

**Department of Applied Mathematics**  
**F/O Engineering and Technology, A.M.U., Aligarh**

Syllabus for Ph.D. Test, 2018-19

**Section B (Syllabus)**

**Note:** 1. Multiple choice questions (20 Marks)  
2. Subjective Questions (20 Marks)

**Real Analysis:** Sequence and series of functions, Pointwise and uniform convergence, Riemann Stieltjes integrals with properties, Power series, Abel's theorem and Taylor theorems, Functions of several variables, Partial derivatives, Jacobian, Multiple integrals.

**Special Functions and Vector Calculus:** Gradient, Divergence, Curl, Vector identities, Directional derivatives, Line, surface and volume integrals, Stokes', Gauss and Green's theorems, Bessel functions, Legendre polynomials, Gauss Hypergeometric functions, Hermite and Laguerre polynomials.

**Complex Analysis:** Continuity and differentiability, analytic functions, Cauchy's theorem, Cauchy's integral formula, Taylor and Maclaurin expansions, Laurent's series, Singularities, Theory of residues and contour integration, Conformal mappings.

**Functional Analysis:** Normed and Banach spaces, Inner product and Hilbert spaces, Fundamental theorems, Fixed point theorem and its applications.

**Topology:** Continuous maps, Compactness, Separation properties.

**Algebra:** Groups, Subgroups, Lagrange's theorem, Normal subgroups, Quotient group, Homomorphism, Permutation group, Cayley's theorems, Sylow theorem, Rings, Ideals, Fields. Vector space, Basis, Linear transformations, Matrices, Rank and Nullity, Eigen values and Eigen vectors, Characteristic and Minimal Polynomials, Diagonalizability, Jordan canonical form.

**Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations, Numerical differentiation and integration. Solution of IVP by single and multistep methods.

**Ordinary Differential Equations:** Existence and uniqueness theorems of solution of initial value problems for second and higher order differential equations. Series solution of second order linear differential equations near ordinary point, Singularity and the solution in the neighbourhood of regular singular point, Euler equation and Frobenius method. Linear homogeneous boundary value problem. Variation of parameters.

**Partial Differential Equations:** Lagrange's and Charpit's general method for solving PDE's, Cauchy problem for first order PDE's, Classification of second order PDE's, general solution of higher order PDE's with constant coefficients, Method of separation of variables for Laplace, heat and wave equations.

**Graph Theory:** Graphs, subgraphs & components. Degrees & distances. Operations on graphs. Trees & cycles. Connectivity. Planarity. Eulerian & Hamiltonian graphs. Colourings. Perfect graphs & Ramsey theory.

**Polynomial Theory:** The zeros of the derivative, the convex hull of critical points, zeros of the polar derivative and its generalization to abstract spaces, Apolar polynomials, linear combinations of polynomials, combinations of a polynomial and its derivatives, A two-circle theorem for polynomials, two-circle theorems for rational functions and their general case.

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