the farmer plants Kale one year, he does not plant it the next year. In any year, the farmer plants no more than one of the vegetables that he planted the previous year.

Which of the following is a possible sequence of combinations for the farmer to plant in two successive years?

A. beans, corn, kale; corn, peas, squash
B. beans, corn, peas; beans, corn, squash
C. beans, peas, squash; beans, corn, kale
D. corn, peas, squash; beans, kale, peas

Correct answer: (C)

Logical reasoning

The greatest chance for the existence of extraterrestrial life is on a planet beyond our solar system. This is because the Milky Way galaxy alone contains 100 billion other suns, many of which could be accompanied by planets similar enough to earth to make them suitable abodes of life.

Above argument assumes which of the following?

A. Living creatures on another planet would probably have the same appearance as those on Earth.
B. It is likely that life on another planet would require conditions similar to those on Earth.
C. If the appropriate physical conditions exist, life is an inevitable consequence.
D. More than one of the suns in the galaxy is accompanied by an Earth-like planet.

Correct answer: (B)

Quantitative Test

1. The average (arithmetic mean) of two numbers is 2X+1. If one of the numbers is X then other number is
   A.   X+1
   B.   2X-1
   C.   3X-1
   D.   3X+2

Correct answer : (D)

2. What is the least number X for which $(2X+1)(X-2) = 0$?

   A.   -1
   B.   -0.5
   C.   0.5
   D.   2

Correct Answer : (B)

Guidelines for Subjective questions

The Subjective paper consists of two sections. "Section A" Consists of long questions pertinent to core subjects provided in the course of studies (units 1-15). Similarly "Section B" consists of technical writing skill test as well as case study.

Sections "A, B, C" (70 %)

1. Entire set consists of 7 (seven) questions, each carrying 10 marks
2. A complete question set should include as many subjects as possible provided in the course of study.
3. A question may completely belong to one particular subject given in course of study or it may be fragmented into two or more than two domain of subjects.
4. The weight for each unit is given in the following table. The long questions should reflect similar weight scheme.

Subject	Weight (%)
1. Computer Networks	5
2. Structured and OO programming	5
3. Artificial Intelligence	3
4. Data Structure	5
5. Computer Architecture/Organization and Microprocessor	5
6. Digital Design	4
7. Software Engineering Principles (System Analysis/design)	6
8. Database Management System	5
9. Operating System	5
10. Theory of Computation	4
11. Compiler Design	5
12. Computer Graphics	3
13. Basic Electrical and Electronics	5
14. Principles of Electronic Communication	5
15. Emerging Technology and Electives	5

Section "D" (30 %)

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

a. 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.

b. 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).

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विषयगत नमूना प्रश्नहरु (Sample questions)

Section "A"

Attempt all questions. Each question carries 10 marks (7 X 10 = 70 Marks).

1.
   a. Explain the principles of public Key infrastructure (PKI).
   b. Illustrate two methods to reduce the aliasing effect in context to Computer Graphics.
   c. Prove that if a heuristic is consistent, it must be admissible.
   [4 +3+3]

2.
   a. What does it mean by strongly typed language?
   b. If G is a directed graph and G has a cycle, explain the process to find a topological ordering for its vertices?
   c. Construct a NFA with three states that accepts the language {ab, abc}*.
   [4+4+2]

3.
   a. Explain the "synchronize and stabilize" software life cycle and illustrate its difference with traditional waterfall life cycle model.
   b. Explain the banker's algorithm in context to deadlock.
   [6+4]

Section "B"

Technical Writing (1 Question carrying 10 marks)

1. The recently promulgated Electronic transaction ordinance, 2061 has provided legal provisions for authentication and regulating for the recognition, true ship, integrity and reliability of creation, production, processing, storage, and communication and dissemination system of electronic records by making reliable and secured transactions carried out by means of electronic data interchange and other means of electronic communications.
   Write an Essay on how this ordinance affects the existing software development scenario in Nepal.

Case Study (1 Question carrying 20 marks)

2. A Kathmandu based transport company wants to establish a computerized ticketing counter at Gongabu bus terminal. Company owns both air conditioned as well as non-AC buses. Besides that, Company also provides service of goods transport. There are various possible users of the proposed software: Owners can monitor and manipulate the accounts and reservation whereas clients can view the status of their ticket and goods. Employees can have limited access according to their role.

   2.1 Calculate the cost/effort for the proposed system using Function points and any effort model of your choice (for e.g. Constructive Cost Model). **(6 marks)**

   Draw a context diagram and Level-1 Data-flow diagram OR USE-CASE diagram for the possible automated system. **(7 Marks)**

   Design the efficient database schema for the proposed system (with appropriate normalization methods). **(7 Marks)**