

SYLLABUS OF SCREENING TEST (MCQ) FOR THE POST OF INFORMATION TECHNOLOGY SPECIALIST, CLASS-II, IN THE DEPARTMENT OF REVENUE (DISASTER MANAGEMENT CELL).

THE SCREENING TEST SHALL BE OF 02 HOURS DURATION OF MAXIMUM 100 MARKS i.e. 70 QUESTIONS FROM THE SYLLABUS MENTIONED BELOW AND 20 QUESTIONS OF GENERAL KNOWLEDGE OF HIMACHAL PRADESH AND 10 QUESTIONS CONSISTING OF NATIONAL AND INTERNATIONAL AFFAIRS

1. DATA COMMUNICATION & COMPUTER NETWORKS

Introduction: Data Communication, Network Components, Protocol & Standards, Standard Organization, Topologies, Transmission modes, Categories of Networks.

The OSI Reference Model: Layered architecture, Functions of layers, TCP/IP reference model, Comparison of OSI & TCP/IP models, Physical layer- Guided and wireless transmission media, twisted pair, coaxial cable, fiber optics, radio, microwave, infrared, Communication satellites, IEEE standards: 802.3 (Ethernet), 802.4 (Token Bus), 802.5 (Token Ring), 802.11(Wireless LAN), 802.15 (Bluetooth).

Data Link Layer and Mac Layer : Design issues, Framing techniques, Flow control, Error Control, Error Detecting code and Error Correcting codes, Data link Control and Protocols-- For noiseless Channel— Simplest Protocol, Stop-and-Wait Protocol, For Noisy Channel-- Stop-and-Wait ARQ, Go-Back-N ARQ, and Selective-Repeat ARQ Protocol, HDLC Protocol, and PPP Protocol, Multiple Access, Random Access - MA, CSMA, CSMA/CD, CSMA/CA, Controlled Access—Reservation, Polling, Token passing, Channelization--FDMA, TDMA, CDMA.

Network Layer: Network layer design issues, Addressing, Routing algorithms- shortest path routing, flooding, distance vector routing, link state routing, hierarchical routing, broadcast routing, multicast routing, routing for mobile hosts, Congestion Control algorithms— congestion prevention policies, congestion control in virtual circuit & datagram sub-networks, definition of quality of service, Internetworking— Tunneling, internet-work routing, fragmentation, Network layer in Internet— IP protocol, IP Address, OSPF, BGP, Internet multicasting, Mobile IP, IPv4, IPv6, Internet radio, VoIP.

Transport Layer: Concept of transport service, elements of transport protocols, TCP and UDP, A simple transport protocol, Remote procedure call, Performance issues in computer networks. **Application layer services & protocols:** Domain name system, SMTP, File transfer protocol, HTTP, HTTPS, TELNET, World Wide Web.

Network Security: Attacks on Computers & Computer security- Need for security, approaches, principles, types of attacks, Cryptography concept and techniques, Symmetric Key algorithms- DES, Asymmetric key algorithms - RSA, Digital signature, Firewalls, E-mail security, Web security, social issues in network security.

2. OPERATING SYSTEM

Introduction: Definition of Operating System, Functions of Operating System, Different Types of Systems- Simple Batch System, Multi- Programmed Batched System, Time Sharing System, Personal Computer Systems, Parallel Systems, Distributed Systems, Real Time Systems.

Process Management: Process- Process Concept, Process Scheduling, Operation On Processes, Cooperating Processes, Threads, Inter-Process Communication, CPU Scheduling--scheduling criteria, scheduling algorithms - FCFS, SJF, priority scheduling, round robin

scheduling, multilevel queue scheduling, multilevel feedback queue scheduling, multiple processor scheduling, real time scheduling. Process Synchronization - The Critical Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions; Deadlocks - Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Memory Management: Logical & physical address space, Swapping, Continuous Allocation - single partition, multiple partition, internal, external fragmentation, Paging, Segmentation, Segmentation with Paging, Virtual Memory, Demand Paging, Performance of Demand Paging, Page Replacement Algorithms - FIFO, optimal, LRU, LRU approximation algorithms, counting algorithms, Thrashing, Demand Segmentation,

File System: File Concept, Access Methods - sequential, direct, index, Directory Structure - single-level, two-level, tree-structured, acyclic-graph, general graph, File System Implementation - File System Structure, Allocation Methods - contiguous allocation, linked allocation, indexed allocation; Free Space Management - bit vector, linked list, grouping, counting, Directory Implementation - linear list, hash table, Efficiency and Performance, Recovery - consistency checking, backup and restore, Secondary Storage Structure: Disk Structure, Disk Scheduling, FCFS, SSTF, SCAN, C-SCAN, Look Scheduling, Selection of a Scheduling Algorithm, Disk Management - disk formatting, boot block, bad blocks, Security problem; authentication - passwords, program threats, system threats- worms, viruses, threat monitoring, encryption.

3. DATA BASE MANAGEMENT SYSTEM

Basic Concepts: File Systems vs. DMBS, Characteristics of the Data Base Approach, Abstraction and Data Integration, Database users, Advantages and Disadvantages of a DBMS.

Data Base Systems Concepts and Architecture: Schema and Instances, DBMS architecture and Data Independence, Data Base languages and Interfaces, DBMS functions and component modules, Centralized and Client/Server Architectures for DBMS, Data Models.

Entity Relationship Model: Entity Types, Entity Sets, Attributes & keys, Relationships, Relationships Types, Roles and Structural Constraints, Design issues, E-R Diagrams, Design of an E-R Database Schema, Reduction of an E-R schema to Tables.

Relational Data Model: Relational model concepts, Integrity constraints over Relations, Relational Algebra - Basic Operations, Relational Calculus, Codd Rules, SQL - Data Definition and Data Types, Components of SQL - DDL, DML, and DCL, Schema Change Statement in SQL, Views, Joins & Queries in SQL, Specifying Constraints & Indexes in SQL, Database Triggers, SQL Injection, Relational Data Base Management System - RDBMS, Basic structure, Data Base Structure & its manipulation in RDBMS, Storage Organization, Conventional Data Models -An overview of Network and Hierarchical Data Models, Relational Data Base Design - Functional Dependencies, Decomposition, Normal forms based on primary keys (1 NF, 2 NF, 3 NF, & BCNF), Multi-valued Dependencies, 4 NF, Join dependencies, 5 NF, Algorithms for Query Processing and Optimization.

Transaction Processing Concepts: Introduction to Transaction Processing, Transaction & System Concepts, Properties of Transaction, Schedules and Recoverability, Serializability of Schedules.

Concurrency Control Techniques: Locking Techniques, Time stamp ordering, Multi-

version Techniques, Optimistic Techniques, Granularity of Data items.

Recovery Techniques: Recovery concepts, Recovery Techniques in centralized DBMS, Object and Object-Relational Databases; Database Security and Authorization. Data Base Security - Introduction to Data Base Security issues.

Enhanced Data Models: Temporal Database Concepts, Multimedia Databases, Deductive Databases, XML and Internet Databases; Mobile Databases, Geographic Information Systems, Genome Data Management, Distributed Databases.

4. Data Warehouse & Data Mining

Data Warehousing: Concepts of Data warehouse, difference between operational database system and data warehouse, Multidimensional Data Model - data cube, Stars - Snowflakes - Fact Schemas for multidimensional database, concept hierarchies, Building of a Data Warehouse, Fact and dimension tables, Data Marts, Metadata, data quality problems, ETL processes - Extraction, Loading, Transformation techniques, Error event table, change data capture, Data-cubes, dimensions and measures, ELT processes. Data Mining Primitives, Data Preprocessing - Data cleaning, Data integration, Data transformation, Discretization and concept Hierarchy generation, Definition and Specification of a generic data mining task, Description of Data mining query language. Knowledge Discovery Database (KDD), OLAP engines and OLAP operations, Multi-dimensional data model, OLAP Engines, Data Modeling (Cube), Operation on multidimensional Data Model, Data Warehouse architecture, Types of OLAP (MOLAP and ROLAP) servers, Life cycle of data warehouse implementation, Relationship between data warehouse and data mining. Concept of non-structure Databases, operations using NOSQL, Supervised & Un-supervised techniques,

Supervised Techniques: Classification techniques, Decision trees, Bayesian classifier and Predictions, Issues regarding classification and predication, Different classification methods including Decision Tree induction - Bayesian Classification, Neural network technology, K-Nearest Neighbor Classifier- Case-based Reasoning - Fuzzy set theory - genetic algorithm, Prediction: Linear and Multiple Regression - Nonlinear Regression - Other Regression Models, Classifier Accuracy etc. Association Algorithms - Association Analysis, A priori algorithm, Association rule mining, Mining Single Dimensional Boolean Association rule in truncation database, mining multilevel association rule, Discussion on few associations rule algorithm such as Apriority, frequent pattern growth, etc. from association rule to correlation analysis.

Un-supervised Techniques: Clustering Techniques - Hierarchical and partitioned clustering. K-means, Cluster Analysis - Types of data in cluster analysis, Partition based Clustering, Hierarchical Clustering, Density based Clustering, Grid based Clustering, Model based Clustering, Discussion on scalability of clustering algorithm, Outlier analysis, Parallel approaches to clustering. Introduction to CLARA, CLARANS, Hierarchical - DBSCAN, BIRCH, CURE, Categorical-STIRR, ROCK, CACTUS etc.,

Advanced Mining Concepts: Data Mining attributes, Result Data Presentation, Data Preprocessing process, Dispersion of data, Essential of Graph mining, FP-tree construction, sample of text mining, Data mining issues in object-oriented databases, spatial databases, and multimedia, Data bases, time series databases, text databases, web mining - web usage

mining, web Content mining, web log attribute, Mining-Pattern, opinion, Social media and crowd-sourcing data mining, Web content Mining, Web structure Mining, Web usage Mining, Text Mining. Temporal and Spatial Data Mining - Basic concepts of temporal data Mining, Introduction to the GSP algorithm, SPADE, SPIRIT, WUM.

5. SOFTWARE ENGINEERING

Introduction: Evolving Role of Software, Software Engineering, Changing nature of Software, Software Myths, Terminologies, Role of management in software development Software. **Process Models:** 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), Adaptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering.

Software Life Cycle Models: Build & Fix Model, Water Fall Model, Incremental Process Model, Evolutionary Process Models, Unified Process, Comparison of Models, Other Software Processes, Selection of a Model.

Software Requirements Analysis & Specifications: Requirements Engineering, Types of Requirements, Feasibility Studies, Requirements Elicitation, Developing Use Cases, Requirements Analysis Documentation, Software Requirement and Specification (SRS) Document. Validation and Management.

Software Architecture: Its Role, Views, Component & Connector View and its architecture style, Architecture Vs Design, Deployment View & Performance Analysis.

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

Software Project Planning: Relationship to lifecycle, project planning, project control, project organization, configuration management, version control, quality assurance, metrics Size estimation, Cost Estimation, COCOMO, COCOMO – II, Software Risk Management Project Scheduling and Staffing, Time-line Charts.

Function Oriented Design: Design principles, Module level Concepts, Notation & Specification, Structured Design Methodology and Verification, Object-Oriented Design - OO Analysis & Design, OO Concepts, Design Concepts, UML –Class Diagram, Sequence & Collaboration Diagram, Other diagrams & Capabilities, Design Methodology – Dynamic and Functional Modeling, Internal Classes & Operations.

Detailed Design: PDL, Logic/Algorithm Design, State Modeling of Classes, Verification – Design Walkthroughs, Critical Design Review, Consistency Checkers.

Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Testing; White-box and Black-box Testing; 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.

6. COMPUTER GRAPHICS

Input-Output Devices: Definition of Computer Graphics and Applications, Video Display Devices- Raster-Scan Displays, Random-Scan Displays, Color CRT Monitors, Direct View Storage Tubes, Flat Panel Displays Input Devices: Keyboard, Mouse, Trackball and Space ball, Joysticks, Digitizers, Image Scanners, Touch Panels, Light Pens, Voice Systems.

Output Primitives: Line Drawing Algorithms (DDA, Brenham's Circle) Generating Algorithm: Midpoint Circle Drawing Algorithm, Ellipse Generating Algorithm, Midpoint Ellipse Generating Algorithm, Character Generation.

2D Transformations: Translation, Rotation, Scaling, Reflection, Shear, Composite Transformation-Translation, Rotations, Scaling, Two Dimensional Viewing: Window-To-Viewport Coordinate Transformation, Clipping Operations, Point Clipping, Line Clipping-(Cohen-Sutherland Line Clipping, Liang- Barsky Line Clipping, Nicholl-Lee-Nicholl Line Clipping), Polygon Clipping-(Sutherland- Hodgeman Polygon Clipping, Weiler-Atherton Polygon Clipping), Curve Clipping, Text Clipping, Three Dimensional Concepts: Three Dimensional Display Methods-Parallel Projection, Perspective Projection, Surface Rendering,

3D Transformations: Translation, Rotation, Scaling, Reflection, Shear, Curves and Surfaces: Bezier Curves, B-Spline Curves, Fractal Geometry Methods, Octrees, Visible-Surface Detection Methods: Back Face Detection, Depth Buffer Method, A- Buffer Method, Scan Line Method, Depth Sorting Methods, Concept of Shading: Modeling Light Intensity, Diffuse And Specular Reflection, Refracted Light, Concept Of Shading Methods.

7. WEB TECHNOLOGIES

Web Terminologies: Internet, WWW, Web Browser, Web Browser Communication with Web Server, Web Server, Uniform Resource Locator (URL), Hyper Text Transfer Protocol Secure (HTTPS).

HTML5 Introduction: Structure of HTML5 Program, Heading Styles, Text Styles, Other Text Effects; List - Definition, Creating Ordered and Unordered Lists, Adding Images, Creating Tables, Multimedia, Graphics; Form - Tags, Elements, Input Types, Text Area, Checkboxes, Submit Button, Frames, Audio Tag, Video Tag, i-frame, Form Validation, Designing Static Web Pages with HTML5.CSS 3.0:Concepts and its Properties i.e. Border, Backgrounds, Fonts, Text Effects, Buffering, Web Log, Web Cache Positioning, CSS Selectors, CSS List, CSS Tables, CSS Menu Design. Using BOOTSTRAP to build mobile responsive website, JavaScript Introduction - Variables, Obtaining User Input, Operators, Control Structure, Looping Constructs, Break and Continue Statements, User Defined Functions, Recursion and Iterations, Array Declaration and Memory Allocation, Passing Array as an Argument to Function, Basic Form Validation in Java Script

Java Script Objects: Date, String, Boolean, Window, Document, Cookies, Document Object Model (DOM), Event Handling using JavaScript, PHP Introduction: Installing and Configuring PHP and MYSQL, Variables, Basic Data Types, Operators, Constants, Array, Looping with Associative Array using each() and for each(), Objects, Strings Processing, Form Processing, Connecting to

Database, Performing Basic Database operations (Insert, Update ,Delete ,Select etc.), Setting Query parameter, Executing Query Join (Self Join, Inner Join, Outer Join ,Cross Join), Cookies, Create Session, Accessing Data from Database into HTML page.

AJAX Introduction: Creating Simple Ajax Application, create an XML http Request Object, interacting with the Web Server Using XML Http Request Object, Difference between Ajax and Non-Ajax Applications.

Working with PHP and AJAX: Process Clients Requests, Accessing Files Using PHP, Implementing Security and Accessibility in AJAX; Application: Introduction, Secure AJAX Applications.

8. ARTIFICIAL INTELLIGENCE

Overview of A.I.: Definition of AI, The Importance of AI, previous works in the history of AI, AI and related fields, Problem spaces and Search.

Knowledge: Definition and Importance of Knowledge, Knowledge-Based Systems, Representation of Knowledge, Knowledge Organization, Knowledge Manipulation, Acquisition of Knowledge.

Natural Language Processing: Overview of Linguistics, Grammar and Language, Parsing Techniques, Semantic Analysis and Pragmatics.

Multi Agent Systems: Agents and Objects, Agents and Expert Systems, Generic Structure of Multi agent Systems, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies, Agent Development Tools.

Genetic Algorithms (GA): Encoding Strategies, Genetic Operators, Fitness Functions and GA Cycle, Problem Solving using GA.

Artificial Neural Networks (ANN): Supervised, Unsupervised and Reinforcement Learning, Single Perceptron, Multi-Layer Perceptron, Self- Organizing Maps, Hopfield Network

Pattern Recognition: Introduction, Recognition and Classification Process, Learning Classification Pattern, Recognizing and Understanding Speech.

Expert Systems: Definition, Rule Based System Architecture, Non- Production System Architecture, Basic Components of Expert system.

9. PARALLEL COMPUTING

Introduction to Distributed and Parallel Computing Technologies: Introduction to Soft Computing, Introduction to Parallel Computing, Introduction to Distributed Computing, Introduction to Edge Computing; various issues involved in designing a distributed system, the Challenges faced. Emerging trends in distributed systems, System models: Physical, Architectural and Fundamental models

Inter-process Communication (IPC): characteristics, group communication, Multicast Communication, Remote Procedure call, Network virtualization. Methods in IPC, Pipes, messaging queues, semaphores, shared memory, sockets.

Distributed File System: File service architecture, Network file system, Transactional Concurrency Control - Transactions, Nested transactions, Locks-Optimistic concurrency

control, distributed mutual exclusion – purpose of distributed mutual exclusion, central server algorithm, ring based algorithm, Bully algorithm.

Edge Computing: Relevant Technologies, Advantages of FEC: SCALE, Advantages: SCANC, Hierarchy, Business Models, Opportunities and Challenges, Addressing the Challenges - Networking Challenge, Management Challenge, Miscellaneous Challenges, Middle wares: Introduction, Need, Design Goals, State-of-the-Art Middleware Infrastructures. **Data Management in Fog Computing:** Introduction, Background, Data Management, Case Studies: Big Data Analytics, Health Monitoring, Smart Transportation and IoT Applications. **Parallel Computing:** Introduction to parallel Computing, parallel computing paradigm, parallel architecture, shared memory systems, cache coherence, distributed memory system, shared address space system - Open MP, Parallel random access machine (PRAM), PRAM Models, shared memory models.

10. CLOUD COMPUTING

Overview of Computing Paradigm: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloud computing, Business driver for adopting cloud computing. Introduction to Cloud Computing Cloud Computing (NIST Model), Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing. Role of Open Standards.

Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services. Service Models (XaaS): Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS).

Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud. Infrastructure as a Service (IaaS): Introduction to IaaS, IaaS definition,

Virtualization: Introduction to virtualization, Different approaches to virtualization Hypervisors, Machine Image, Virtual Machine(VM), Resource Virtualization: Server, Storage, Network Virtual Machine(resource)provisioning and manageability, storage as a service, Data storage in cloud computing(storage as a service) Platform as a Service(PaaS):Introduction to PaaS, What is PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management, Computation & Storage, Software as a Service(PaaS):Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS.

Service Management in Cloud Computing: Service Level Agreements (SLAs), Billing & Accounting, Comparing Scaling Hardware - Traditional vs. Cloud, Economics of scaling: Benefitting enormously Managing Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing.

Cloud Security: Infrastructure Security: Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & AccessManagement, Access Control, Trust, Reputation, Risk. Authentication in cloud computing: Client access in cloud, Cloud contracting Model, Commercial and business considerations.