SYLLABUS

for written Examination to be conducted for the post of Assistant Professor in the stream of Information Technology

UNIT I: Number System and Discrete Mathematics

Data representation, complements, computer arithmetic-Add, Sub., Mul., and Div. Data types, error detection codes, Fixed point representation, floating point representation, number system and conversion.

Equivalent relations partial ordering representation and properties of relation set operation counting mathematical induction and discrete.

Probability basics of counting, baye's theorem, Inclusion-Exclusion principle, Mathematical induction, Permutations and Combinations, pigeon hole principle.

Group Theory: Groups, Subgroups, Semi Groups, Product and Quotients of Algebraic Structures, Isomorphism, Homomorphism, Automorphism, Rings, Integral Domains, Fields, Applications of Group Theory.

Graph theory: Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets.

UNIT II: Operating system and Simulation concepts

Basics of Operating Systems: Operating System Structure, Operations and Services; System Calls, Operating-System Design and Implementation; System Boot.

Process Management: Process Scheduling and Operations; Interprocess Communication, Communication in Client–Server Systems, Process Synchronization, Critical-Section Problem, Peterson's Solution, Semaphores, Synchronization.

CPU Scheduling: Scheduling Criteria and Algorithms; Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling.

Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection; Recovery from Deadlock.

Memory Management: Contiguous Memory Allocation, Swapping, Paging, Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files.

Introduction to Simulation: Introduction to Simulation, advantages and disadvantages of simulation, application, software design, systems and systems environment, components of a system, discrete and continuous systems

Model of a system, types of models, discrete-event simulation, steps in a simulation study, Simulation of Queueing systems.

Generation of Pseudo-Random Numbers: Techniques for Generation of Pseudo-Random Numbers: Linear Congruential, Combined Linear Congruential, Random Number streams, Tests for Random Numbers.

UNIT III: Data structures and Design, Analysis of Algorithms

Data Structures: Arrays and their Applications; Sparse Matrix, Stacks, Queues, Priority Queues, Linked Lists.

Trees: Forest, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, B Tree, B+ Tree, B* Tree, Data Structure for Sets, Graphs, Sorting and Searching Algorithms; Hashing.

Time and Space Complexities; Asymptotic Notation, Recurrence Relations.

Design Techniques: Divide and Conquer; Dynamic Programming, Greedy Algorithms, Backtracking, Branch and Bound.

Lower Bound Theory: Comparison Trees, Lower Bounds through Reductions.

Graph Algorithms: Breadth-First Search, Depth-First Search, Shortest Paths, Maximum Flow, Minimum Spanning Trees.

Complexity Theory: P and NP Class Problems; NP-completeness and Reducibility.

UNIT IV: Database Management System and Warehouse

Database need and evolution, Characteristics of a Database approach, Data Models, Schemas, and Instances, Three-Schema Architecture and Data independence, Database Language and Interfaces, Centralized and Client/Server Architecture for DBMS

Entity-Relationship Diagram, Relational Model- Constraints, Languages, Design and Programming, Relational Database Schemas, Update Operations and Dealing with Constraint Violations, Relational Algebra and Relational Calculus, Codd Rules.

Data Definition and Data Types, Constraints, Queries, Insert, Delete, and Update Statements, Views, Stored Procedures and Functions, Database Triggers.

Functional Dependencies and Normalization, Algorithms for Query Processing and Optimization, Transaction Processing, Concurrency Control Techniques.

Data warehouse Definition, goals and need of Data Warehouse, Evolution of data warehouse. Principles of Data Warehousing (Architecture and Design Techniques): Three-tier Architecture for a warehouse, Data Warehouse Models

Data Pre-processing, ETL and Data Cleaning, Missing values, Noisy data, Data cleaning as process, Decision Trees, Clustering, OLAP V/S OLTP Technologies, operations of OLAP, Data model for OLTP and OLAP.

UNIT V: Software Engineering

Software Process, Generic Process Model – Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models, Project Management, Component Based Development, Aspect-Oriented Software Development, Formal Methods, Agile Process Models – Extreme Programming

(XP), Adptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering.

Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling; Requirements Review, Software Requirment and Specification (SRS) Document.

Software Design: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design.

Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability.

Estimation and Scheduling of Software Projects: Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts.

Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Tesing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing.

Software Configuration Management: Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering.

UNIT VI: Networks and Security

Computer Networks: Network Topologies, Local Area Networks, Metropolitan Area Networks, Wide Area Network, Wireless Networks, Internet.

Network Models: Layered Architecture, OSI Reference Model and its Protocols; TCP/IP Protocol Suite, Physical, Logical, Port and Specific Addresses; Switching Techniques.

Functions of OSI and TCP/IP Layers: Framing, Error Detection and Correction; Flow and Error Control; Sliding Window Protocol, HDLC, Multiple Access – CSMA/CD, CSMA/CA, Reservation, Polling, Token Passing, FDMA, CDMA, TDMA, Network Devices, Backbone Networks, Virtual LANs.

IPv4 Structure and Address Space; Classful and Classless Addressing; Datagram, Fragmentation and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP), Direct and Indirect Network Layer Delivery; Routing Algorithms, TCP, UDP and SCTP Protocols; Flow Control, Error Control and Congestion Control in TCP and SCTP.

Network Security: Malwares, Cryptography and Steganography; Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls.

UNIT VII: Data communication and Client Server Architecture

Data Communication: Components of a Data Communication System, Simplex, Half-Duplex and Duplex Modes of Communication; Analog and Digital Signals; Noiseless and Noisy Channels; Bandwidth, Throughput and Latency; Digital and Analog Transmission; Data Encoding and Modulation Techniques; Broadband and Baseband Transmission; Multiplexing, Transmission Media, Transmission Errors, Error Handling Mechanisms.

World Wide Web (WWW): Uniform Resource Locator (URL), Domain Name Service (DNS), Resolution - Mapping Names to Addresses and Addresses to Names; Electronic Mail Architecture, SMTP, POP and IMAP; TELNET and FTP.

Client Server Architecture: Client Server Architecture, Two-Tier Architecture, Three-Tier Architecture, N-Tier Architecture, N-Tier vs 2-Tier Architecture. types of Servers, File Server, Database Server, Communication Server, Object Server, Groupware Server, Transaction Server, Characteristics and types of Clients, Thin Client, Fat Client. Client Server System Architecture, Client Server Building Blocks, Hardware, Client Hardware, Server Hardware, Client Server Building Blocks, Software, Client Server Systems Development Methodology

Project Management, Architecture Definition, Systems Development Environment, Middleware, Types of Middleware, DCE, MOM, TP, Monitors, ODBC, Design Overview of ODBC, ODBC Architecture, Components, Applications, Driver Managers, Database Drivers, ODBC Data Sources, Network Operating System, Base Services, External Services.

UNIT VIII: Programming Paradigms and Languages

Programming Language Concepts, Paradigms and Models, Programming Environments, Virtual Computers and Binding Times, Programming Language Syntax, Stages in Translation, Formal Transition Models.

Elementary Data Types: Properties of Types and Objects; Scalar and Composite Data Types.

Procedural Programming: Tokens, Identifiers, Data Types, Sequence Control, Subprogram Control, Arrays, Structures, Union, String, Pointers, Functions, File Handling, Command Line Arguments, Preprocessors.

Object Oriented Programming: Class, Object, Instantiation, Inheritance, Encapsulation, Abstract Class, Polymorphism. Tokens, Identifiers, Variables and Constants; Data types, Operators, Control statements, Functions Parameter Passing, Virtual Functions, Class and Objects; Constructors and Destructors; Overloading, Inheritance, Templates, Exception and Event Handling; Streams and Files; Multifile Programs.

UNIT IX: Theory of Computation and Compiler Design

Regular Language Models: Deterministic Finite Automaton (DFA), Non-Deterministic Finite Automaton (NDFA), Equivalence of DFA and NDFA, Regular Languages, Regular Grammars, Regular Expressions, Properties of Regular Language, Pumping Lemma, Non-Regular Languages, Lexical Analysis.

Context Free Language: Pushdown Automaton (PDA), Non-Deterministic Pushdown Automaton (NPDA), Context Free Grammar, Chomsky Normal Form, Greibach Normal Form, Ambiguity, Parse Tree Representation of Derivation Trees, Equivalence of PDA's and Context Free Grammars; Properties of Context Free Language.

Turing Machines: Standard Turing Machine and its Variations; Universal Turing Machines, Models of Computation and Church-Turing Thesis; Recursive and Recursively-Enumerable Languages; Context-Sensitive Languages, Unrestricted Grammars, Chomsky Hierarchy of Languages

Compilers: Syntax Analysis: Associativity, Precedence, Grammar Transformations, Top Down Parsing, Recursive Descent Predictive Parsing, LL(1) Parsing, Bottom up Parsing, LR Parser, LALR(1) Parser.

Semantic Analysis: Attribute Grammar, Syntax Directed Definitions, Inherited and Synthesized Attributes; Dependency Graph, Evaluation Order, S-attributed and L-attributed Definitions; Type-Checking.

Run Time System: Storage Organization, Activation Tree, Activation Record, Stack Allocation of Activation Records, Parameter Passing Mechanisms, Symbol Table.

Intermediate Code Generation: Intermediate Representations, Translation of Declarations, Assignments, Control Flow, Boolean Expressions and Procedure Calls.

Code Generation and Code Optimization: Control-flow, Data-flow Analysis, Local Optimization, Global Optimization, Loop Optimization, Peep-Hole Optimization, Instruction Scheduling.

UNIT X: Artificial Intelligence and Business Intelligence

Definition, AI approach for solving problems, Turing Test and Rational Agent Approaches, State Space Representation of Problems, Logic, Semantic Networks, Frames, Rules, Scripts, Conceptual Dependency and Ontologies, Expert Systems, Handling Uncertainty in Knowledge, Components of a Planning System, Linear and Non-Linear Planning, Goal Stack Planning, Hierarchical Planning, STRIPS, Partial Order Planning.

Heuristic Search Techniques, Game Playing, Min-Max Search, Alpha Beta Cutoff Procedures

Agents and Objects, Agents and Expert Systems, Generic Structure of Multiagent System, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies.

Business Intelligence, Decision Support Systems, Applications of BI, Types of Digital Data - structured, semi structured and unstructured data, Terminologies-Data, Knowledge Information, Intelligence.

BI Technology, BI Roles & Responsibilities, Best practices in BI, Framework of BI, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI from text and the Web: Text and Web mining, enterprise content management.

Measures, Metrics, KPIs and Performance Management, Reporting Tools- Scorecards, Dashboards.