WEST BENGAL COUNCIL OF HIGHER SECONDARY EDUCATION
SYLLABUS FOR CLASS XI AND XII
SUBJECT: BASIC MATHEMATICS FOR SOCIAL SCIENCES (BMSS)

Course Objectives

The curriculum for 'Basic Mathematics for Social Sciences (BMSS) has been designed in response to the changing demands of society. In order to address the evolving demands of specific disciplines, the current 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 opting for Social Science, Philosophy, and Education etc:

- To develop general interest in Mathematics as a discipline
- To gain a good measure of insight and knowledge to application oriented problems (daily life problems)
- To experience the fashion of demonstrating an outcome or resolving an issue
- To use the gained information to solve practical life oriented mathematical and statistical problems
- To be able to solve practical problems by forming and solving mathematical and statistical structures associated therewith
- To develop the power of solving problems logically step by step
- To develop a sense of appreciation and respect for notable mathematicians and their contributions to mathematics
- To cultivate an optimistic outlook in order to evaluate and perform coherently

Course Outcomes

At the end of the course the students are expected to develop expertise in various areas of the subject especially in practical 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:

- To be able to develop problem solving skills and apply mathematical concepts to real life situations
- To be able to develop a mindset to collaborate with peers to solve mathematical problems
- To be able to understand the graphical representation of curves and to be able to make predictions and draw conclusions based on statistical data
- To be able to communicate mathematical ideas and solutions both verbally and in written form
- To be able to present mathematical arguments and justifications
- To be able to perform up to (at least) satisfactory level in formal evaluation
- To be able to understand the relevance of mathematics in real-world applications
- To be able to compete in the several Entrance Examinations successfully

CLASS - XI

SEMESTER – I

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 100 Hours**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	ALGEBRA	55	22
	1. Theory of Quadratic Equations: General form of quadratic equation $p(x) = 0$ [where $p(x) = ax^2+bx + c, (a \neq 0)$ is a polynomial in x of degree 2, $a, b, c \in R$.]; Zeros of a polynomial $p(x)$, also known as the roots of the polynomial equation $p(x) = 0$, To find the solutions/roots of quadratic equations with rational coefficients by middle-term factorization, the method of perfect squares and by Sridharacharya's method(statement only), Discriminant, Nature of roots [The case of discriminant less than 0 should be excluded], Relation between roots and coefficients [namely $\alpha + \beta = -\frac{b}{a}$, $\alpha\beta = \frac{c}{a}$ $(a \neq 0)$]; Some simple cases to find the values of $\frac{1}{\alpha}+\frac{1}{\beta}$, $\alpha^2 + \beta^2$, $\alpha^3 + \beta^3$ etc.	20	8
	2. Some Important Series: Inductive way of verification of the following formulae: $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$, $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$, $\sum_{i=1}^{n} i^3 = (\frac{n(n+1)}{2})^2$ [Principle of Mathematical Induction is not necessary], Applications of these formulae for some given positive integer	15	6
	3. Laws of Indices	10	4
	4. Logarithm	10	4
UNIT-II	Trigonometry	15	6
	1. Trigonometric ratios; Trigonometric ratios of $0^o, 30^o, 45^o, 60^o, 90^o$; Trigonometric identities like $sin^2x + cos^2x = 1$ and other identities from trigonometric ratios; Complementary angles and supplementary angles and the values of $\sin x, \cos x, \tan x$	15	6

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	for $x = 120^o, 135^o, 150^o, 180^o$etc.		
UNIT-III	Logical Reasoning	15	6
	1. Number series coding and decoding and odd man out 2. Direction Tests 3. Seating Arrangements 4. Blood relations	15	6
UNIT-IV	Theory of Sets	15	6
	Definition of set, Representation of sets: Roster form, Set-builder form, Some types of sets: empty set, singleton sets, universal set, finite sets, infinite sets[for infinite sets examples only, such as $\mathbb{N}$ (set of natural numbers), $\mathbb{W}$ (set of whole numbers), $\mathbb{Z}$ (set of integers), $\mathbb{Q}$ (set of rational numbers), $\mathbb{R}$ (set of real numbers)], Cardinality of finite sets; Set relation: Subset, Superset (Example:$\mathbb{N} \subseteq \mathbb{W}$), Proper subset (Example: $\mathbb{N} \subset \mathbb{W}$), Special Thinking: A$\subset B \Rightarrow$A$\subseteq B$ but converse is not necessarily true (examples only);	15	6

SEMESTER – II

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 80 HOURS**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	ALGEBRA	20	10
	1. Permutations and Combinations: Factorial of any natural number, $0! = 1(axiom)$; $n_{P_r} = \frac{n!}{(n-r)!}$ $(0 \leq r \leq n;\ r, n \in \mathbb{W})$; Very simple problems for linear permutation (circular permutation should be excluded). $n_{C_r} = \frac{n!}{r!(n-r)!}$ $(0 \leq r \leq n;\ r, n \in \mathbb{W})$, $n_{C_r} = n_{C_{n-r}}, n_{C_{r-1}} + n_{C_r} = n+1_{C_r}$ (approach by Including or excluding particular item): use of these formulae for solving simple problems [Inductive method of learning the formulae is to be encouraged. Principle of Mathematical Induction is not necessary] Problems with repetitions; Restricted permutations (simple problems only); Restricted combinations (simple problems only); Problems on dice and cards	10	5
	5. Binomial Theorem: Formula of general term; Statement of Binomial theorem for positive integral index (proof is not required); Idea of Pascal triangle; Term independent of one term in the expansion; Middle term(s) formulae in the expansion of $(x+a)^n$, where *n* is a positive integer	10	5
UNIT-II	COORDINATE GEOMETRY (2D)	20	10
	Idea of rectangular Cartesian coordinate system (Recapitulation only, no questions for examination); Inclination and slope/gradient of a straight line; Distance formula between two points in a plane; Section formula (mid- point coordinate calculation), co-ordinates of centroid	8	4

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	of a triangle slope: $m = \frac{y_2 - y_1}{x_2 - x_1}$, for a straight line passing through two distinct points $(x_1, y_1), (x_2, y_2)$, Equation to Straight line and its different forms: $ax + by + c = 0$, $y = mx + c$, Intercept form: $\frac{x}{a} + \frac{y}{b} = 1$ (not passing through origin), Slope-point form: $y - y_1 = m(x - x_1)$ and simple applications	12	6
UNIT-III	Theory of Sets	20	10
	Important Theorem (statement only): Null set is considered as a subset of any set; Power set of a finite set and its cardinality(verification with sets with cardinality ≤ 4); Set operations: Union, Intersection, Difference, Symmetric Difference, and Complement of a set in the universal set, Notion of disjoint sets; Venn Diagram; Some Important Properties (excluding proofs): Commutative property for Union and Intersection of sets, Distributive property of Union over Intersection and Intersection over Union for sets, Verification of the above with Venn diagram and for finite sets(with cardinality ≤ 6), De Morgan's Laws(excluding proof) and verification with sets (with cardinality ≤ 6) Inclusion and Exclusion theorem of set theory(Cardinality theorem) for two sets and three sets; Simple problems including word problems using this theorem; Cartesian product of two finite sets, Ordered pair; Cardinality of Cartesian product of two finite sets Relation: Definition, inverse relation, simple applications Introducing mapping or functions through diagrams, Acquaintance of Mapping as a particular relation and giving the algebraic form(where possible), Idea of injectivity and surjectivity through diagrams and relation, identification of domain, co-domain an range of a function	20	10
UNIT-IV	Limits and Derivatives	20	10
	Types of functions (polynomial functions, rational functions, exponential functions, logarithmic functions and functions like $f(x) =$	10	5

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	$\|x-a\|$, a is an arbitrary constant), graphs of these functions, Idea of limit; Difference between Right hand limit and Left hand limit. Limit formulae: $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}, n\in\mathbb{Q}$, $\lim_{x\to 0}\frac{e^x-1}{x}=1$, $\lim_{x\to 0}\frac{\log_e(1+x)}{x}=1$; Simple problems using these formulae. Representation of a limit of a function like $\lim_{x\to a} f(x)$, limit of addition, subtraction, product and division of two functions Derivative as a rate of change of measure (First principle to calculate derivative is excluded); Differentiation formulae: For an arbitrary constant, $\frac{dc}{dx}=0$ $\frac{dx^n}{dx}=nx^{n-1}, n\in\mathbb{Q}$, $\frac{de^x}{dx}=e^x$, $\frac{d\log_e x}{dx}=\frac{1}{x}$, $\frac{da^x}{dx}=a^x\log_e a\ (a>0)$; Chain rule; Simple problems using these formulae	10	5

[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

Sl. No.	Topics	Activities
1.	Theory of sets	Evaluation of H.C.F. and L.C.M. of two or three numbers using Venn diagrams
2.	Theory of quadratic equation	For the quadratic equation $ax^2 + bx + c = 0, a \neq 0$, to prove that sum of the roots is equal to $\frac{-b}{a}$ and product of the roots is equal to $\frac{c}{a}$ without using Sridharacharya's formula; Forming of three quadratic equations having roots (i) as integers for the first equation, (ii) as conjugate irrational numbers for the second equation, (iii) as proper fractions for the third equation, to verify the above mentioned formulae
3.	Combinations	Derivation of the formula $\boldsymbol{n_{C_{r-1}} + n_{C_r} = n + 1_{C_r}}$ and verification of this formula for at least three pairs positive integers
4.	Trigonometry	The key source of the trigonometric identities, namely $\boldsymbol{sin^2x + cos^2x = 1, tan^2x + 1 = sec^2x}$, $\boldsymbol{cot^2x + 1 = cosec^2x}$ as the Pythagoras theorem for right angled triangle
5.	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 $n(B) = q$
6.	Limits and Derivatives	Evaluating $\lim_{x\to c} \frac{x^2-c^2}{x-c}$, $\lim_{x\to c} \frac{x^3-c^3}{x-c}$, $\lim_{x\to c} \frac{x^4-c^4}{x-c}$, and inductive learning of the generalized formula $\lim_{x\to c} \frac{x^n-c^n}{x-c}$ for integer *n*

Marks division for the Project Assessment

Sl. No.	Item	Marks
1.	Project Notebook	10
2.	Doing and Writing a project during the project assessment	05
3.	Viva	05
	Total	**20**

CLASS - XII

SEMESTER – III

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 100 Hours**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	Algebra	30	12
	1. Arithmetic progressions and sequences: Idea through examples, formulae for general term, sum of the first n terms and related simple problems	12	5
	2. Geometric progression and sequences: Idea through examples, formulae for general term, sum of the first n terms and simple problems	12	5
	3. Concept of arithmetic mean and geometric mean of positive numbers, simple problems and simple applications on AM $\geq$ GM	6	2
UNIT- II	Mathematical Reasoning	10	4
	Statement, truth value, truth table, tautology, contradiction in mathematical reasoning OR ($P \vee Q$), AND ($P \wedge Q$), NOT ($\sim P$). IF THEN ($P \rightarrow Q$), IF AND ONLY IF ($P \leftrightarrow Q$) statements (where P and Q are two statements), and their truth tables and simple applications	10	4
UNIT-III	Statistics	20	8
	Measure of Central Tendency (Mean, Median, Mode for discrete data and grouped data); Arithmetic mean (A.M.)and geometric mean(G.M.) for two positive numbers; A.M.$\geq$G.M.(verification only)	20	8
UNIT-IV	Coordinate Geometry	40	16
	1. Two dimensional geometry: Circle: Different forms: $x^2 + y^2 = r^2$,	20	8

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	$(x-a)^2+(y-b)^2=r^2$, $x^2+y^2+2gx+2fy+c=0$, Determining Centre, Radius etc., Simple problems Parabola: Different forms: $y^2=4ax$,$x^2=4ay$, geometrical interpretations, Determining Focus, Directrix, Axis and Length of Latus Rectum of a Parabola; Simple problems **2. Three dimensional geometry:** Developing it as an extension of two dimensional geometry, idea of rectangular coordinate system(X-axis, Y-axis, Z-axis), distance formula between two points, section formula, simple applications, coordinates of the centroid of a triangle in space	20	8

SEMESTER – IV

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 80 HOURS**

COURSE CODE: THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	Algebra	24	12
	1. Matrix-I Theory of Matrices (order up to 3×3) Idea of rows and columns of a matrix, idea of equal matrices, null matrix, square matrix, diagonal matrix, scalar matrix, identity matrix, Transpose of a matrix Algebra of matrices: addition, subtraction, multiplication by a scalar and multiplication of matrices	6	3
	2. Determinants Solving system of linear equations in two or three variables using Cramer's rule (number of independent equations is same as number of variables), minors and cofactors of an element in a determinant	8	4
	3. Matrix-II Adjoint of a matrix, singular and non-singular matrices, Inverse of a non-singular matrix of order 2×2, Solution of system of two independent linear equations of two variables using matrix inversion method	6	3
	4. Linear inequalities Basic idea and location of region represented by a linear in-equation in one or two variable(s) with respect to the graph of the corresponding equation (hand drawn graph on plain paper)	4	2

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-II	**CALCULUS**	**30**	**15**
	1. Continuity- by definition: $\lim_{x\to a^+} f(x) = \lim_{x\to a^-} f(x) = f(a)$. Differentiation (up to second order), simple problems, maxima and minima(local)- related to the problems involving marginal cost, demand function, cost function etc., basic idea of slope of a tangent to a curve at some point using derivative, simple problems	**8**	**4**
	1. Integration **Integration as an operation just opposite process of differentiation;** **Simple problems using formulae:** **$\int x^n\,dx = \frac{x^{n+1}}{n+1} + c(n \neq -1)$,** **$\int \frac{1}{x}dx = \log_e\lvert x\rvert + c$, $\int e^x\,dx = e^x + c$, integration by parts (excluding trigonometric functions), statement of fundamental theorem of integral calculus, definite integration – simple problems only**	**8**	**4**
	2. Application of integral calculus **Finding area bounded by the plane curves- straight lines, parabola**	**6**	**3**
	3. Differential Equations **Definition of differential equations, order and degree of a differential equation, formation of a differential equation for simple cases, solving differential equations on simple problems based on algebraic functions using variable separation technique, homogeneous differential equation, differential equation of the form like $\frac{dy}{dx} = f(ax + by + c)$**	**8**	**4**
UNIT-III	**Probability and statistics**	**16**	**8**
	1. Probability **Important terminology: random experiment, sample space,**	**8**	**4**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	events, simple event, compound event , mutually exclusive events, collectively exhaustive events, equally likely events (regarding the number of sample points), classical definition of probability and related problems Conditional probability- idea of independent events: Idea of probability distribution, Formation of distribution function from statistical approach – very simple cases only: Random variable and its probability distribution, mean and variance of a random variable for discrete case from given distribution 2. Statistics Idea of bivariate data: calculation of covariance and correlation coefficient; Geometric point of view of correlation coefficient	8	4
UNIT-IV	LINEAR PROGRAMMING	10	5
	Simple examples of Linear Programming Problems, Idea of convex set: Objective function, constraints, feasible solution, convex set of solutions, corner points of solution set(region): Maximization problem, minimization problem; Solving linear programming problem by graphical method (Two variable cases, feasible solution cases)	10	5

[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

Sl. No.	Topics	Activities
1.	Arithmetic progression	By using the notion of arithmetic progression to establish (i) $1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$ (ii) Sum of the first *n* odd positive integers is a perfect square for any positive integer *n*
2.	Geometric Progression	Algebraic derivation of A.M. is greater than equal to G.M. for sets of two and four positive real numbers. And use of this fact for at least two problems
3.	Statistics	Representation of geometric mean of two positive numbers geometrically and hence proves geometrically that A.M. is greater than equal to G.M. for two positive numbers Evaluation the criteria for equality
4.	Calculus	Study of continuity of modulus functions graphically. Verification of those ideas by definition of continuity, Posing two functions one of his continuous and other is not at o point of the domain
5.	Calculus	Difference between global and local optimum values, considering the function $f(x) = x + \frac{1}{x}$ one can see that the local maximum is less than the local minimum.
6.	Probability	Posing a particular random experiment and considering two particular events A and B, which are independent, it is to be proved that the events (i) A^c, B; (ii)A, B^c; (iii) A^c, B^c by evaluating the actual numerical values of the probabilities of the respective events.
7.	Probability	To write the sample space, when a coin is tossed once, two times, three times. If X stands for the number of heads then find the all possible values of X along with the corresponding probabilities for above three cases.

Marks division for the Project Assessment

Sl. No.	Item	Marks
1.	Project Notebook	10
2.	Doing and Writing a project during the project assessment	05
3.	Viva	05
	Total	**20**