# CRET LEVEL – 1 EXAM

## SYLLABUS

## Algebra -:

- Basic theory of Groups, Permutation groups (Symmetric and Dihedral groups); Group actions, Class equation, Sylow Theorems and their applications; Euclidean domains, Principal ideal domains and Unique factorization domains; Fields, Finite fields, Galois theory.

## Linear Algebra -:

- Finite dimensional vector spaces; Linear transformations and their matrix representations, Systems of linear equations, Eigenvalues and Eigenvectors, Characteristic and Minimal polynomials, Diagonalization, Inner product spaces, Gram- Schmidt orthonormalization process, Modules over rings, Exact sequences, Hom Functor, Projective and Injective Modules.

## Real Analysis -:

- Limit, Continuity and Differentiability of functions of one and several real variables; Convergence of sequences and series of constants; Uniform convergence of sequence and series of functions, power series, Fourier Series; Riemann's theory of integration, Multiple integrals, line surface and volume integrals,

Theorems of Green, Stokes and Gauss; Cardinality, Lebesgue measure, Measurable functions; Lebesgue integral, Fatou's lemma, Dominated convergence theorem.

## Complex Analysis -:

- Analytic functions, conformal mappings, bilinear transformations; complex integration: Cauchy's integral theorem and formula; Liouville's theorem, Maximum modulus principle; Taylor and Laurent's series; Residue theorem and applications for evaluating real integrals.

## Topology -:

- Basic concepts of topological spaces including metric spaces, product and quotient topology, Connectedness, Compactness, First and Second countability and separation axioms; Homotopy of maps, Fundamentals groups.

## Differential Equations -:

- Ordinary and Partial differential equations of first and second order, Solution techniques, Laplace Equations, Wave Equation, Diffusion Equations, Existence theory for Ordinary differential equations; System of Differential Equation, Power series methods: Legendre and Bessel functions and their properties.
- **Mathematical Methods:** Fourier Series, Fourier Transforms, Sturm-Liouville Problems, Laplace transforms and their Applications, Calculus of variations and Linear Integral Equations.

## Functional Analysis -:

- Banach spaces, Hahn-Banach extension theorem, Open mapping and Closed graph theorems, Principle of

**Uniform Boundedness, Weak and Weak* topology; Hilbert spaces, orthonormal bases, Rieses Representation Theorem, Self-adjoint and Normal operators.**

## Mechanics -:

- **Euler's dynamical Equations, Lagrange's and Hamiltonian equations of Motion, Canonical transformations, Poission's brackets, Stresses and rates of strains components, Navier-Stokes Equations of viscous fluid motion and the equation of continuity, Kalvin Circulation Theorem, Uniform Line Sources, Doublets and Vortices, Milne-Thomson Circle Theorem, Blasius Theorem.**

## Differential Geometry -:

- **Elementary theory of curves and surfaces in Euclidian 3-space; Basic concepts in differentiable Manifolds, Tensors, Riemannian metrics, Riemannian manifolds, Levi Civita connection on a Riemannian manifold, Riemannian curvature tensor, Sectional, Ricci and Scalar curvatures, Einstein manifolds.**