## MATHEMATICAL SCIENCES

Mathematical Sciences question paper will consist of 40 multiple choice questions from mathematics. There will be negative marking for wrong answers. Duration of the test is 2 hours.

## SYLLABUS

1. **Algebra:**

   **Theory of Equations:**
   Relation between roots and coefficients of an equation, Symmetric functions of roots, Rolle's theorem, Reciprocal Equations, Descartes' Rule of Signs, Cubic and quartic equations, Complex numbers and De Moivre's Theorem.
   **Determinants:**
   Properties of determinants, Solution of a Linear System, Cramer's Rule.
   **Inequalities:**
   AM-GM inequality, Cauchy-Schwarz inequality.
   **Set Theory:**
   Relations, Functions, Bijections, Cardinality, Permutations and combinations of sets and multisets, Discrete probability.
   **Algebraic Structures:**
   Groups, Subgroups, Cosets, Normal subgroups, Symmetric group, Homomorphisms. Rings, Integral Domains, Ideals, Prime and Maximal Ideals, Polynomial Rings.
   **Vector Spaces:**
   Subspaces, Linear independence, Bases and dimension, Linear transformations, Matrices, Rank and nullity, eigenvalues and eigenvectors, Cayley-Hamilton Theorem.

2. **Geometry:**

   **Two-dimensional Coordinate Geometry:**
   Conic sections and their equations in Cartesian and polar coordinates. Pair of straight lines, circle, ellipse, parabola and hyperbola.
   **Three-dimensional Co-ordinate Geometry:**
   Lines, Direction Cosines, Skew lines, Planes, Spheres, Cylinders and Cones.

3. **Vector Algebra and Vector Calculus:**

   Vectors, addition, scalar multiplication, dot product, cross product, Scalar triple product, Equations to the Line and the Plane, Grad, Divergence and Curl, Vector Integration, Green's, Gauss' and Stokes' Theorems.

4. **Calculus and Analysis:**
   Real Number System, Sequence and Series, Continuity, Differentiability, Mean Value Theorems, Intermediate Value Theorem, L'Hospital's Rule, Tangents and Normals, Maxima and Minima, Riemann Integration, Multiple Integrals, Partial differentiation, Lengths, areas and volumes by integration.


5. **Differential Equations**:
   First Order ODE; Method of Separation of Variables; Exact equations; Euler's equation; Orthogonal Family of curves, Second Order Linear ODE: Variation of Parameters.