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Syllabus for Ph.D. Entrance Examination

PAPER-I

(RESEARCH METHODOLOGY)

1. **Basic concept of research problem**
    - Rationale of research
    - Identification of research problem
    - Research objective
    - Types of research- fundamentals/applied/action/quantitative/qualitative
2. **Review of literatures**
    - Primary source
    - Secondary source
    - Searching e-resources, using research engines
    - Searching database
    - Writing literature review
3. **Methods of research**
    - Concept and formulation of hypothesis
    - Survey method
    - Experimental method (variable, designs)
    - Historical methos
    - Content analysis
4. **Sampling of data**
    - Concept of sampling
    - Probability sampling techniques
    - Non probability sampling techniques
    - Sampling error
5. **Collection of data**
    - Primary data generation
    - Secondary data collection
    - Methods of data generation/collection- by experiments, questionnaire, interview schedule, focus groups etc.
6. **Analysis of data**
    - Statistical analysis techniques
    - Qualitative analysis techniques
    - Application of computer in research data analysis
7. **Reports preparation**
    - Structure and component of research report
    - Organization of data
    - Indexing of journal and research output
    - Citation, reference, bibliography
    - Copyright, plagiarism, originality of research work

8. **Research ethics**
    - Ethics in research
    - National and International regulations/law/ethics related to research on human, Animals and Environments

PAPER-II

(COMPUTER APPLICATION)

UNIT-I

Discrete Mathematics: Propositional logic, predicate logic, logical equivalence, normal forms, inference rules, proof techniques (direct, contradiction, contrapositive, induction). Set Theory: Sets, relations, functions, equivalence relations, partial orders, lattices, Combinatorics: Permutations, combinations, pigeonhole principle, inclusion–exclusion principle. Graph Theory: Graph representations, isomorphism, connectivity, Euler and Hamiltonian graphs, trees, spanning trees, planar graphs, graph coloring, matchings. Boolean Algebra: Boolean functions, minimization (K-maps), applications in digital systems.

Data Structures: Simple and composite structure, Recursion and recursive problem solving, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps, Graph theory. Tree and graph traversals, Connected components, Spanning trees.

UNIT-II

Algorithms: Fundamental concepts of algorithm, algorithmic complexity, asymptotic notations (Big-O, Big-Ω, Big-Θ), growth of functions, recursion tree, Master's methods, Algorithm design paradigms such as divide and conquer, greedy algorithms, and dynamic programming, searching and sorting algorithms, graph algorithms: BFS, DFS, shortest paths, and minimum spanning trees, NP-completeness, P vs NP problem.

Operating System: Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Belady's anomaly, Memory management and virtual memory, File systems, I/O systems, Protection and security.

UNIT-III

Databases: ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Theory of Computation: Regular languages and finite automata, DFA, NDFA, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability. LR Parser, construction of SLR and canonical LR parser table, using ambiguous grammar, creating YACC lexical analyzer with LEX, error recovery in YACC, Chomsky hierarchy of languages, CFG.

UNIT-IV

Machine Learning: Introduction to machine learning, types of learning (supervised, unsupervised, semi-supervised, reinforcement learning), data preprocessing, feature extraction and feature selection. Supervised learning: k-nearest neighbors, decision trees, random forests, support vector machines. Unsupervised learning: k-means clustering, hierarchical clustering, PCA. Model evaluation: Confusion matrix, performance metrics (accuracy, precision, recall, F1-

score). Basics of neural networks and deep learning, optimization techniques, applications of machine learning.

Data Warehousing and Data Mining: Concept of data mining, Data Mining: On what kind of data?, Data mining functionality, Are all the patterns interesting?, OLAP operations, Classification of data mining systems, What is a data warehouse?, A multi-dimensional data model, Data warehouse architecture, Data warehouse implementation, Further development of data cube technology, From data warehousing to data mining. Concept of Transaction, Transactional database, Distributed Database, Commit Protocols.

UNIT-V

Basics of Digital Image Processing: Grayscale and color images, image histograms, Fundamental steps in DIP: Image Enhancement: Contrast stretching, histogram equalization, smoothing and sharpening filters. Feature Extraction and Representation: Edges, corners, texture features, shape descriptors. Applications of DIP: Medical imaging, remote sensing, computer vision overview.

Python Programming: Python variables and data types, control structures, functions and modules, file handling, exception handling, standard libraries, NumPy, Pandas, Matplotlib, basic data preprocessing and visualization, Python for scientific computing: data cleaning, transformation, aggregation, Matplotlib and Seaborn for data visualization, exploratory data analysis. Python for Research and Machine Learning: Basic data preprocessing, feature scaling and normalization, handling missing values, integration with machine learning libraries (Scikit-learn overview), scripting for experiments, reproducibility and performance considerations.

IMPORTANT NOTE

There will be a total of 50 multiple choice questions (MCQs) for each of the two papers. Paper-I will focus on Research Methodology and Paper-II will cover specific Subject.

Each question in both papers carries 1 mark and will have a total of 50 marks for each paper. The duration for solving each paper is 1 hour. Students must appear for both Paper-I and Paper-II as specifies for the entrance. After completion and submission of Paper-I, the question Paper-II will be provided to the students.

Scheme:

Paper-I Research Methodology

Number of questions- 50 MCQs covering whole syllabus
Maximum Marks- 50
Duration- 1 hr

Paper-II Computer Application

Number of questions- 50 MCQs covering whole syllabus
Maximum Marks- 50
Duration- 1 hr