

Mathematics Syllabus - Class XI & XII

CLASS XII

UNIT I: SETS AND FUNCTIONS

1. SETS (*Periods 14*)

- Sets and their representations. Empty set. Finite and Infinite sets. Equal sets. Subsets. Subsets of a set of real numbers especially intervals (with notations). Universal set. Venn diagrams.
- Union and Intersection of sets. Difference of sets. Complement of a set, Properties of Complement sets.

2. Relations & Functions (*Periods 16*)

- Ordered pairs, Cartesian product of sets. Number of elements in the Cartesian product of two finite sets. Cartesian product of the reals with itself (up to $\mathbb{R} \times \mathbb{R} \times \mathbb{R}$).
- Definition of Relation, 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 and Range of a function.
- Real valued function of a real variable, domain and range of these functions.
- Constant, identity, polynomial, rational, modulus, signum and greatest integer functions with their graphs.
- Sum, difference, product and quotients of functions.

3. Trigonometric Functions (*Periods 20*)

- Positive and Negative angles, Measuring angles in radians and in degrees and conversion from one measure to another.
- Definition of trigonometric functions with the help of unit circle.
- Truth of the identity $\sin^2 x + \cos^2 x = 1$, for all x .
- Signs of trigonometric functions and sketch of their graphs. Expressing $\sin(x \pm y)$ and $\cos(x \pm y)$ in terms of $\sin x$, $\sin y$, $\cos x$ & $\cos y$.
- Deducing identities like:

- $\tan(x \pm y) = (\tan x \pm \tan y) / (1 \mp \tan x \cdot \tan y)$
 - $\cot(x \pm y) = (\cot x \cdot \cot y \mp 1) / (\cot y \pm \cot x)$
 - $\sin x \pm \sin y = 2\sin[(x \pm y)/2] \cdot \cos[(x \mp y)/2]$
 - $\cos x + \cos y = 2\cos[(x + y)/2] \cdot \cos[(x - y)/2]$
 - $\cos x - \cos y = -2\sin[(x + y)/2] \cdot \sin[(x - y)/2]$
 - Identities related to $\sin 2x$, $\cos 2x$, $\tan 2x$, $\sin 3x$, $\cos 3x$ and $\tan 3x$.
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UNIT II: ALGEBRA

1. Complex Numbers and Quadratic Equations (Periods 10)

- Need for complex numbers, especially $\sqrt{-1}$, to be motivated by inability to solve every quadratic equation.
- Brief description of algebraic properties of complex numbers. Argand plane.

2. Linear Inequalities (Periods 10)

- Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line.

3. Permutations and Combinations (Periods 14)

- Fundamental principle of counting. Factorial n.
- Permutations and combinations, derivation of formulae and their connections, simple applications.

4. Binomial Theorem (Periods 08)

- Statement and proof of the binomial theorem for positive integral indices.
- Pascal's triangle. Simple applications.

5. Sequence and Series (Periods 10)

- Sequence, Series. Arithmetic Mean (A.M.), Geometric Progression (G.P.), general term of a G.P., sum of n terms of a G.P.,
 - Arithmetic and Geometric series, infinite G.P. and its sum, geometric mean (G.M.). Relation between A.M. and G.M.
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UNIT III: COORDINATE GEOMETRY

1. **Straight Lines** *(Periods 10)*

- Brief recall of 2-D from earlier classes.
- 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, intercepts form.
- Distance of a point from a line.

2. **Conic Sections** *(Periods 14)*

- Sections of a cone: Circles, ellipse, parabola, hyperbola, a point, a straight line and pair of intersecting lines as a degenerated case of a conic section.
- Standard equations and simple properties of parabola, ellipse and hyperbola.
- Standard equation of a circle.

3. **Introduction to Three-dimensional Geometry** *(Periods 08)*

- Coordinate Axes and Coordinate planes in three-dimensions.
- Coordinates of a point.
- Distance between two points.

UNIT IV: CALCULUS

1. **Limits and Derivatives** *(Periods 20)*

- Derivative introduced as rate of change both as that of distance function and geometrically, intuitive idea of limit.
- Definition of derivative, relate it to slope of tangent of the curve.
- Derivative of sum, product, quotient of functions.
- Derivative of polynomials and trigonometric functions.

UNIT V: STATISTICS AND PROBABILITY

1. **Statistics** *(Periods 10)*

- *Measure of dispersion:* Mean deviation, Variance and Standard deviation of ungrouped/grouped data.

2. **Probability** (Periods 16)

- Events: Occurrence of events, 'not', 'and' & 'or' events, exhaustive events, mutually exclusive events.
- Axiomatic (set theoretic) probability, connection with theories of earlier classes.
- Probability of an event, probability of 'not', 'and', & 'or' events.

CLASS XII

UNIT I: RELATION AND FUNCTIONS

1. **Relations and Functions** (Periods 10)

- Types of relations: Reflexive, symmetric, transitive and equivalence relations.
- One to one and onto functions.

2. **Inverse Trigonometric Functions** (Periods 10)

- Definition, range, domain, principal value branches.
- Graphs of inverse trigonometric functions.
- Elementary properties of inverse trigonometric functions.

UNIT II: ALGEBRA

1. **Matrices** (Periods 18)

- Concept, notation, order, equality, types of matrices, zero matrix, transpose of a matrix, symmetric and skew symmetric matrices.
- Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication.
- Non-commutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of order 2).

- Invertible matrices and proof of the uniqueness of inverse, if it exists (Here all matrices will have real entries).

2. **Determinants** (Periods 20)

- Determinant of a square matrix (up to 3×3 matrices), minors, cofactors and applications of determinants in finding the area of a triangle.
- Adjoint and inverse of a square matrix.
- Consistency, inconsistency and number of solutions of system of linear equations by examples.
- Solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

UNIT III: CALCULUS

1. **Continuity and Differentiability** (Periods 22)

- Continuity and Differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function.
- Concepts of exponential, logarithmic functions.
- Derivatives of $\log_a x$ and e^x . Logarithmic differentiation.
- Derivative of functions expressed in parametric forms. Second order derivatives.

2. **Application of Derivatives** (Periods 10)

- Applications of derivatives: Rate of change, increasing/decreasing functions, maxima and minima (first derivative test motivated geometrically and second derivative test by examination of sign of second order derivative).
- Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

3. **Integrals** (Periods 22)

- 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 type –

- $\int dx / (x^2 \pm a^2)$, $\int dx / \sqrt{(x^2 \pm a^2)}$, $\int dx / (a^2 - x^2)$, $\int dx / (ax^2 + bx + c)$,
 $\int dx / \sqrt{(ax^2 + bx + c)}$
- $\int (px + q) dx / (ax^2 + bx + c)$, $\int (px + q) dx / \sqrt{(ax^2 + bx + c)}$, $\int \sqrt{(a^2 \pm x^2)} dx$

- Definite Integral. Fundamental Theorem of Calculus (without proof).
- Basic properties of definite integrals and evaluation of definite integrals.

4. Application of Integrals (Periods 10)

- Applications in finding the area under simple curves, especially lines, arcs of circles/parabolas/ellipses (in standard form only).

5. Differential Equations (Periods 10)

- Definition, order and degree, general and particular solutions of a differential equation.
- Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree.
- Solutions of linear differential equation of the type –
 - $dy/dx + Py = Q$,
 - $dx/dy + Px = Q$
 - where P and Q are functions of x (or y) or constants.

UNIT IV: VECTORS AND THREE-DIMENSIONAL GEOMETRY

1. Vectors (Periods 12)

- Vectors and scalars, magnitude and direction of a vector.
- Direction cosines/ratios of vectors.
- Types of vectors (equal, unit, zero, parallel and collinear 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 (dot) product of vectors, projection of a vector on a line.
- Vector (cross) product of vectors.

2. Three-dimensional Geometry (*Periods 10*)

- Direction cosines/direction ratios of a line joining two points.
- Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two lines.
- Angle between two lines.

UNIT V: LINEAR PROGRAMMING

(*Periods 10*)

- Introduction, related terminology such as constraints, objective function, optimization, graphical method of solution for problems in two variables.
- Feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

UNIT VI: PROBABILITY

(*Periods 16*)

- Multiplication theorem on probability. Conditional probability, independent events, total probability, Bayes' theorem.

