

Syllabus for Ph.D. Entrance Examination 2024: Ph.D in Engineering

Group A: Engineering Mathematics

1. **Linear Algebra:** Vector space, basis, linear dependence and independence, matrix algebra, Eigenvalues and eigenvectors, rank, solution of linear equations- existence and uniqueness.
2. **Probability and Statistics:** Mean, median, mode, standard deviation, combinatorial probability, probability distributions, binomial distribution, Poisson distribution, exponential distribution, normal distribution, joint and conditional probability.
3. **Calculus:** Differentiation and integration, partial derivatives, gradients, Jacobian and Hessian matrices, optimization techniques (gradient descent, stochastic gradient descent).

Group B: Electronics & Communication Engg / Electrical Engg. / Instrumentation Engg.

4. **Continuous-time signals:** Fourier series and Fourier transform, sampling theorem and applications.
5. **Discrete-time signals:** DTFT, DFT, z-transform, discrete-time processing of continuous-time signals.
6. **LTI systems:** definition and properties, causality, stability, impulse response, convolution, poles and zeros, frequency response, group delay, phase delay.
7. **Digital signal processing:** FIR and IIR structure, filter design, discrete fourier transform, fast fourier transform, wavelet.
8. **Random processes:** autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems.
9. **Information theory:** entropy, mutual information and channel capacity theorem.

Group C: Computer Science

10. **Discrete Mathematics:** Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Combinatorics: counting, recurrence relations, generating functions.
11. **Graph theory:** Graph: connectivity, matching, coloring. Paths and cycles, Connected components, Tree, Digraphs, Eulerian trails, Hamiltonian paths, Planar graphs.
12. **Elements of computing:** Basics of programming (using pseudo-code and any one of the languages from C, C++, Java, Python), Procedure call and parameter passing.
13. **Data Structures:** Array, Linked list, Stack, Queue, Binary tree, Heap, AVL tree, B-tree.
14. **Design and Analysis of Algorithms:** Asymptotic notation, Searching, Sorting, Selection, Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph algorithms: Breadth First Search, Depth First Search, Shortest Path, minimum spanning trees
15. **Formal Languages and Automata Theory:** Finite automata and regular languages. Pushdown automata and context-free languages. Turing machines and recursively enumerable languages. Undecidability