VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Jnana Sagara Campus, Vinayakanagara, Cantonment, BALLARI - 583 105.

Department of Studies in Computer Science

Ph.D. Entrance Test Syllabus (2019-20)

Part A: Research Methodology (40 Marks)

UNIT I
Research objectives, motivation research approaches, significance, research methods versus methodology, research and scientific method, research process, criteria of good research, Defining a research problem, research design

UNIT II
Sampling design, methods of data collection, processing and analysis of data - Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry, Measures of Relationship, Regression Analysis, Multiple Correlation and Regression, Association in Case of Attributes.: Probability distributions – Binomial, Poisson, Uniform, exponential and normal distributions.

UNIT III
Sampling- Central Limit Theorem, Sampling Theory, Sandler's *A*-test Standard Error, Estimating the Population Mean, Estimating Population Proportion, Sample Size and its Determination, Testing of hypothesis, Chi-square, Analysis of Variance (ANOVA), multivariate analysis technique.

UNIT IV
Algorithmic Research: NP-Hard and NP-Complete problems, approximation algorithms, PRAM algorithms, Mesh algorithm, Hypercube algorithms.

UNIT V
Report Writing, Layout of the Research Report, Types of Reports, Oral Presentation, writing a research report, publishing a scientific paper.

Part B: Core Syllabus – Computer Science (60 Marks)

1. DATA STRUCTURES AND ALGORITHMS

UNIT-I

Stack: Definition and examples, Primitive operations, Example, The stack as an ADT, Representing stacks in C, Implementing the pop operation, Testing for exceptional conditions, Implementing the push operation, Examples for infix, postfix, and prefix expressions, Basic definition and examples, Program to evaluate a postfix expression, Converting an expression from infix to postfix, Program to convert an expression from infix to postfix.

Recursion and Queues: Recursive definition and processes, Factorial function, Multiplication of natural numbers, Fibonacci sequence, Binary search, Properties of recursive definition or algorithm. Recursion in C, Factorial in C, Fibonacci numbers in C, Binary search in C, Towers of Hanoi problem. The queue and its sequential representation, the queue as ADT, C implementation of queues, Insert operation, Priority queue, and Array implementation of a priority queue.

UNIT II

Lists: Linked lists, Inserting and removing nodes from a list, Linked implementation of stacks, get node and free node operations, Linked implementation of queues, Linked list as a data structure, Example of list operations, Header nodes, Lists in C, Array implementation of lists, Limitations of array implementation, allocating and freeing dynamic variables, Linked lists using dynamic variables, Queues as lists in C, Examples of list operations in C, Non integer and non-homogeneous lists, Other list structures: Circular lists, Stack as a circular list, Queue as a circular list, Primitive operations on circular lists, doubly linked lists.

Trees: Binary trees, operations on binary trees, Applications of binary trees, Binary tree representation, Node representation of binary tree, Internal and external nodes, Implicit array representation of binary trees, Choosing a binary tree representation, Binary tree traversal in C, Threaded binary trees.

UNIT-III

Graphs and Their Applications: Graphs: Definitions, Application of graphs, C representation of graphs, Traversal methods for graphs, Depth first traversal, and Breadth first traversal.

Algorithms: Notion of algorithm, Fundamentals of algorithmic problem solving, problem types, linear data structures, graphs, trees, sets and dictionaries.

Analysis of algorithm efficiency: Analysis frame-work, asymptotic notations and basic efficiency classes, mathematical analysis of non-recursive and recursive algorithms, empirical analysis of algorithms

UNIT-IV

Brute Force and Divide and Conquer: selection sort and bubble sort, sequential search and brute-force string matching, closest-pair and convex -hull problems, exhaustive search, merge sort, quick sort, binary search, binary tree traversals, Strassen's matrix multiplication.

Decrease-and-Conquer and Transform-and-Conquer: Insertion sort, depth first search, topological sorting, presorting, Gaussian elimination, balanced search trees, heap sort, Horner's rule.

UNIT-V

Dynamic programming: Computing a Binomial coefficient, Warshall's and Floyd's algorithms, the Knapsack problem and memory functions. Greedy technique-Prim's algorithm, Dijkstra'a algorithm, Huffman trees. Decision trees, P, NP, and NP-complete problems, challenges of numerical algorithms.

2. DATABASE MANAGEMENT SYSTEM

UNIT-I
Introduction: Data modelling for a database, abstraction and data integration, the three-level architecture, components of DBMS, advantages and disadvantages, data associations, data model classification, Entity-Relationship model.

UNIT-II
File organization and storage, secondary storage devices, RAID technology, operations in file, heap files and sorted files, hashing techniques, type of single level ordered index, multi-level indexes, B-trees and B+trees, indexes on multiple keys, other types of indexes.

UNIT-III
The Relational Model: Relational database, relational algebra, relational calculus SQL- Data definition, relational database manipulation using SQL, views, embedded data manipulation. Relational Database Design: Anomalies in a database, functional dependency, normal forms, lossless join and dependency, BCNF, normalization through synthesis, higher order normal forms.

UNIT-IV
Transaction processing, desirable properties of transaction, schedules and recoverability, serializability of schedules concurrency control, locking techniques, time stamp ordering multi version concurrency control, granularity of data items.

UNIT-V
Database recovery techniques based on deferred up data and immediate updating, shadow pages, ARIES recovery algorithm, database security and authorization, security issue access control based on granting/revoking of privileges, introduction of statistical database security.

3. COMPUTER NETWORKS AND SECURITY

UNIT I
Introduction: Networks, types of connections – Topologies, Protocols and Standards – OSI Model, TCP/IP Protocol Suite, Functions of Data Link Layer. Wireless WANs: Cellular Telephone and Satellite Networks. SONET, Virtual-Circuit Networks: Frame Relay and ATM.

UNIT II
Network Layer: Logical addressing – IPV4, IPV6, Address mapping–ARP, RARP, BOOTP and DHCP, ICMP, Delivery, Forwarding, Unicast and Multicast Routing protocols.

UNIT III
Transport Layer: Process to Process Delivery, User Datagram Protocol, Transmission Control Protocol, SCTP, Congestion Control with Examples, QoS.

UNIT IV
Application Layer: Domain Name Space, DDNS, Remote Logging, Electronic Mail, and File Transfer, WWW, HTTP

UNIT V
Network Management: SNMP, Network Security- Security Services, Security in the Internet: IPSec, SSUFLS, PGP, VPN, and Firewalls

4. Data Mining

UNIT I
Introduction to Data Mining: Related technologies - Machine Learning, DBMS, OLAP, Statistics, Data Mining Goals, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications, Example: weather data

UNIT II
Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model, OLAP operations, Example: loan data set. Data pre-processing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Introduction to Weka Data Mining System, Example experiments with Weka - filters, discretization. Data mining knowledge representation: Visualization techniques, Experiments with Weka – visualization

UNIT III
Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures, Experiments with Weka - using filters and statistics
Data mining algorithms -Association rules: Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis, Experiments with Weka - mining association rules

UNIT IV
Data mining algorithms- Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R algorithm, Decision trees, Covering rules, Experiments with Weka - decision trees, rules. Data mining algorithms- Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models

UNIT V
Evaluating what's been learned: Basic issues, Training and testing, Estimating classifier accuracy (holdout, cross-validation, leave-one-out), Combining multiple models (bagging, boosting, stacking), Minimum Description Length Principle (MLD), Experiments with Weka - training and testing. Clustering: Basic issues in clustering, First conceptual clustering system: Cluster/2, Partitioning methods: k-means, expectation maximization (EM), Hierarchical methods: distance-based agglomerative and divisible clustering, Conceptual clustering: Cobweb, Experiments with Weka - k-means, EM, Cobweb

5. DIGITAL IMAGE PROCESSING

UNIT I
Digital Image Fundamentals: The origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Basic relationships between pixels.

UNIT II
Image Enhancement in the Spatial Domain: Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

UNIT III
Image Enhancement in the Frequency Domain: Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering. Color Image Processing: Color models, pseudocolor image processing, color transformations, smoothening and sharpening.

UNIT IV
Image Restoration: A model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.

UNIT V
Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion based segmentation.
Morphological Processing: Some basic Morphological operations.

6. SOFTWARE ENGINEERING

UNIT 1
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), Adptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering.

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

UNIT III
Software Design: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level 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.

UNIT IV
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.

UNIT V
Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Testing; 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.

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

Note:

1. Ph.D. Entrance test is for 100 Marks (1 marks each) and MCQ type.
2. Research methodology (Part A) carries 40 marks and core subject (Part B) carries 60 marks.