



Syllabus for Written-Test and Interview

1. **Discrete Mathematics:** Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.
2. **Algorithms, Programming and Data Structures:** Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths. Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
3. **Linear Algebra:** Matrices, determinants, Vector spaces, Linear transformations and their matrix representations, rank and nullity; systems of linear equations, eigenvalues and eigenvectors, LU decomposition, minimal polynomial, Cayley-Hamilton Theorem, diagonalization, symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal and unitary matrices; Finite dimensional inner product spaces, Gram-Schmidt orthonormalization process.
4. **Numerical Analysis:** Numerical solutions of algebraic and transcendental equations: bisection, secant method, Newton-Raphson method, fixed point iteration; Interpolation: error of polynomial interpolation, Lagrange and Newton interpolations; Numerical differentiation; Numerical integration: Trapezoidal and Simpson's rules; Numerical solution of a system of linear equations: direct methods (Gauss elimination, LU decomposition), iterative methods (Jacobi and Gauss-Seidel).
5. **Probability and Statistics:** Classical, relative frequency and axiomatic definitions of probability, conditional probability, Bayes' theorem, independent events; Random variables and probability distributions, moments and moment generating functions, quantiles; Standard discrete and continuous univariate distributions; Probability inequalities (Chebyshev, Markov, Jensen); Function of a random variable; Jointly distributed random variables, marginal and conditional distributions, product moments, joint moment generating functions, independence of random variables; Transformations of random variables, sampling distributions, distribution of order statistics and range; Characteristic functions; Modes of convergence; Weak and strong laws of large numbers; Central limit theorem for i.i.d. random variables with existence of higher order moments. Unbiasedness, consistency, sufficiency, completeness, uniformly minimum variance unbiased estimation, method of moments and maximum likelihood estimations; Confidence intervals; Tests of hypotheses, most powerful and uniformly most powerful tests, likelihood ratio tests, large sample test, Sign test, Wilcoxon signed rank test, Mann-Whitney U test, test for independence and Chi-square test for goodness of fit.