



# **Ph.D Entrance Syllabus**

# **Mathematics**

#### **Real Analysis:**

Finite, Countable, and Uncountable Sets, Metric Spaces, Compact Sets, and Connected Sets. Limits of Functions, Continuous Functions, Continuous and Compactness, Continuity and Connectedness, Discontinuities, Monotone Functions, Infinite Limits, and Limits at Infinity. The Continuity of Derivatives of Higher Order – Taylor's Theorem, Differentiation of Vector-Valued Functions. Definition and Existence of the Integral, Properties of The Integral, Integration, and Differentiation, Integration of Vector-Valued Functions.

## **Complex Analysis:**

Analytic Functions and Harmonic Functions, Cauchy – Riemann Equations, Sufficient Conditions. Contour Integration, Cauchy – Goursat Theorem, Antiderivatives, Integral Representation for Analytic Functions, Theorems of Morera and Liouville and Some Applications, Uniform Convergence of Series, Taylor, and Laurent Series Representations, Singularities, Zeros and Poles, Applications of Taylor and Laurent Series. Residue Theorem, Calculus of Residues.

#### **Differential Equations:**

Ordinary Differential Equations, Existence and Uniqueness of Solutions of Initial Value Problems for First Order Ordinary Differential Equations, Singular Solutions of First Order Ordinary Differential Equations, Boundary Value Problems: Green's Function, Partial Differential Equations: Lagrange and Charpit Methods, Cauchy Problem.

## Linear Algebra:

Vector Spaces, Subspaces, Quotient Spaces, Linear Independence and Dependence, Bases and Dimension, Kernel, Range, Isomorphism, Matrix Representation of Linear Transformation, Dual Spaces Cayley – Hamilton Theorem, Canonical Forms, Inner Product Spaces.

#### **Functional Analysis:**

Normed spaces, Continuity of linear maps, Hahn-Banach Extension and Separation Theorems, Banach spaces, Uniform Boundedness Principle and its applications, Closed Graph Theorem, Open Mapping Theorem and their applications, Examples of compact operators on normed spaces, Inner product spaces, Hilbert spaces, Orthonormal basis.