Tamil Nadu Public Service Commission
Syllabus
Computer Science, Computer Application and Information Technology
(Degree Standard)

Code: 555

Unit I: Mathematical Foundations and Computer Architecture (10 Questions)

Set Theory – Relations – Functions – Propositional Logic – Predicate Logic – Propositional Calculus – Random Variable – Discrete and Continuous Random Variable -Binomial – Poisson , Geometric and Normal Distribution - QUEUEING MODELS – Markovian queues - Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.

BOOLEAN ALGEBRA AND LOGIC GATES – Review of Number Systems – Arithmetic Operations – Binary Codes – Boolean Algebra and Theorems – Boolean Functions – Simplification of Boolean Functions using Karnaugh Map and Tabulation Methods – Logic Gates – NAND and NOR Implementations. COMBINATIONAL LOGIC – Combinational Circuits – Analysis and Design Procedures – Circuits for Arithmetic Operations, Code Conversion – Decoders and Encoders – Multiplexers and Demultiplexers – Introduction to HDL – HDL Models of combinational circuits – SEQUENTIAL LOGIC - Sequential Circuits – Latches and Flips Flops – Analysis and Design Procedures – State Reduction and State Assignment – Shift Registers – Counters – HDL for Sequential Logic Circuits – Computer Organization – Components of a computer system - Addressing Modes - Instruction Set Architecture – RISC and CISC Architectures CPU Performance Metrics - Data path and Control – Hazards: Structural, Data and Control Hazards - Dynamic Scheduling - Memory Hierarchy – Cache Memories – Virtual Memory – Associative memories – Accessing I/O devices - Interrupts - Direct Memory Access – Multicore Architectures - Cache coherence policies – GPU architectures and programming - - MEMORY AND I/O SYSTEMS – programmed I/O, DMA and interrupts, I/O processors.

Unit II: Computer Programming (C,C++,Java, Python,.Net) (20 Questions)

Data Types, Operators, Expressions, Type casting - Arrays – Structures, Unions - Enumeration Types - Storage Classes - Preprocessor directives - Functions, Recursion - Pointers to arrays, structures, unions and functions – Dynamic Memory Allocation – Files. Object Oriented Programming using C++ and Java: Classes – Objects - Methods – Constructors and Destructors – Scope – Data Encapsulation – Polymorphism - Overloading and Overriding –Inheritance – Types of Inheritance – Interfaces - Abstract Classes and Methods – Virtual Classes and Functions – Final Methods and Classes - Exception Handling - Assertions – Garbage Collection – Cloning – Reflections - Files. Streams – Formatted Input and Output – Collections – Generic Classes and Methods Multithreading – Object Concurrency – Serialization

Python Interpreter and Interactive Mode-Data types-Statements- Expressions-Boolean Values and Operators-Strings-Arrays of Numbers- Lists-Tuples-Dictionaries-Functions-File Reading and Writing - Python Packages, Errors Handling and Exceptions.

Window Based Application-Core ASP.NET-ASP.NET web forms-Server Control-Data Binding-Window Communication Foundation-.NET compact Framework-Optimizing Performance - Packaging and Deployment.

Unit III: Data structures and Algorithms (10 Questions)

Asymptotic Notation, O, Ω, θ – Recurrence Equations –- Linear Data Structures – Abstract Data Types (ADTs) – List ADT – array based implementation – linked list implementation – singly linked lists – circularly linked lists – doubly-linked lists – applications of lists – Polynomial Manipulation – All operation (Insertion, Deletion, Merge, Traversal) – Stack ADT – Evaluating arithmetic expressions – other applications – Queue ADT – circular queue implementation – Double ended Queues – Priority Queues - application of queues – Trees: Binary Tree - Binary Search Tree-Tree Traversals –Operations- AVL Tree-Splay Tree-Red Black Tree- Binary Heap- Skew Heap- Leftist Heap - Binomial Heap-Fibonacci Heap- Sorting

algorithms: Insertion sort – Selection sort – Shell sort – Bubble sort – Quick sort – Merge sort – Radix sort – Heap Sort - Searching: Linear search – Binary Search - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing – Graph Algorithms: Minimum Spanning Tree – Shortest Path Algorithms - Graph Traversals - Directed Acyclic Graph- Topological Ordering-All Pair Shortest Path Algorithms- Floyd Warshall algorithm- Bellman Ford Algorithm-Network Flow Algorithms- Ford Fulkerson Algorithm-Amortized Analysis of Algorithms - Algorithm Analysis: Asymptotic Analysis-Solving Recurrence Equations-Algorithm Design Techniques-Greedy Algorithms-Dynamic Programming-Divide and Conquer- Back Tracking Naïve, Knuth Morris Pratt algorithm– Vertex Cover, Hamiltonian Cycle - Complexity classes – P, NP, NP Complete, NP Hard.

Unit IV: Operating Systems and Compiler Design (20 Questions)

OPERATING SYSTEMS OVERVIEW – Computer System Overview – Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview – objectives and functions, Evolution of Operating System – Computer System Organization – Operating System Structure and Operations –System Calls, System Programs, OS Generation and System Boot – PROCESS MANAGEMENT – Processes – Process Concepts, Process Scheduling, Operations on Processes, Interprocess Communication; Threads – Overview, Multicore Programming, Multithreading Models; – Thread and SMP Management. Process Synchonization – Critical Section Problem, Mutex Locks, Semaphores, Monitors; CPU Scheduling and Deadlocks – STORAGE MANAGEMENT – Main Memory – Contiguous Memory – Allocation, Segmentation, Paging, 32 and 64 bit architecture Examples; Virtual Memory – Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples – I/O SYSTEMS – Mass Storage Structure – Overview, Disk Scheduling and Management; File System Storage – File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation – File System Structure, Directory Structure, Allocation Methods, Free space Management; I/O Systems.

Linux Operating Systems features - Distributed Systems: Distributed System Models-Distributed Communications-Global States-Causal Ordering of Events-Distributed Mutual Exclusion Algorithms-Deadlock detection in Distributed Systems- Consensus and Agreement Algorithms.

Phases of Compilers - One and Two Pass Assemblers – Loaders, Linkers - Macroprocessors and Emulators - text editors, programming languages, lexical analysis, parsing techniques, precedence grammars, symbol tables, scope rules and parameter passing mechanisms, syntax directed translation, run time environment, machine code generation, interpreters.

Unit V: Database Management Systems and Advanced DBMS (40 Questions)

INTRODUCTION TO DBMS – File Systems Organization – Sequential, Pointer, Indexed, Direct – Purpose of Database System – Database System Terminologies – Database Characteristics – Data models – Types of data models – Components of DBMS – Relational Algebra. LOGICAL DATABASE DESIGN: Relational DBMS – Codd's Rule – Entity – Relationship model – Extended ER Normalization – Functional Dependencies, Anomaly – 1 NF to 5 NF – Domain Key Normal Form – Denormalization. Structured Query Language (SQL) & QUERY OPTIMIZATION – SQL Standards – Data types – Database Objects – Data Definition Language (DDL) – Data Manipulation Language (DML) – Data Control Language (DCL) – Transaction Control Language (TCL) – Embedded SQL – Static vs Dynamic SQL – QUERY OPTIMIZATION: Query Processing and Optimization – Heuristics and Cost Estimates in Query Optimization – TRANSACTION PROCESSING AND CONCURRENCY CONTROL – Introduction – Properties of Transaction – Serializability – Concurrency Control – Locking Mechanisms – Two Phase Commit Protocol – Dead lock – TRENDS IN DATABASE TECHNOLOGY – RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Object Oriented Database Management Systems-Object Oriented Relational Database management Systems.

Introduction to Distributed Databases – Multidimensional and Parallel databases – Spatial and Multimedia databases – Mobile and web databases – Data Warehouse – Mining – Data marts - NoSQL Database-CAP Theorem - Document Based Systems-Key Value Stores-Column Based Database-Graph Database-Database Security-Access Control Mechanisms-Big Data-Big Data Analytics-Big Data Tools – Geographics Information System – Map Reduce Framework – Hadoop , HDFS.

Unit VI: Computer Networks and Security (40 Questions)

NETWORKING FUNDAMENTALS –Building a network- requirements – Layering and protocols – Internet Architecture – Network software – Performance; Link layer Services – Framing – Error Detection – Flow control – MEDIA ACCESS & INTERNETWORKING – Media access control- Ethernet (802.3) – wireless LANs -802.11 – Bluetooth – switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)- ROUTING – Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM) - TRANSPORT LAYER – Overview of Transport layer – UDP- Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements – APPLICATION LAYER - Traditional applications - Electronic Mail (SMTP, POP3, IMAP,MIME) HTTP –Web Services - DNS –SNMP – Mobile Computing – Mobile Computing Vs. wireless Networking – Mobile Computing Application – Characteristics of Mobile Computing – Structure of Mobile Computing Applications. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes – MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER – Overview of Mobile IP- Features of Mobile IP- Key Mechanism in Mobile IP – Route Optimization. Overview of TCP/ IP – Architecture of TCP/ IP – adaptation of TCP Window – Improvement in TCP Performance – MOBILE AD-HOC NETWORKS – Ad- Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols – Popular Routing Protocols – Vehicular AdHoc networks (VANET)- MANET Vs VANET – Security – Cryptographic Algorithms – Caesar Cipher – Hill Cipher – Vignere cipher – LFSR Sequences – Number Theory –GCD –Chinese Remainder Theorem – Fermat's Theorem and Euler's Theorem – Symmetric key Cryptography – DES – AES Algorithms – Public key algorithms – RSA – Diffe–Hellman Algorithm – ElGamal System – Elliptic Key Cryptography – Digital Signatures – Digital Certificates – Hashing – MD5 – SHA1 – Key Management – Kerberos –PKI –IP Security – Email Security – SSL – SET –OS Security – Database Security.

Classification of Cybercrimes-Types of Malicious Attacks Cyber Laws – The Indian IT Act – Malicious Software – Common Attack Vectors – Social Engineering Attacks – Wireless Network Attacks – Web Application Attacks- Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems.

Unit VII: Embedded Systems and Cloud Computing (10 Questions)

Embedded System design process, Embedded processors – ARM Processor – Architecture, ARM Instruction sets – Addressing Modes – Pipelining – Embedded C Programming – Looping Structures – Register Allocation – Function calls – Pointer aliasing – Structure arrangement – bit fields – unaligned data and endianness – inline functions and inline assembly – portability issues. Profiling and cycle counting – instruction scheduling – Register allocation – Conditional execution – looping constructs – bit manipulation – optimized primitives. Multiple tasks and processes – Context switching – Scheduling policies – Interprocess communication mechanisms – Exception and interrupt handling – Performance issues. Meeting real time constraints – Multi-state systems and function sequences – Embedded software development tools – Emulators and debuggers – Design methodologies – Internet of Things (IoT) – Sensors.

Cloud Components, Infrastructure, Architecture, Applications, Benefits, Limitations, Cloud Deployment Models, Cloud Technologies. Infrastructure as a Service (IaaS) – Storage as a Service – Compute as a Service – Platform as a Service (PaaS) – Software as a Service (SaaS): CRM as a Service, Social Computing Services, Document Services. Taxonomy, Server Virtualization, Desktop Virtualization, Network Virtualization, Storage Virtualization, Hypervisor. Hardware and Infrastructure – Server, Clients, Network, Software Defined Networks

(SDN). Accessing the Cloud- Web Applications, Web API, Web Browsers.

8-Bit Embedded Processor - IOT Devices – Arduino - Sensors and Actuators - IOT Communication Models and API - Communication Protocols - Programming and Interfacing - Connecting to the Cloud - Cloud Technologies: Cloud Characteristics-Cloud Service and Deployment Models-Virtualization-Virtual Machines-Server, Network and Storage Virtualization-Hypervisor-Cloud Security Requirements-Threats: Malicious Attacks-Events and Alerts- Security Information and Event Management - Hadoop –Map Reduce Technique.

Unit VIII: Web Technology, Mobile Technology and Multimedia Technologies (30 Questions)

SCRIPTING LANGUAGES –Web page designing using HTML, Scripting basics – Client side and server side scripting. Java Script – Object, names, literals, operators and expressions – statements and features – events – windows –documents – frames –date types –built-in functions – Browser object model – Verifying forms – HTML5 – CSS3 – HTML 5 canvas – Web site creation using tools – Event Handling- PhP Scripting - Multithreaded Programming – Input / Output – files – Utility Classes – String Handling – JDBC – JDBC Overview –JDBC implementation – Connection class – Statements – Catching Database Results, handling database Queries. Networking –Inet Address class – URL class – TCP sockets – UDP sockets, Java Beans –RMI – APPLETs – Java applets – Life Cycle of an Applet – Adding Images to an Applet – Adding Sound to an Applet – Passing Parameters to an Applet - Event Handling. Introducing AWT: Working with Windows Graphics and Text. Using AWT Controls, Layout Managers and Menus. Servlet – life cycle of a servlet. The Servlet API, Handling HTTP Request and Response, Using Cookies, Session Tracking - MVC Architecture – Nodejs - Events – Listeners – Timers - Callbacks – Handling Data - Implementing HTTP Service in Nodejs – NOSQL – MongoDB – Frameworks – SPRING – MERN – MEAN – Flutter.

Cellular Networks – Tessellation , Frequency Reuse and Handoff – Generation of Cellular Networks – Long Term Evolution - Mobile IP – Techniques for Composing Application – Dynamic Linking – Handed Application Architecture – IOS Platform – Event Based Programming.

Properties of MultiMedia Systems – Data Stream – Basic Sound Concepts – Images and Graphics – Video and Animation – Multimedia Compression : JPEG and MPEG – Audio encoding Techniques – R Trees and KD Trees.

Unit IX: Software Engineering and Project Management (10 Questions)

SOFTWARE PROCESS AND PROJECT MANAGEMENT: Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models - Software Project Management: Estimation – LOC and FP Based Estimation, COCOMO Model – Project Scheduling – Scheduling, Earned Value Analysis – Risk Management – Introduction to Agility - Agile Process - Extreme Programming - XP Process - REQUIREMENTS ANALYSIS AND SPECIFICAION – Software Requirement: Functional and Non – functional, User requirements, System requirement, Software Requirements - Document – Requirement Engineering Process : feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management – Classical analysis: Structured system Analysis, Petri Nets – Data Dictionary - SOFTWARE DESIGN –Design process design Concepts – Design Model – Design Heuristic –Architectural Design – Architectural styles, Architectural mapping using dataflow – User Interface Design: Interface Analysis, Interface design – Component level Design: Designing Class based components, Traditional Components –TESTING AND IMPLEMENTATION –Software testing fundamental – Internal and external views of Testing – white box testing – basis path testing - control structure testing – black box testing – Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging – Software Implementation Techniques : Coding practices – Refactoring – Roles and Responsibilities in a Software Team - Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection, Risk Mitigation, Monitoring and Management(RMMM) – Scheduling and Tracking – Relationship between people and effort, Task Set & Network, Scheduling, Earned Value Analysis (EVA) – Process and Project Metrics - DEVOPS Essentials - Build Model Using MAVEN - Building DEVOPS using Azure – ISO 9000 – CMMI, TQM and Six Sigma.

Unit X: Artificial Intelligence, Machine Learning and Data Science (10 Questions)

Artificial Intelligence: Problem Solving Agents-Search Algorithms- Uninformed Search strategies-Heuristics Search Strategies-Local Search and Optimization Problems-Adversarial Search – Constraint Satisfaction Problem(CSP)-Logics-Propositional Logic-First Order Logic- Reasoning: Probabilistic Reasoning

Machine Learning: Types of Learning-Linear Regression Models and Types-Logistic Regression-Bayesian Linear Regression - Gradient Descent- Linear Classification Models - Discriminant Functions - Probabilistic Discriminative Models-Probabilistic Generative Models-SVM-Decision Tree
- Naïve Bayes-Bayesian Modelling - Ensembling-Bagging and Boosting – Stacking - Random Forest - Clustering-Gaussian Mixture Models - Expectation Maximization Algorithm - K Means - Probabilistic Graphical Models – Hidden Markov Model (HMM) - Bayesian Inference - Neural Network - Multi Layer Perceptron - Feed forward Neural Networks - Back Propagation - Regularization

Data Science: Types of Data and Variables - Describing Data - Describing Relationships – Statistical Testing-Python Libraries for Data Wrangling – NumPY – Pandas -Data Visualization – MATPlotLIB – Seaborn – Keras - Tensor Flow.

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