MATHEMATICS

UNIT I:

1. Set Theory:

Set theory, Empty and Finite sets. Subsets, Power set, Universal set. Venn diagrams. Union, intersection and Difference of sets. Groups, subgroups, normal subgroups, quotient groups, homomorphism, cyclic groups, permutation groups, Caley's theorem, Sylon theorem, Rings.

2. Relations and Functions:

Relations and Functions, Cartesian product of sets. domain, co-domain and range of a relation. Function as a special kind of relation from one set to another. Pictorial representation of a function, domain, co-domain and range of a function. Various types of functions with their graphs.

UNIT II:

3. Mathematical Induction:

Principle of Mathematical Induction and simple applications. Complex Numbers and Quadratic Equations, Need for complex numbers, description of algebraic properties of complex numbers. Argand plane and polar representation of complex numbers. Statement of Fundamental Theorem of Algebra, solution of quadratic equations in the complex number system, Square-root of a Complex number.

4. Linear Inequalities:

Linear Inequalities, Algebraic solutions of linear inequalities in one variable and their representation on the number line. Solution of system of linear inequalities in two variables.

5. Permutations and Combinations:

Permutations and Combinations, Fundamental principle of counting. n! function. Permutations and combinations derivation of formulae and their connections, simple applications. Binomial theorem for positive integral indices, simple applications.

6. Sequence and Series:

Arithmetic Progression, Geometric Progression, general term of these series, sum of *n* terms of a Geometric Progression, infinite Geometric Progression and its sum. Relation between Arithmetic Mean and Geometric Mean.

UNIT III:

7. Two-Dimensional Coordinate Geometry:

Straight Lines, shifting of origin. General equation of a line, various forms of equations of a line. Equation of family of lines passing through the point of intersection of two lines. Distance of a point from a line. Circles, ellipse, parabola, hyperbola, degenerated conic section. Standard equations and simple properties of parabola, ellipse and hyperbola. Standard equation of a circle.

8. Three-dimensional Geometry:

Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points and section formula. Direction cosines/ratios of a line joining two points. Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two

lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a point from a plane.

9. Vector Analysis:

Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors, position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar product of vectors, projection of a vector on a line. Vector product of vectors, scalar triple product.

UNIT IV:

10. Statistics and Probability:

Measure of dispersion, mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances. Sample space and events with classical, empirical, axiomatic definition of probability, Occurrence of events, 'not', 'and' & 'or' events, Multiplications theorem on probability. independent events, mutually exclusive events, conditional probability. Baye's theorem. Discrete and continuous univariate distributions namely, Bionomial, Poission and Normal.

11. Matrices and Determinants:

Types of matrices, symmetric and skew symmetric matrices. Operations on matrices and their properties, Invertible matrices and proof of the uniqueness of inverse. Determinant of a matrix, properties, minors, cofactors and applications of determinants. Adjoint and inverse matrix. solutions of system of linear equations and examples, solving system of linear equations in two or three variables using inverse of a matrix.

UNIT V:

12. Differential Calculus:

Derivative of a function, Continuity and differentiability, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions. derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function. Concepts of exponential, logarithmic functions. Derivatives of $\log_e x$ and e^x. Logarithmic differentiation. Derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems and their geometric interpretations. Applications of derivatives in finding tangents and normals, approximation, maxima and minima. Simple problems.

13. Integral Calculus:

Integration, Integration of a functions by substitution, by partial fractions and by parts, example related cases. Definite integrals as a limit of a sum. Fundamental Theorem of Calculus. Basic properties of definite integrals and evaluation of definite integrals. Applications of the Integrals in finding the area under simple curves.

14. Differential Equations:

Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order

and first degree. Solutions of linear differential equation. Homogeneous and non-homogeneous linear ODEs, variation of parameters. Lagrange and Charpit method for solving first order Partial differential equations, Cauchy's problem for first order PDE, classification of second order PDEs.

15. Linear Programming:

Mathematical formulation of linear programming problems, different types of linear programming problems, Graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions. Simplex method, dual of LPP, Dual simplex method.

UNIT VI:

16. Calculus of Variation:

Variation of a functional, Euler-Lagrange equation, necessary and sufficient conditions for extrema. Variation methods for boundary value problems in ODEs and PDEs.

17. Numerical Analysis:

Numerical solutions of algebraic equations: method of iteration and Newton-Raphson method, Rate of convergence, solution of system of linear algebraic equations using Gauss elimination and Gauss-Seidel method. Interpolation in equal and unequal differences. Solution of IVP.