JRF IN MATHEMATICS 2017

TEST CODE MTA, MTB

There will be two tests MTA and MTB of 2 hours duration each in the forenoon and in the afternoon. Topics to be covered in these tests along with an outline of the syllabus and sample questions are given below:

1) Topics for MTA (Forenoon examination) : Real Analysis, Measure and Integration, Complex Analysis, Ordinary Differential Equations and General Topology.

2) Topics for MTB (Afternoon examination) : Algebra, Linear Algebra, Functional Analysis, Elementary Number Theory and Combinatorics.

Candidates will be judged based on their performance in both the tests.

OUTLINE OF THE SYLLABUS

1 General Topology : Topological spaces, Continuous functions, Connectedness, Compactness, Separation Axioms. Product spaces. Complete metric spaces. Uniform continuity. Baire category theorem.

2 Functional Analysis : Normed linear spaces, Banach spaces, Hilbert spaces, Compact operators. Knowledge of some standard examples like C[0, 1],L^p[0, 1]. Continuous linear maps (linear operators). Hahn-Banach Theorem, Open mapping theorem, Closed graph theorem and the uniform boundedness principle.

3 Real analysis : Sequences and series, Continuity and differentiability of real valued functions of one and two real variables and applications, uniform convergence, Riemann integration.

4 Linear algebra : Vector spaces, linear transformations, characteristic roots and characteristic vectors, systems of linear equations, inner product spaces, diagonalization of symmetric and Hermitian matrices, quadratic forms.

5 Elementary number theory and Combinatorics: Divisibility, congruences, standard arithmetic functions, permutations and combinations, and combinatorial probability.

6 Lebesgue integration : Lebesgue measure on the line, measurable functions, Lebesgue integral, convergence almost everywhere, monotone and dominated convergence theorems.

7. **Complex analysis :** Analytic functions, Cauchy's theorem and Cauchy integral formula, maximum modulus principle, Laurent series, Singularities, Theory of residues, contour integration.

8. **Abstract algebra :** Groups, homomorphisms, normal subgroups and quotients, isomorphism theorems, finite groups, symmetric and alternating groups, direct product, structure of finite Abelian groups, Sylow theorems. Rings and ideals, quotients, homomorphism and isomorphism theorems, maximal ideals, prime ideals, integral domains, field of fractions; Euclidean rings, principal ideal domains, unique factoristation domains, polynomial rings. Fields, characteristic of a field, algebraic extensions, roots of polynomials, separable and normal extensions, finite fields.

9. **Ordinary differential equations :** First order ODE and their solutions, singular solutions, initial value problems for first order ODE, general theory of homogeneous and nonhomogeneous linear differential equations, and Second order ODE and their solutions.