## Part IV: Mathematics

### 1. Algebra

1.1 Complex numbers, addition, multiplication, conjugation, polar representation, properties of modulus and principal argument, triangle inequality, roots of complex numbers, geometric interpretations; Fundamental theorem of algebra.

1.2 Theory of Quadratic equations, quadratic equations in real and complex number system and their solutions.

1.3 Arithmetic and geometric progressions, arithmetic, geometric and arithmetico geometric series, sums of finite arithmetic and geometric progressions, infinite geometric series, sums of squares and cubes of the first n natural numbers.

1.4 Logarithms and their properties.

1.5 Exponential series.

1.6 Permutations and combinations, Permutations as an arrangement and combination as selection, simple applications.

1.7 Binomial theorem for a positive integral index, properties of binomial coefficients, Pascal's triangle

1.8 Matrices and determinants of order two or three, properties and evaluation of determinants, addition and multiplication of matrices, adjoint and inverse of matrices, Solutions of simultaneous linear equations in two or three variables, elementary row and column operations of matrices, Types of matrices, applications of determinants in finding the area of triangles.

1.9 Sets, Relations and Functions, algebra of sets applications, equivalence relations, mappings, one to one, into and onto mappings, composition of mappings, binary operation, inverse of function, functions of real variables like polynomial, modulus, signum and greatest integer.

1.10 Mathematical reasoning and methods of proofs, mathematically acceptable statements. Connecting words/phrases – consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied" by", "and", "or", "there exists" and through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words – difference between contradiction, converse and contra positive, Mathematical induction

1.11 Linear Inequalities, solution of linear inequalities in one variable (Algebraic) and two variables (Graphical).

## 2. Trigonometry

2.1 Measurement of angles in radians and degrees, positive and negative angles, trigonometric ratios, functions with their graphs and identities.

2.2 Solution of trigonometric equations.

2.3 Inverse trigonometric functions

## 3. Two-dimensional Coordinate Geometry

3.1 Cartesian coordinates, distance between two points, section formulae, shift of origin.

3.2 Straight lines and pair of straight lines: Equation of straight lines in various forms, angle between two lines, distance of a point from a line, lines through the point of intersection of two given lines, equation of the bisector of the angle between two lines, concurrent lines.

3.3 Circles: Equation of circle in standard form, parametric equations of a circle.

3.4 Conic sections: parabola, ellipse and hyperbola their eccentricity, directrices & foci.

## 4. Three dimensional Coordinate Geometry

4.1 Co-ordinate axes and co-ordinate planes, distance between two points, section formula, direction cosines and direction ratios, equation of a straight line in space and skew lines.

4.2 Angle between two lines whose direction ratios are given, shortest distance between two lines.

4.3 Equation of a plane, distance of a point from a plane, condition for coplanarity of three lines, angles between two planes, angle between a line and a plane.

## 5. Differential calculus

5.1 Domain and range of a real valued function, Limits and Continuity of the sum, difference, product and quotient of two functions, Differentiability.

5.2 Derivative of different types of functions (polynomial, rational, trigonometric, inverse trigonometric, exponential, logarithmic, implicit functions), derivative of the sum, difference, product and quotient of two functions, chain rule, parametric form.

5.3 Geometric interpretation of derivative, Tangents and Normal. Increasing and decreasing functions,

5.4 Maxima and minima of a function.

5.5 Rolle's Theorem, Mean Value Theorem and Intermediate Value Theorem.

## 6. Integral calculus

6.1 Integration as the inverse process of differentiation, indefinite integrals of standard functions.

6.2 Methods of integration: Integration by substitution, Integration by parts, integration by partial fractions, and integration by trigonometric identities.

6.3 Definite integrals and their properties, Fundamental Theorem of Integral Calculus, applications in finding areas under simple curves.

6.4 Application of definite integrals to the determination of areas of regions bounded by simple curves.

## 7. Ordinary Differential Equations

7.1 Order and degree of a differential equation, formulation of a differential equation whole general solution is given, variables separable method.

7.2 Solution of homogeneous differential equations of first order and first degree

7.3 Linear first order differential equations

## 8. Probability

8.1 Various terminology in probability, axiomatic and other approaches of probability, addition and multiplication rules of probability.

8.2 Conditional probability, total probability and Baye's theorem

8.3 Independent events

8.4 Discrete random variables and distributions with mean and variance.

## 9. Vectors

9.1 Direction ratio/cosines of vectors, addition of vectors, scalar multiplication, position vector of a point dividing a line segment in a given ratio.

9.2 Dot and cross products of two vectors, projection of a vector on a line.

9.3 Scalar triple products and their geometrical interpretations.

## 10. Statistics

10.1 Measures of dispersion

10.2 Analysis of frequency distributions with equal means but different variances

## 11. Linear Programming

11.1 Various terminology and formulation of linear Programming

11.2 Solution of linear Programming using graphical method, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (upto three nonitrivial constraints)

## 12. Mathematical modeling

12.1 Formulation of simple real life problem, solution using matrices, calculus and linear programming.