



GANDAKI UNIVERSITY

गण्डकी विश्वविद्यालय

SYLLABUS FOR WRITTEN EXAMINATION

Open Competition

Post: Assistant Professor of Computer Engineering

Subject: Second Paper (Full Marks: 100)

Objectives:

This written examination syllabus is designed to assess candidates' knowledge, analytical ability, research aptitude, and teaching competence in Computer Engineering, as well as their awareness of emerging technologies and contemporary national and global issues relevant to the discipline.

Examination Weightage:

SN	Component	Weight (%)
1	Fundamental and core knowledge of the Bachelor's Degree curriculum in Computer Engineering	70
2	Recent trends, emerging technologies, and advances in Computer Engineering	15
3	National and global trends, issues, and professional practices in Computer Engineering	15
	Total	100

1. Fundamental and core knowledge of the Bachelor's Degree curriculum in Computer Engineering (70%)

Candidates are expected to demonstrate a sound understanding of the following subject areas, based on the standard Bachelor of Computer Engineering curriculum prescribed by Nepalese universities.

A. Engineering Mathematics

- Linear Algebra: vector spaces, linear transformations, matrices, and applications
- Matrix theory and matrix decomposition techniques
- Eigenvalues, Eigenvectors, and their applications
- Ordinary differential equations
- Laplace transforms and engineering applications
- Probability theory and random variables
- Statistical methods and inference
- Numerical methods for engineering computation
- Optimization techniques (linear and nonlinear optimization)

B. Digital Logic, Computer Organization & Architecture

- Number systems, Boolean algebra, logic gates, K-maps
- Combinational and sequential circuit design (adders, multiplexers, flip-flops, counters, registers)
- Instruction set architecture, addressing modes, CPU organization

- Memory hierarchy, cache mapping techniques, virtual memory
- Pipelining, instruction-level parallelism, RISC vs CISC
- I/O organization, interrupts, DMA, bus architecture
- Advanced/parallel computer architecture: multiprocessing, multicore systems, GPU architecture basics

C. Programming, OOP & Programming Technology

- Programming fundamentals in C (pointers, arrays, structures, file handling, dynamic memory)
- Object-oriented programming in C++/Java: classes, inheritance, polymorphism, encapsulation, abstraction, exception handling
- Programming technology / Java: collections, multithreading, JDBC, GUI basics
- Software development practices: version control (Git), debugging, unit testing

D. Data Structures & Algorithms

- Arrays, linked lists, stacks, queues, trees (BST, AVL, B-trees), heaps, hashing
- Graph representations and traversals (BFS/DFS)
- Sorting and searching algorithms and their complexity analysis
- Algorithm design paradigms: divide-and-conquer, greedy, dynamic programming, backtracking
- Asymptotic notation, time/space complexity, NP-completeness basics

E. Theory of Computation & Compiler Design

- Finite automata, regular expressions and languages
- Context-free grammars, pushdown automata
- Turing machines, decidability, computability, NP-hardness
- Compiler phases: lexical analysis, parsing, semantic analysis, code generation, optimization

F. Operating Systems

- Process management, scheduling algorithms, threads and concurrency
- Process synchronization: semaphores, monitors, classical synchronization problems
- Deadlock detection, prevention and avoidance
- Memory management: paging, segmentation, virtual memory
- File systems and I/O management
- Distributed operating systems: distributed file systems, clock synchronization, mutual exclusion, load balancing

G. Database Management Systems

- ER modeling, relational model, relational algebra
- SQL, normalization (1NF–BCNF), functional dependencies
- Transaction management, concurrency control, ACID properties
- Indexing, query optimization
- Introduction to NoSQL and distributed databases

H. Computer Networks & Data Communication

- OSI and TCP/IP reference models
- Data communication fundamentals: transmission media, modulation, multiplexing
- Network layer: IP addressing, subnetting, routing protocols
- Transport layer: TCP/UDP, congestion control

- Application layer protocols: HTTP, DNS, FTP, SMTP
- Network security fundamentals: cryptography basics, firewalls, VPN
- Wireless and mobile networking basics

I. Software Engineering & Project Management

- SDLC models: waterfall, iterative, agile/Scrum
- Requirements engineering, software design principles, UML modeling
- Object-oriented software engineering, design patterns
- Software testing techniques and quality assurance
- ICT project management: scope, cost, schedule, risk management
- Engineering economics: cost-benefit analysis, depreciation, feasibility studies

J. Computer Graphics, Image Processing & AI

- 2D/3D transformations, line and curve drawing algorithms, clipping
- Rendering, shading, and animation basics
- Digital image fundamentals, image enhancement, filtering, segmentation
- Pattern recognition basics
- Artificial Intelligence: search algorithms, knowledge representation, expert systems
- Machine learning fundamentals: supervised/unsupervised learning, neural networks basics

K. Microprocessors & Embedded Systems

- Microprocessor architecture (8085/8086 basics), instruction sets, interfacing
- Microcontroller fundamentals and embedded system design
- Real-time operating system concepts
- Sensors, actuators and interfacing basics for embedded/IoT devices

L. Digital Signal Processing

- Sampling theory and signal reconstruction
- Discrete-time signals and systems
- Z-transform
- Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)
- Convolution and correlation
- Frequency response and spectral analysis
- Digital Filter Design
- Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) Filters
- Applications of DSP in image processing, speech processing, and communication systems

M. Web, Cloud & Emerging Platform Technologies

- Web technology: HTML/CSS, client-server architecture, web application frameworks
- Cloud computing: service models (IaaS/PaaS/SaaS), deployment models, virtualization
- Cybersecurity fundamentals: threats, vulnerabilities, security protocols, ethical hacking basics
- Simulation and modelling fundamentals

2. Recent Advances and Emerging Technologies in Computer Engineering (15%)

Candidates should be able to understand the recent advances, emerging technologies, and innovative applications in Computer Engineering, and their ability to relate these developments to teaching, research, and professional practice.

- Artificial Intelligence and Machine Learning advances: deep learning, transformer architectures, large language models (LLMs) and generative AI
- Data Science and Big Data analytics: data engineering pipelines, business intelligence
- Cloud-native computing, edge computing, and serverless architectures
- Internet of Things (IoT) and smart systems integration
- Blockchain, distributed ledger technology, and cryptocurrency fundamentals
- Cybersecurity trends: zero-trust architecture, ransomware defense, AI-driven security
- 5G/6G networks and next-generation wireless communication
- DevOps, CI/CD, containerization (Docker) and orchestration (Kubernetes)
- Quantum computing fundamentals and potential applications
- Augmented Reality (AR), Virtual Reality (VR), and the metaverse concept
- Green computing and sustainable/energy-efficient IT infrastructure
- Human-computer interaction and accessible computing technologies

3. National and global trends, issues, and professional practices in Computer Engineering (15%)

Candidates should be familiar with the policy, industrial, research, and societal aspects of Computer Engineering in Nepal and globally, including:

- Nepal's Digital Nepal Framework and national ICT policy priorities
- University Grants Commission (UGC) Nepal policies on higher education, research, and quality assurance in engineering programs
- IT/ITES industry growth in Nepal: software exports, startups, and the freelancing/outsourcing economy
- E-governance initiatives and digital public service delivery in Nepal
- Nepal's National Cyber Security Policy and data protection developments
- Brain-drain and skilled IT workforce migration trends affecting Nepal's technical education
- Global regulatory trends: AI governance and ethics frameworks (e.g., EU AI Act discussions), data privacy laws (GDPR and comparable national frameworks)
- Role of ICT in achieving the UN Sustainable Development Goals (SDGs)
- Global technology industry shifts: semiconductor supply chains, AI infrastructure investment, and geopolitical technology competition
- International accreditation and academic collaboration trends in engineering education (outcome-based education, ABET-aligned practices)
- Digital divide and inclusive technology access issues, particularly in developing and LDC contexts including Nepal.