SETS, RELATION AND MAPPING


Properties of complement sets. Simple problems on union and intersection on not more than three sets.

2. Relations & Mapping:

Ordered pairs. Cartesian product of sets. Number of elements in the Cartesian product of two finite sets. Cartesian product of the reals with itself (upto R x R). Different types of relations, pictorial diagrams, 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 & range of a function. Real valued functions of real variables, domain and range of these functions. Different types of functions. Graphs of function. Sum, difference, product and quotients of functions.

MODULE-2

SEQUENCE AND SERIES (FINITE AND INFINITE), COMPLEX NUMBERS AND QUADRATIC EQUATIONS, PERMUTATIONS & COMBINATIONS

1. Sequence and Series:


2. Complex Numbers:

Complex numbers as ordered pair of reals, representation of a complex number in form of \( a + ib \). Polar form and conjugate of a complex number, Argand diagram, algebra of complex numbers, modulus and argument of a complex number. Square and cube root of complex numbers and their properties, triangle inequality, simple problems.

3. Quadratic Equations: Its rational, irrational and complex roots, relation between roots and coefficients of a quadratic equation, nature of roots, formation of quadratic equation, symmetric
functions of the roots, quadratic expressions, its maximum and minimum values. Simple applications.

3. Permutations & Combinations:
Fundamental theorem of counting, permutation as arrangement and combination as selection. Permutation and combination of like and unlike things. Circular permutation is to be excluded. Simple applications.

MODULE-3

BINOMIAL THEOREM, MATRICES AND DETERMINANT
1. Binomial Theorem:
Binomial theorem for positive integral indices, general and middle term, term independent of x and greatest term in binomial expansion, simple applications.

2. Matrices and Determinant:
Matrices of order \( \leq 3 \), algebra of matrices, types of matrices, determinant up to 3\textsuperscript{rd} order. Properties of determinants, evaluation of determinants, area of triangle by using determinant, Adjoint and evaluation of inverse of a square matrix using determinant and by elementary transformations test of consistency and solution of simultaneous linear equations using inverse of a matrix and determinants (Cramer’s rule).

MODULE-4

TRIGONOMETRY
1. Trigonometric ratios of associated angles, compound angles, multiple and submultiple angles, conditional identities, general solution of trigonometric equations, inverse circular functions, simple applications.


MODULE-5

TWO DIMENSIONAL GEOMETRY
1. Straight Line:
Cartesian co-ordinate system, translation of co-ordinate axes, Locus of a point, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two-point form, intercept form and normal form. General equation of
a line, concurrence of three straight lines. Equation of family of lines passing through the point of intersection of two lines. Distance of a point from a line. Equation of internal and external bisectors of angles between two intersecting lines, Centroid, orthocenter, circum centre of a triangle.

2. **Conic Sections:**
Standard form of equation of circle, general form of the equation of a circle, its radius and centre, equation of a circle when the end points of a diameter are given. Point of intersection of a line and a circle with the centre at origin and condition for a line to be tangent to a circle, Equation of the tangent and simple properties.

3. **Conics:**
Parabola, ellipse, hyperbola in standard form, condition for \( y = mx + c \) to be a tangent and their simple properties.

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**MODULE-6**

**VECTORS AND THREE DIMENSIONAL GEOMETRY**

1. **Vectors:**
Idea of vectors and scalars, types of vector, components of a vector in two and three dimensional space, Triangle and parallelogram laws of vectors, scalars and vector products, scalar triple product.
Geometrical representation of product of vectors. Simple applications.

2. **Three dimensional Geometry:**
Direction angles, direction cosines / ratios of a line joining two points. Orthogonal projection of a line segment on a straight line. Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two lines Cartesian and vector equation of a plane in Cartesian and vector forms. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a line and plane from a point. Condition of co-planarity of two straight lines, condition for a straight line to lie on a plain and simple applications.

**MODULE-7**

**DIFFERENTIAL CALCULUS**

1. **Continuity and Differentiability**
Limit, Continuity and differentiability of function, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions, concept of exponential and logarithmic functions. Logarithmic functions as inverse of exponential functions. Derivatives of different types of functions.
Second order derivatives. Rolle’s Theorem and Lagrange’s Mean value theorems (without proof) and their geometric interpretations and simple applications. Indeterminate forms using L’Hospital rule.

MODULE-8

INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

INTEGRAL CALCULUS:
Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts. Only simple integrals of the following type to be evaluated.

\[ \int \frac{dx}{x^2+a^2}, \int \frac{dx}{a^2+x^2}, \int \frac{dx}{\sqrt{x^2+a^2}}, \int \frac{dx}{\sqrt{a^2+bx+c}}, \int \frac{px+q}{\sqrt{ax^2+bx+c}} \ dx, \int \frac{dx}{\sqrt{x^2+a^2}} \ dx, \int \sqrt{ax^2+bx+c} \ dx, \int (px+q) \sqrt{ax^2+bx+c} \ dx, \int \frac{(\cos x+msinx)}{p\cos x+q\sin x+c} \ dx, \int \frac{dx}{a+bcosx}, \int e^{ax} \sin bx \ dx, \int e^{ax} \cos bx \ dx, \int e^x [f(x)+f'(x)] \ dx. \]

Definite integrals as a limit of a sum. Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

2. Differential Equations:
Definitions, 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 specification of variables, homogeneous differential equations of first order and first degree solutions of linear differential equation of the type: \( \frac{dy}{dx} + py = q \), where \( p \) and \( q \) are functions of \( x \) only.

MODULE-9

APPLICATIONS OF DERIVATIVES, APPLICATION OF THE INTEGRALS

1. Applications of derivatives: Rate of change, approximation of functions increasing, decreasing functions, Tangent and normal, maxima and minima. Simple applications.


MODULE-10

PROBABILITY, STATISTICS, MATHEMATICAL REASONING, LINEAR PROGRAMMING, LINEAR INEQUALITIES


Multiplication theorem on probability, Conditional probability, dependent and independent events, total probability, Baye’s theorem, Random variable and its probability distribution, mean
and variance of random variable. Repeated independent (Bernoulli) trials and Binomial distribution its mean and variance.

2. Statistics:

Measure of dispersion; mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances.

3. Mathematical Reasoning:

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 their use through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words difference between contradiction. Converse and contrapositive, truth table.

4. Linear Inequalities:

Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Solution of system of linear inequalities in two variables-graphically. Inequalities involving modulus function.

5. Linear Programming: