

## **Written Test Pattern and Syllabus**

1. Applicants who have qualified and have a valid score card in national level exams like GATE/UGC-NET/CSIR-NET/NBHM, etc. are exempted from the written test. Such applicants are expected to produce the valid score card while reporting at the institute.
2. The Question Paper consists two-parts. Part A consists of 50 Multiple Choice Type Questions, each carrying 1 mark. Part B consists of 10 Multiple Choice Type Questions, each carrying 5 marks.
3. The written test has NEGATIVE MARKING. For every incorrect 1-mark question,  $1/3$  marks are deducted and for every incorrect 5-mark question,  $5/3$  marks are deducted.
4. The duration of the examination is 180 mins.

## Syllabus for Ph.D candidates – Mathematics

**Real Analysis:** Sequences and series, convergence. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral.

**Complex Analysis:** Cauchy-Riemann equations, analytic functions, harmonic functions. Conformal mappings, Mobius transformations. Open mapping theorem, Liouville's theorem, Rouché's theorem, Morera's theorem. Poles and Singularities, Contour integrals, Cauchy Integral formula. Taylor's series, Laurent's series. Residues, Cauchy Residue theorem.

**Linear Algebra:** Vector spaces, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices. Eigenvalues and eigenvectors. Matrix representation of linear transformations. Inner product spaces, orthonormal basis, Gram-Schmidt orthogonalization.

**Algebra:** Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups. Rings, ideals, prime and maximal ideals, quotient rings, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, algebraic extensions, Galois theory, Module theory.

**Ordinary Differential Equations:** Solution methods for ordinary first order differential equations. General theory of homogenous and non-homogeneous linear ordinary differential equations, variation of parameters, power series methods.

**Graph Theory and Combinatorics:** Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle. Graphs, Euler and Hamilton graphs, Trees and other special families of graphs. Matching, independent set, coloring, graph isomorphism.