Ph.D. Entrance Test (RAT) Syllabus for Computer Science (Department of Computer Science)

Multiple choice Questions on following topics:

Section A: Research Methodology (50%)

1. Introduction to Research (5 Marks)
- Definition, objectives, and significance of research
- Types of research: Basic, applied, qualitative, quantitative
- Research process overview

2. Research Problem & Hypothesis (5 Marks)
- Identifying and formulating a research problem
- Characteristics of a good research problem
- Meaning and types of hypotheses
- Formulation and testing of hypotheses

3. Research Design (5 Marks)
- Meaning and need for research design
- Types of research design (exploratory, descriptive, experimental)
- Features of a good research design

4. Data Collection Methods (10 Marks)
- Primary and secondary data
- Methods of primary data collection: Survey, interview, observation, questionnaire
- Sampling techniques: Probability and non-probability sampling
- Tools for data collection and pilot study

5. Data Analysis and Interpretation (10 Marks)
- Editing, coding, and tabulation
- Use of statistical tools (mean, median, mode, standard deviation, correlation, regression – basic concepts only)
- Hypothesis testing: t-test, chi-square (conceptual understanding)
- Use of software tools (basic introduction to SPSS, Excel, etc.)

6. Research Reporting and Ethics (10 Marks)
- Structure and components of a research report
- Referencing styles: APA, MLA (basic overview)
- Plagiarism and research ethics
- Presentation of findings

7. Recent Trends in Research (5 Marks)
- Overview of digital research tools
- Online databases and open-access resources
- Introduction to AI in research

Section B: Subject-specific (50%)

1. Discrete Structures and Theory of Computation (8 Marks)
- Set theory, relations, functions
- Propositional and predicate logic
- Combinatorics and graph theory
- Regular languages and finite automata
- Context-free grammars and pushdown automata
- Turing machines, decidability

2. Data Structures and Algorithms (8 Marks)
- Arrays, stacks, queues, linked lists, trees, graphs
- Searching, sorting, hashing
- Algorithm analysis: time and space complexity
- Greedy, dynamic programming, divide and conquer, backtracking
- NP-completeness, approximation algorithms

3. Computer System Architecture and Operating Systems (6 Marks)
- Digital logic: gates, multiplexers, flip-flops
- Memory hierarchy, cache, virtual memory
- Instruction formats, addressing modes
- Process management, scheduling, synchronization
- Deadlock, memory and file management

4. Programming Languages and Software Engineering (6 Marks)
- Programming paradigms: procedural, object-oriented, functional
- Concepts of C, C++, Java, Python (basic to intermediate)
- Software development life cycle (SDLC)
- Software design, testing, and maintenance
- Agile models, UML, requirement analysis

5. Databases and Web Technologies (6 Marks)
- Relational databases: ER models, normalization
- SQL queries and transaction management
- Indexing and hashing, concurrency control
- Basics of XML, HTML, CSS, JavaScript
- Web technologies: client-server architecture, web services

6. Computer Networks and Security (6 Marks)
- OSI and TCP/IP models
- Protocols: IP, TCP, UDP, HTTP, FTP
- Network devices, subnetting, routing
- Cybersecurity fundamentals: encryption, firewalls, digital signatures
- Network attacks and prevention techniques

7. Artificial Intelligence and Emerging Areas (5 Marks)

- AI fundamentals: search algorithms, knowledge representation
- Machine Learning basics: supervised/unsupervised learning
- Neural networks, deep learning (basic concepts)
- Natural language processing
- Cloud computing, IoT, big data (introduction)