TULSIRAMJIGAIKWAD-PATIL College of Engineering and Technology
Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institution Affiliated to RTM Nagpur University)

Post-Graduation Studies

Syllabus for Written Test (Paper-2)

The subjects for PhD entrance examination for shortlisted candidates are the following (along the lines of GATE syllabus):

1. **Engineering Mathematics**

Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence, relations, generating functions. Linear Algebra: Matrices, determinants, system of linear equations, Eigenvalues and eigenvectors, LU decomposition, Trace of a matrix, Hessian, Gradient, Jacobian; Symmetric Matrices, Orthogonal-Matrices. Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration. Chain Rule. Taylor Series. Probability and Statistics: Mean, median, mode, standard deviation, combinatorial probability, probability distributions, binomial distribution, Poisson distribution, exponential distribution, Normal distribution, joint and conditional probability.

2. **Data Structures**: Linear data structures: arrays, stack, queue, linked lists; non-linear data structures: binary search tree, balanced binary search tree, heap tree, graphs; representation of data structures in computer memory; applications and complexity of operations on / using data structures.

3. **Design and Analysis of Algorithms**: Asymptotic notations, sorting and search- insertion sort, selection sort, merge sort, quick sort, binary search, design techniques: divide and conquer, greedy, dynamic programming, data structures: heaps, union of disjoint sets, search trees, algorithms on graphs: exploration, connectivity, shortest paths, directed acyclic graphs, spanning trees, Intractability: NP completeness, reductions.

4. **Theory of Computation**: Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and Un decidability.

5. **Computer Organization and Architecture**: Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

6. **Operating Systems**: Inter-process communication, deadlock, memory management, file system design, device/IO management.

7. **Computer Networks**: TCP/IP protocol stack and design of Internet, application layer: HTTP, FTP, DNS, P2P file sharing. And transport layer: Issues related to process-to process communication and reliable data transfer, TCP and UDP operations; network layer: routing, addressing, QoS issues, IPv4 and IPv6 protocols; data link layer: wired and wireless local area networks and protocols.

8. **Databases**: ER-model, Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

9. **Basics of Machine Learning and Deep Learning**: Backprop (Application of Chain Rule); Linear Regression; Basics of Feed forward Neural Networks, Logistic Regression.

10. **Programming Test**: Expressions, Operators (unary, binary, ternary), Conditionals (if, else, nested conditionals), Loops (for, while, do-while, notion of loop invariants, nested loops; notions of precondition and post condition), Arrays (numerical arrays, strings, searching in arrays), Sorting (such as bubble sort, merge sort). Functions and return values, arguments, pass by value, the effect of passing pointers (like pass by reference).

Tulsiramji Gaikwad-Patil College Of Engineering & Technology • Nagpur • SEAL

Dr. Pragati Patil