DEPARTMENT OF APPLIED MATHEMATICS
FACULTY OF ENGINEERING &TECHNOLOGY
Syllabus for Ph.D Admissions Test 2026-27 onwards

SECTION-B

Algebra: Groups, Subgroups, Normal subgroups, Quotient groups, Homomorphisms, Cyclic groups, Permutation groups, Symmetric groups, Cayley's theorem, Sylow theorems, Rings, Ideals, Euclidean domain, Principal ideal domain, Embedding and Polynomial rings, Irreducibility criteria, Fields, Finite fields, Extensions of field.

Linear Algebra: Vector spaces, Subspaces, Basis, Dimension, Algebra of linear transformations, Algebra of matrices, Rank and Nullity, Eigen values and Eigen vectors, Cayley-Hamilton Theorem, Matrix representation of linear transformations, Characteristic and Minimal polynomials, Canonical forms, Diagonal forms, Triangular forms, Jordan forms.

Real Analysis: Elementary set theory, Countable and Uncountable sets, Real number system as a complete ordered field, Sequences and Series, Bolzano Weierstrass theorem, Heine Borel theorem, Continuity, Uniform continuity, Differentiability, Mean value theorem, Sequences and series of functions, Uniform convergence, Riemann sums and Riemann integral, Improper Integrals, Monotonic functions, Types of discontinuity, Functions of bounded variation, Lebesgue measure, Lebesgue integral, Functions of several variables, Directional derivative, Partial derivative, Derivative as a linear transformation, Inverse and implicit function theorems.

Complex Analysis: Analytic functions, Cauchy-Reimann equations, Cauchy's theorem, Cauchy's integral formulas, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Power series, Taylor & Laurent series, Singularities, Theory of residues and contour integrations, Conformal mappings.

Functional Analysis: Metric space, Normed space, Banach space, Finite dimensional normed spaces and subspaces, Linear operators, Bounded and continuous linear operators, Inner product space, Hilbert space, Hilbert-adjoint operator, Self-adjoint, Unitary and normal operators, Orthogonal complements and direct sums, Orthonormal sets and sequences, Fundamental theorems for normed and Banach spaces, Banach fixed point theorem, Application of Banach's theorem to linear equations and differential equations.

Topology: Basis, Dense sets, Subspaces and Product topology, Separation axioms, Connectedness and Compactness.

Numerical Analysis: Numerical solutions of algebraic and transcendental equations, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Interpolation for equal and unequal intervals, Numerical differentiation and integration, Numerical solutions of ordinary differential equations, Numerical solutions of partial differential equations, Iterative method for eigen values: Power Method, Jacobi Method.

Ordinary Differential Equations: Existence and uniqueness theorems for initial value problems of first and higher order ODEs, Singular solutions of first order ODEs, Series solution of second order linear differential equations, Euler equation and Frobenius methods, General theory of homogenous and non-homogeneous linear differential equations, Variation of parameters and method of undetermined coefficients, Sturm-Liouville boundary value problems, Green's function and its applications to BVP.

Partial Differential Equations: Lagrange's and Charpit's methods for solving first order PDEs, Cauchy problem for first order PDEs, Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Special Functions: Gamma and Beta functions, Gauss hypergeometric functions, Confluent hypergeometric functions, Bessel and Jacobi functions, Orthogonal polynomials (Legendre, Hermite, Laguerre and their associated forms) and Gegenbauer polynomials, Zeros and orthogonality of orthogonal polynomials.

Integral Equations: Integral equations of I and II kinds of Fredholm and Volterra equations, Relation between differential and integral equations, Solution of integral equations by successive substitution, Successive approximation (Resolvent kernel), Solution of integral equations: Iterated kernels, Degenerate kernels, Eigen values and Eigen functions, Applications of integral equations, Construction of Green functions.

Differential Geometry and Tensor: Calculus of R^n, Diffeomorphism, Differentiable manifolds, Tangent vectors and tangent spaces, Vector fields, Lie algebra of vector fields, Affine connection, Torsion and curvature of a connection, Structure equation of Cartan, Space-like, time-like and null vectors, Contravariant and covariant tensors, Rank of a tensor, Algebra of tensors, Inner product and outer product, Contraction, Quotient law, Metric tensor, Christoffel symbol of I and II kinds, Transformation laws and their properties.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema, Variational methods for boundary value problems in ordinary and partial differential equations.

Classical Mechanics: General motion of rigid bodies, Moments and products of inertia, Constraints, Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle, Principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, Theory of small oscillations.

****