

**WEST BENGAL COUNCIL OF HIGHER SECONDARY EDUCATION**  
**SYLLABUS FOR CLASS XI AND XII**  
**SUBJECT : MATHEMATICS ( MATH )**

### **Course Objectives**

The Mathematics curriculum has undergone periodic revisions in response to the field's expansion and the changing demands of society. The senior secondary stage serves as a springboard for students to pursue professional programs in engineering, physical and biological science, commerce, or computer applications, or to pursue higher education in mathematics. In order to address the evolving demands of all student categories, the current revised syllabus has been created. More focus has been placed on the application of certain principles, drawing inspiration for the issues from real-world scenarios and other academic disciplines.

The following are the main goals of teaching mathematics to senior school students:

- To develop general interest in Mathematics as a discipline.
- To gain critical insight and knowledge of fundamental terminology, concepts, principles, symbols, and skills, especially through motivation and visualization, as well as mastery of underlying procedures and abilities.
- To experience the logic flowing while demonstrating an outcome or resolving an issue.
- To use the gained information and abilities to solve issues, using many approaches where feasible.
- To familiarize students with the various applications of mathematics in everyday life.
- Developing a sense of appreciation and respect for notable mathematicians and their contributions to mathematics is important.
- To cultivate an optimistic outlook in order to reason, evaluate, and speak coherently.
- To cultivate curiosity for the topic by taking part in competitions related to it.

### **Course Outcomes**

At the end of the course the students are expected to develop expertise in various areas of the subject and gain critical insights into the background dynamics of the problem solving process.

The following are the major course outcomes. A student is expected to:

- Develop problem solving skills and apply mathematical concepts to real life situations.
- Cultivate critical thinking and analytical skills in mathematical context.
- Collaborate with peers to solve complex mathematical problems.
- Make predictions and draw conclusions based on statistical data.
- Get a preliminary idea of using technology, like calculators in problem solving.
- Effectively communicate mathematical ideas and solutions both verbally and in writing.
- Present mathematical arguments and justifications.
- Prepare for standardized examinations based on the curriculum.
- Understand the relevance of mathematics in real-world applications.

# CLASS - XI

## SEMESTER – I

### SUBJECT: MATHEMATICS ( MATH )

FULL MARKS: 40

CONTACT HOURS: 100 Hours

#### COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	<b>SETS AND FUNCTIONS</b>	<b>45</b>	<b>15</b>
	<b>1. Sets</b> Sets and their representations, Empty set, Finite and Infinite sets, Equal sets, Subsets, Subsets of the set of real numbers especially intervals (with notations). Power set. Universal set. Venn diagrams. Union and Intersection of sets. Difference of sets. Complement of a set. Properties of Complement sets.	<b>15</b>	<b>4</b>
	<b>2. Relations and Functions</b> Ordered pairs. Cartesian product of sets, Number of elements in the Cartesian product of two finite sets. Cartesian product of the set of reals with itself (up to $R \times R \times R$ ). 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 functions, domain and range of these functions, constant, identity, polynomial, rational, modulus, exponential, logarithmic, signum and greatest integer functions with their graphs. sum, difference, product and quotients of functions.	<b>15</b>	<b>4</b>
	<b>3. Trigonometric Functions</b> 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, domain, range and sketch their graphs. Expressing $\sin(x \pm y)$ and $\cos(x \pm y)$ in terms of $\sin x$ , $\cos x$ , $\sin y$ and $\cos y$ .	<b>15</b>	<b>7</b>

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	<p>Deducing identities like the following:</p> $\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y}, \quad \cot(x \pm y) = \frac{\cot x \cot y \mp 1}{\cot y \pm \cot x}$ $\sin x + \sin y = 2 \sin \frac{x+y}{2} \cos \frac{x-y}{2}$ $\cos x + \cos y = 2 \cos \frac{x+y}{2} \cos \frac{x-y}{2},$ $\sin x - \sin y = 2 \cos \frac{x+y}{2} \sin \frac{x-y}{2},$ $\cos x - \cos y = -2 \sin \frac{x+y}{2} \sin \frac{x-y}{2}$ <p>Identities related to <math>\sin 2x</math>, <math>\cos 2x</math>, <math>\tan 2x</math>, <math>\sin 3x</math>, <math>\cos 3x</math> and <math>\tan 3x</math>.            General solutions of trigonometric equations of the type  <math>\sin \theta = \sin \alpha</math>, <math>\cos \theta = \cos \alpha</math> and <math>\tan \theta = \tan \alpha</math>.</p>		
<b>Unit-II</b>	<b>ALGEBRA</b>	<b>30</b>	<b>15</b>
	<p><b>1. Complex Numbers and Quadratic Equations</b></p> <p>Need for complex numbers, especially <math>\sqrt{-1}</math>, to be motivated by inability to solve some of the quadratic equations. Algebraic properties of complex numbers. Argand plane, polar representation of complex numbers, modulus, argument. solution of quadratic equation in complex number system.</p> <p><b>2. Linear Inequalities</b></p> <p>Linear inequalities. Algebraic solutions of linear inequalities in one variable and modulus function and their representation on the number line. Graphical solution of linear inequalities in two variables.</p> <p><b>3. Permutations and Combinations</b></p> <p>Fundamental principle of counting. Factorial <math>n</math> (<math>n!</math>). Permutations and combinations, derivation of formulae for <math>{}^n P_r</math> and <math>{}^n C_r</math> and their connections, simple applications.</p>	<p><b>13</b></p> <p><b>5</b></p> <p><b>12</b></p>	<p><b>6</b></p> <p><b>4</b></p> <p><b>5</b></p>
<b>Unit-III</b>	<b>CALCULUS</b>	<b>25</b>	<b>10</b>
	<p><b>1. Limits and Derivatives</b></p> <p>Intuitive idea of limit. Limits of polynomials and rational functions, trigonometric, exponential and logarithmic functions. Derivative introduced as rate of change both as that of distance function and geometrically. Definition of derivative, relate it to slope of tangent of the curve, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions.</p>		

**SEMESTER – II**

**SUBJECT: MATHEMATICS ( MATH )**

**FULL MARKS: 40**

**CONTACT HOURS: 80 HOURS**

**COURSE CODE : THEORY**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit-I	ALGEBRA	35	15
	<b>1. Principle of Mathematical Induction</b> Process of the proof by induction motivating the application of method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications.	7	3
	<b>2. Binomial theorem</b> History, Statement and proof of the binomial theorem for positive integral indices. Pascal's Triangle, General and middle term in Binomial expansion, Simple applications.	13	6
	<b>3. Sequence and series</b> Sequence and series. Arithmetic Progression (A.P.), Arithmetic Mean (A.M.), Geometric Progression (G.P.), Geometric Mean (G.M.) relation between A.M. & G.M., Arithmetic-Geometric Progression Series (AGP series), infinite G.P. and its sum, sum to $n$ terms of the special series $\sum x$ , $\sum x^2$ and $\sum x^3$	15	6
Unit-II	COORDINATE GEOMETRY (2D)	30	15
	<b>1. Straight lines</b> Brief recall of two dimensional geometry from earlier classes. Slope of a line and angle between two lines. Various forms of equations of a line: Parallel to Axis, Point-slope form, slope intercept form, two point form, intercept form, distance of a point from a line.	10	5
	<b>2. Conic sections</b> Sections of a Cone: circle, ellipse, parabola, hyperbola, a point, a straight line and a pair of intersecting lines as a degenerated case of conic section; Standard equation of circle, general equation of circle, Standard equations and simple properties of Parabola, Ellipse and Hyperbola.	20	10

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit-III	<b>STATISTICS AND PROBABILITY</b>	<b>15</b>	<b>10</b>
	<p><b>1. Statistics</b></p> <p>Measures of dispersion: Range, mean deviation, variance and standard deviation of ungrouped/ grouped data</p>	<b>5</b>	<b>3</b>
	<p><b>2. Probability</b></p> <p>Random experiments, outcomes, Sample spaces (set representation), Events: Occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events, Axiomatic (set theoretic) probability, connections with other theories of earlier classes. Probability of an event, probability of 'not', 'and' and 'or' events.</p>	<b>10</b>	<b>7</b>

[ Note:20 Hours reserved for Remedial classes, Tutorials and Home Assignments.]

## Course: Project for Class XI

**Full Marks: 20**

Projects should be conducted regularly throughout the year. A project notebook is to be prepared by each and every student where all the below mentioned activities should be recorded. There should be a project assessment once a year (once in Class XI and once in Class XII) where the student will be asked to do one of the activities and write it in his/her script provided for the purpose. The student should carry his/her project notebook during the assessment. A viva should also be conducted during the assessment to test the knowledge of the student regarding the project activity.

### List of Projects for Class XI

<u>Sl. No.</u>	<u>Topics</u>	<u>Activities</u>
1	Sequence and Series	To illustrate that the arithmetic mean of two different positive numbers is always greater than the geometric mean.
2	Complex Number	To interpret geometrically the meaning of $i = \sqrt{-1}$ and its integral powers.
3	Trigonometric Functions	To illustrate the values of sine and cosine functions for different angles which are multiples of $\frac{\pi}{2}$ and $\pi$ .
4	Theory of Sets	To show that the total number of subsets of a given set with 'n' number of elements is $2^n$ .
5	Theory of Sets	Theoretic Operations using Venn Diagrams.
6	Relations and Functions	To verify that for two sets A and B, $n(A \times B) = pq$ and the total number of relations from A and B is $2^{pq}$ , where $n(A) = p$ and $n(B) = q$ .
7	Limits and Derivatives	To find analytically $\lim_{x \rightarrow c} f(x) = \frac{x^2 - c^2}{x - c}$
8	Probability	To write the sample space, when a coin is tossed once, two times, three times.
9	Conic Sections	To recognize different types of conics and its parts.
10	Permutations and Combinations	To find out the number of permutations and combinations from a set of 3 different objects taking 2 at a time.

### Marks Division for the Project Assessment

<u>Sl. No.</u>	<u>Item</u>	<u>Marks</u>
1	Project Notebook	10
2	Doing and writing a project during the project assessment	5
3	Viva	5
	<b>Total</b>	<b>20</b>

# CLASS - XII

## SEMESTER – III

### SUBJECT: MATHEMATICS ( MATH )

FULL MARKS: 40

CONTACT HOURS: 100 Hours

#### COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	<b>RELATIONS AND FUNCTIONS</b>	<b>20</b>	<b>7</b>
	<b>1. Relations and Functions</b> Types of relations: Reflexive, symmetric, transitive and equivalence relations. One-to-one and onto functions, composite functions, inverse of a function.	<b>10</b>	<b>4</b>
	<b>2. Inverse Trigonometric Functions</b> Definition, range, domain, principal value branches. Graphs of inverse trigonometric functions. Elementary properties of inverse trigonometric functions.	<b>10</b>	<b>3</b>
UNIT- II	<b>ALGEBRA</b>	<b>25</b>	<b>10</b>
	<b>1. Matrices</b> Concept, notation, order, equality, types of matrices, zero matrix, identity matrix, transpose of a matrix, symmetric and skew-symmetric matrices. Addition, multiplication and scalar multiplication of matrices; properties of addition, multiplication and scalar multiplication. Simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices. Existence of non-zero matrices whose product is a 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).	<b>15</b>	<b>6</b>
	<b>2. Determinants</b> Determinant of a square matrix (upto $3 \times 3$ matrices), properties of determinants, minors, cofactors and application 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. Solutions of system of linear equations in two or three variables (having unique solution) using inverse of a matrix.	<b>10</b>	<b>4</b>

UNIT No.	TOPICS	CONTACT HOURS	MARKS
<b>UNIT-III</b>	<b>CALCULUS</b>	<b>38</b>	<b>15</b>
	<p><b>1. Continuity and Differentiability</b>            Concept of Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions, concept of exponential and logarithmic functions, Derivatives of logarithmic and exponential functions, Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives.</p> <p><b>2. Application of Derivatives</b>            Application of derivatives, Rate of change of quantities, increasing and decreasing functions, tangents and normals, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems on basic principles and real life situations.</p>	<p><b>20</b></p> <p><b>18</b></p>	<p><b>8</b></p> <p><b>7</b></p>
<b>UNIT-IV</b>	<b>PROBABILITY</b>	<b>17</b>	<b>8</b>
	Conditional Probability, Multiplication theorem on probability, independent events, total probability, Bayes' theorem, Random variable and its probability distribution. Mean and variance of a random variable.		



**SEMESTER – IV**

**SUBJECT: MATHEMATICS ( MATH )**

**FULL MARKS: 40**

**CONTACT HOURS: 80 HOURS**

**COURSE CODE : THEORY**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
Unit-I	<b>VECTORS AND THREE-DIMENSIONAL GEOMETRY</b>	<b>30</b>	<b>15</b>
	<b>1. Vectors</b> Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of a vector. 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. Definition, Geometrical Interpretation, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors.	<b>10</b>	<b>5</b>
	<b>2. Three-Dimensional Geometry</b> Introduction to 3D geometry, Coordinate axes and coordinate planes in 3D. Coordinates of a point, distance between two points, Direction cosines and direction ratios of a line joining points. Cartesian equation and vector equation of a line, skew lines, shortest distance between two lines. Angle between two lines.	<b>20</b>	<b>10</b>
Unit-II	<b>CALCULUS</b>	<b>40</b>	<b>20</b>
	<b>1. Integrals</b> Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts. Evaluation of simple integrals of the following types and problems based on them. $\int \frac{dx}{x^2 \pm a^2} \int \frac{dx}{\sqrt{x^2 \pm a^2}} \int \frac{dx}{\sqrt{a^2 - x^2}} \int \frac{dx}{ax^2 + bx + c} \int \frac{dx}{\sqrt{ax^2 + bx + c}}$ $\int \frac{px+q}{ax^2+bx+c} dx \int \frac{px+q}{\sqrt{ax^2+bx+c}} dx \int \sqrt{a^2 \pm x^2} dx \int \sqrt{x^2 - a^2} dx$ $\int \sqrt{ax^2 + bx + c} dx$ Fundamental theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.	<b>20</b>	<b>9</b>

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	<p><b>2. Applications of the Integrals</b></p> <p>Applications in finding the area under simple curves, especially lines, circles/parabolas/ ellipses (in standard form only)</p> <p><b>3. Differential Equations</b></p> <p>Definition, order and degree, general and particular solutions of a differential equation. Solution of differential equations by method of separation of variables, solutions of homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type:</p> $\frac{dy}{dx} + py = q \text{ where } p \text{ and } q \text{ are functions of } x \text{ or constants}$ $\frac{dx}{dy} + px = q \text{ where } p \text{ and } q \text{ are functions of } y \text{ or constants}$	<p><b>10</b></p> <p><b>10</b></p>	<p><b>6</b></p> <p><b>5</b></p>
<b>Unit-III</b>	<b>LINEAR PROGRAMMING</b>	<b>10</b>	<b>5</b>
	Introduction, related terminology such as constraints, objective function, optimization, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded or unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).		

[ Note:20 Hours reserved for Remedial classes, Tutorials and Home Assignments. ]

## Course: Project for Class XII

**Full Marks: 20**

Projects should be conducted regularly throughout the year. A project notebook is to be prepared by each and every student where all the below mentioned activities should be recorded. There should be a project assessment once a year (once in Class XI and once in Class XII) where the student will be asked to do one of the activities and write it in his/her script provided for the purpose. The student should carry his/her project notebook during the assessment. A viva should also be conducted during the assessment to test the knowledge of the student regarding the project activity.

### List of Projects for Class XII

<u>Sl. No.</u>	<u>Topics</u>	<u>Activities</u>
1.	Relations and Function	To verify that the relation $R$ in the set $L$ of all straight lines in a plane, defined by $R = \{(l, m): l \parallel m\}$ is an equivalence relation,
2.	Relations and Function	To demonstrate a function which is one-one but not onto.
3.	Relations and Function	To demonstrate a function which is not one-one but onto.
4.	Differential Calculus	To find analytically the limit of a function $f(x)$ at $x = c$ and also to check the continuity of the function at that point.
5.	Differential Calculus	To verify that amongst all the rectangles of the same perimeter, the square has the maximum area.
6.	Differential Calculus	To understand the concepts of absolute maximum and minimum values of a function in a given closed interval through its graph.
7.	Three-Dimensional Geometry	To explain the concept of octant by three mutually perpendicular planes in space.
8.	Three-Dimensional Geometry	To measure the shortest distance between two skew lines and verify it analytically.
9.	Probability	To explain the computation of conditional probability of a given event $A$ , when event $B$ has already occurred, through an example of throwing a pair of dice.
10.	Linear Inequalities	To verify that a given inequality of the form $ax + by + c < 0$ , $a, b > 0$ , $c < 0$ represents only one of the two half planes.

### Marks division for the Project Assessment

<u>Sl. No.</u>	<u>Item</u>	<u>Marks</u>
1.	Project Notebook	10
2.	Doing and Writing a project during the project assessment	05
3.	Viva	05
	<b>Total</b>	<b>20</b>