

Foundation Course for Ph.D. Scholars in Mathematics

(Effect from July 2014)

Syllabus

Matrix Algebra: Rank of a Matrix, Linear dependence. Solutions of Linear Systems: Existence and Uniqueness. Eigen Values, Eigen Vectors, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Some Applications of Eigen Value Problems, Similarity of Matrices, Diagonalization of a Matrix, Power of a Matrix, Diagonalization by Orthogonal Transformation, Quadratic Forms, Canonical Form of a Quadratic Form, Nature of Quadratic Forms.

Modern Algebra: Definition of Groups, Subgroups and Factor Groups, Lagrange's Theorem, Homomorphisms, Normal Subgroups. Quotients of Groups. Basic Examples of Groups including Symmetric Groups, Matrix Groups, Groups of Rigid Motions of a Plane, Finite Groups of Motions. Automorphisms, Cayley's Theorem, Permutation Groups.

Real Analysis: Limit of Functions. Continuous Functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity. Derivative of a Real Function. Mean Value Theorem, Continuity of Derivatives, L'Hospital's Rule, Derivatives of Higher Order, Taylor's Theorem.

Vector Analysis: Divergence and curl of a vector point function – solenoidal and irrotational functions – physical interpretation of divergence and curl of a vector point function. Integration of vector functions – Line, surface and volume integrals. Gauss - Divergence Theorem – Green's Theorem – Stoke's Theorem.

Differential Equations: General solution of homogeneous equations, non-homogeneous equations, Wronskian, method of variation of parameters.

Numerical Methods: Bisection method, fixed-point iteration, Newton's method. Error analysis for Iterative Methods. Computing roots of polynomials. Interpolation: Lagrange Polynomial. Divided Differences.

Statistics and Probability Theory: Probability, conditional probability, independent events, total probability and Baye's theorem. Random Variable, Probability density function, distribution function, mathematical expectation, variance, Discrete Distributions – Binomial, Poisson, Continuous Distribution – Normal distribution.