Assistant Professor

Computer Engineering

(Syllabus)

FM: 100, PM: 40

Section A

1. **Digital Design, Computer Architecture and organization and micro-processors:**
   - 1.1. Number Systems, Logic Elements, Combinational Logic Circuits
   - 1.2. Sequential Logic, Arithmetic Circuits, MSI Logic Circuits. Counters and Registers,
   - 1.3. IC logic families, Interfacing with Analog Devices, Memory Devices
   - 1.4. Basic Structures: sequential circuits, design procedure, state table and state diagram. Von Neumann I Harvard architecture, RISC/CISC architecture
   - 1.5. Addressing Methods and Programs, representation of data, arithmetic operations, basic operational concepts, bus structures, instruction cycle and excitation cycle
   - 1.6. Processing Unit: instruction formats, arithmetic and logical instruction
   - 1.7. Addressing modes
   - 1.8. Input Output Organization: I/O programming, memory mapped I/O, basic interrupt system, DMA 1.6 Memory Systems
   - 1.9. 808X and Intel microprocessors: programming and interfacing Fundamentals of electronics device and circuits
2. **Artificial Intelligence:**
   - 2.1. Problem Solving: Problem definition, problem as a state space search, problem formulation, problem types: Tor problems, Real world problems, Well-defined problems, Constraint satisfaction problem (Basic concept & examples), Production systems (Definition, Architecture, examples).
   - 2.2. Search Techniques: Uniformed search techniques: depth first search, breadth first search, depth limit search, Iterative deepening search, Bidirectional search, & search strategy comparison. Informed search techniques: Greedy best first search, A* search, Hill climbing search, Simulated annealing, Game playing, Adversarial search techniques-mini-max procedure, alpha beta pruning.
   - 2.3. Knowledge Representation, Inferential reasoning : Formal logic connectives, truth table, syntax, semantics, tautology, validity, well-formed formula, propositional logic, Inference with PL: Resolution, Backward chaining & Forward chaining, predicate logic (FOPL), quantification, inference with FOPL by converting into PL (Existential & Universal instantiation), Directly with FOPL. (Unification & lifting, resolution, backward chaining, forward chaining), Rule based deduction system, Statistical reasoning-probability & Bayes theorem & causal networks, reasoning in belief network.

2.4. Structured Knowledge Representation: Representation and mappings, Approaches to knowledge representation, Issues in knowledge representation, Semantic nets, Frames, Conceptual dependencies and scripts (Rich and Knight).

2.5. Machine Learning: Concepts of learning, learning from examples, explanation based learning, learning by analogy, learning by simulating evolution, learning by training neural nets, learning by training perceptions.

2.6. Applications of Artificial Intelligence: Expert system (Architecture, Expert system development process), Neural Network (Mathematical model, gate realization, Network structure), natural language processing (Steps of NLP parsing), Basic concepts of Machine vision.

3. Theory of Computation:

3.1. BNF, Languages, Grammars

3.2. DFA and NDFA, regular expressions, regular grammars

3.3. Closure, homomorphism

3.4. Pigeonhole principle, pumping lemma

3.5. CFGs, Parsing and ambiguity, Pushdown automata, NPDAs & CFGs

3.6. Turing machines

3.7. Recursively enumerable languages, unrestricted grammars

3.8. The Chomsky hierarchy, Undecidable problems, Church's Thesis

3.9. Complexity Theory, P and NP

3.10. The Structure of a Compiler

3.11. Lexical Analyzer

3.12. Top-down Parsing/Bottom-up Parsing

4. Computer Graphics:

4.1. Graphics Concepts

4.2. Basic raster graphics algorithms and primitives

4.3. Scan conversion

4.4. Graphics hardware

4.5. 2D geometrical transformations and viewing

4.6. 3D geometry and viewing

4.7. Hierarchical modeling

4.8. Projections

4.9. Hidden surface removal

4.10. Shading and rendering

5. Computer Networks:

5.1. Protocol stack, switching

5.2. Link Layer: services, error detection and correction, multiple access protocols, LAN addressing and ARP (Address Resolution Protocol), Ethernet, CSMS/CD multiple access protocol, Hubs, Bridges, and Switches, Wireless LANs, PPP (Point to Point Protocol). Wide area protocols

5.3. 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.

5.4. Transport Layer: principles, multiplexing and de-multiplexing, UDP, TCP, flow control, principles of congestion control, TCP congestion control

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

5.6. Distributed system, Clusters, Network Security, Disaster Recovery, Data Storage Techniques: Clustering, NAS, SAN

6. Operating System:

6.1. Processing and Threads: Symmetric Multiprocessing, Micro-kernels, Concurrency, Mutual Exclusion and Synchronization, Deadlock

6.2. Scheduling

6.3. Memory Management

6.4. 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

6.5. Distributed Systems: Distributed Message passing, RPC, Client-server computing, Clusters

6.6. Security: Authentication and Access Authorization, System Flaws and Attacks, Trusted System

6.7. Common Operating Systems: MS-DOS, Windows Family of Products, Unix Family of Products, Linux Family of Products, Windows Networking, Windows Architecture, Linux Architecture, Troubleshooting Windows, & Linux, Managing Network Printing, Managing Hard Disks and Partitions, Monitoring and Troubleshooting Windows, Users, Groups and Permission on Linux and Windows

7. Structured and object-oriented programming:

7.1. Data types, ADT

7.2. Operators, variables and assignments, control structures, Procedure/function

7.3. Class definitions, encapsulation, inheritance, object composition, Polymorphism

7.4. Pattern and framework

7.5. Programming with C, C++, Java

8. Data Structures and Algorithms:

8.1. General concepts: Abstract data types, Time and space analysis of algorithms, Big Oh and theta notations, Average, best and worst-case analysis

8.2. Linear data structures: Lists, Linked Lists, Stacks, Queues, Priority Queue

8.3. 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

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

8.5. Indexing Methods: Hashing Trees, Suffix Trees

8.6. Graph algorithms: Depth-first Search and Breadth-first Search, Shortest Path Problems, Minimum Spanning Trees, Directed Acyclic Graphs.

8.7. Searching, Merging and Sorting

9. Software Engineering Principles

9.1. Software process: Software Process models, risk-driven approaches

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

9.3. Software requirements: Requirement analysis, requirements solicitation, analysis tools, requirement definition, requirements specification, static and dynamic specifications, requirements review.

9.4. Software design: Design for reuse, design for change, design notations, evaluation Modeling: Use Case and validation, Software Architecture, Context diagram Object-Oriented Concept, Object Structure, Object Feature Diagram, State Diagram, Event Flow Diagram

9.5. Implementation: Programming standards and static analysis, unit testing, integration testing, procedures regression abstraction. Testing, fault tolerance.

9.6. Maintenance: The maintenance problem, the nature of maintenance, planning for maintenance

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

10. Database Management System and Database Design:

10.1. Introduction: The relational model, ER model, SQL, Functional dependency and relational database design, File structure

10.2. Transaction Management and Concurrency Control: Concurrent execution of the user programs, transactions, Concurrency control techniques

10.3. Crash Recovery: Types of failure, Recovery techniques

10.4. Query Processing and Optimization

10.5. Indexing: Hash based indexing; Tree based indexing

10.6. Distributed Database Systems and Object-oriented database system

10.7. Data Mining and Data Warehousing

10.8. Security Management System

10.9. SQL and Embedded SQL, Writing Basic SQL SELECT Statements, Restricting and Sorting data, Single Row Functions, Displaying Data from Multiple Tables, Aggregation of Data Using Group Functions, Sub Queries, Manipulating Data and Creating & Managing Tables, Creating Views and Controlling User Access,

10.10. Database Design: Logical Design, Conceptual Design, Mapping Conceptual to Logical, Pragmatic issues, Physical Design, Integrity and Correctness, Relational Algebra. Relational Calculus. Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF, DKNF,

10.11. Database Design with major RDBMS products: Oracle, Sybase, DB2, SQL Server.

Section B:

1. **Teaching Aptitude:**
   - 1.1 Objective and perspectives
   - 1.2 Required qualities for teaching in higher education: Individual, social and occupational/professional
   - 1.3 Teaching methods
   - 1.4 Student evaluation and assessment
2. **Research Aptitude, publication ethics and Data Interpretation**
   - 2.1. Meaning of research
   - 2.2. Objectives , types and methods
   - 2.3. Research & publication ethics
   - 2.4. data sources, access to data, availability of data and presentation
   - 2.5. Research based article and quality of journal
   - 2.6. dissertation/thesis framework
3. **Tribhuvan University:**
   - 3.1. Higher Education Policy 2076
   - 3.2. Tribhuvan University Acts , Laws and Bylaws

Written Exam Questions [Full Marks: 100, 3Hrs]

Section-A

Chapters	1	2	3	4	5	6	7	8	9	10	Total Marks
MCQ (1 marks each)	2	2	2	2	2	2	2	2	2	2	20
Short [5 marks each]	-	1	1	1	1	1	1	-	-	-	30
Long [10 marks each]	1	-	-	-	-	-	-	1		1	30

Section-B

Chapters	1	2	3	Total Marks
MCQ (1 marks each)	1	2	2	5
Short [5 marks each]	1	1	1	15