MATHEMATICS

CLASS - XI

Time : 3 Hours *100 Marks*

Units	Unitwise Weightage	Marks	Periods
I.	**Sets, Relations and Functions [29 marks]**		
	1. Sets, Relations and Functions	13	23
	2. Trigonometric Functions	16	29
II.	**Algebra [37 marks]**		
	1. Complex Number, Quadratic Equations and Linear Inequalities	13	23
	2. Permutations, Combinations, Mathematical Induction and Binomial Theorem	15	27
	3. Sequence and Series	9	16
III.	**Co-ordinate Geometry [13 marks]**		
	1. Straight Lines	6	11
	2. Circle, Conic Section and Introduction to Three-dimension Geometry	7	13
IV.	**Calculus [6 marks]**		
	Limits and Derivatives	6	11
V.	**Mathematical Reasoning [3 marks]**	3	5
VI.	**Statistics and Probability [12 marks]**	12	22
	Total =	**100**	**180**

Unit-I: Sets, Relations and Functions [29 marks]

1. Sets

Sets and their representations, Finite and infinite sets, Empty set, Equal sets, Subsets, Subsets of the set of real numbers, especially intervals (with notations), Power sets, Universal set, Venn diagrams, Complements of a set, Operation on sets (union, intersection and difference of sets).

2. Relations and Functions

Ordered pairs, Cartesian product of sets, Number of elements in the Cartesian product of two finite sets. The product sets $R \times R$ (or R^2) and $R \times R \times R$ (or R^3) where R is the set of real numbers.

Relation from one set to another, Domain and range of a relation. Function as a special kind of relation from one set to another. Domain, Co domain and range of a function. Diagramatic (Pictorial) representation of a function. Real valued function of a real variable and their domain and range. Some specific functions and their graphs including constant, identity, polynomial, rational, modulus, signum and greatest integer function. Sum, difference, product and quotients of real valued functions.

3. Trigonometric functions

Positive and negative angles, Measurement of angles, Sexagesemal system and circular system, Conversion from one system to another. Definition of trigonometric functions with the help of unit circle. Signs of trigonometric functions (Quadrant Rule). The identity $\sin^2 x+\cos^2 x = 1$. Graphs of trigonometric functions. To express $\cos(x \pm y)$ and $\sin(x \pm y)$ in terms of $\sin x$, $\sin y$, $\cos x$ and $\cos y$. Deduction of other addition and subtraction formulae. To express $\sin x \pm \sin y$ and $\cos x \pm \cos y$ as products. Identities related to multiple and submultiple angles. General solution of trigonometric equations. Sine and Cosine formulae in a triangle and their simple applications.

Unit-II: Algebra **[37 marks]**

1. Complex numbers and Quadratic Equations.

Need for complex numbers. The fundamental imaginary $\sqrt{-1}$ unit (or i). Complex numbers in the form of a + ib, Real and imaginary parts of a complex number, Complex conjugates, Representation of a complex number by a point in a plane, Argand diagram, Modulus and argument (or amplitude) of a complex number, Algebra of complex numbers, Polar representation of a complex number. Statement of Fundamental Theorem of Algebra, Solution of quadratic equation in the complex number system. Square root of a complex number.

2. Linear Inequalities.

Linear inequalities, Algebraic solution 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.

3. Premutations and Combinations.

Fundamental principle of counting, Factorial n where n is a non-negative integer, Permutation as an arrangement, Meaning of ${}^nP_r$ or $P(n,r)$, Permutations in which things (i) may be repeated (ii) are not all different. Combination, Meaning of ${}^nC_r$ or $C(n,r)$. Important properties of ${}^nP_r$ and ${}^nC_r$. Applications of permutations and combinations.

4. Mathematical Induction.

Principles of Mathematical Induction and its applications.

5. Binomial Theorem.

Bionomial theorem for a positive integral index. Pascal's triangle, General term, Middle terms, Equidistant terms, properties of Binomial co-efficients, Simple Applications.

6. Sequence and Series.

Sequence and Series, Arithmetic Progression (A.P.), Arithmetic Mean (A.M.) Insertion of arithmetic means between two numbers, Geometric progression (G.P.), First term, Common ratio, general term, sum to n terms of a G.P., Geometric Mean (G.M.), Insertion of geometric means between two numbers. Relation between A.M. and G.M. sum to n terms of special series $\sum n$, $\sum n^2$ and $\sum n^3$. Infinite G.P. and its sum.

Unit-III: Coordinate Geometry [13 marks]

1. Straight lines :

Brief recall of 2D geometry from earlier classes. Shifting of origin. Slope of a line and angle between two lines, various forms of equation of a straight line, Parallel to axes, slope-intercept form, point-slope form, two point form, intercepts form and normal form. General equation of first degree in two variables represents a straight line. Reduction of the general equation of a line to different forms. System of lines passing through the point of intersection of two lines. Distance of a point from a line.

2. Circle :

Definition, Equation of circle with given centre and radius, General equation of a circle, its centre and radius. Equation of a circle when the end points of a diameter are given. Interior and exterior of a circle.

3. Conic section :

Sections of a cone. Definition of a conic section. Equation of a conic section having given eccentricity, focus and directrix. Standard equation and simple properties of parabola, ellipse and hyperbola.

4. Introduction to Three-dimentional Geometry :

Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points and section formula.

Unit-IV: Calculus [06 marks]

Limits and derivatives :

Idea of limit, Left hand and right hand limits, conditions for existence of limit. Fundamental Theorem on limit (statement only) and standard limits

(i) $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$ (with proof)

iii) $\lim_{x\to 0}\frac{e^x-1}{x}=1$ (with proof)

(ii) $\lim_{x\to 0}\frac{\sin x}{x}=1$ (with proof)

iv) $\lim_{x\to 0}\frac{\lim(1+x)}{x}=1$ (with proof)

Derivative introduced as rate of change both as that of distance function and geometrically. Definition of derivative, relate it to slope of tangent to a curve; Derivative of sum, difference, product and quotient of functions. Derivative of polynomial and trigonometric functions.

Unit-V: Mathematical Reasoning : [03 marks]

Mathematically acceptable statements. Basic connecting words or phrases. Simple and compound statements. Truth tables. Understanding of "and", "or" "implies", "implies by", "if and only if", "there exists", "for all" and their use through variety of examples related to Mathematics. Negation of a statement. Contra positive and converse of an implication.

Validating statement involving connecting words. Checking the truth of a statement by method of contradiction.

Unit-VI: Statistics and Probability **[12 marks]**

1. Statistics :

Measure of dispersion, Mean deviation, Variance and Standard deviation of ungrouped/ grouped data. Analysis of frequency distribution with equal means but different variances.

2. Probability :

Random experiment, Outcomes, sample spaces (set representation), Events, occurrence of events, "not", "and" & "or" events, exhaustive events, mutually exclusive events, Axiomatic (set theoretic) probability, connections with the theories of earlier classes. Probability of an event, probability of "not", "and" & "or" events.

Appendix :

1. Infinite series : Exponential and Logarithmic series.

2. Mathematical Modelling :

Consolidating the understanding developed upto Class X. Focus on modelling problems related to real life (like environment, travel, etc.) and connecting with other subjects of study where many constraints may really need to be ignored, formulating the model, looking for solutions, interpreting them in the problems situation and evaluating the model.

PRESCRIBED TEXTBOOK :

Mathematics (Textbook for Class XI)
Published by : The Council of Higher Secondary Education, Manipur with copy right from the NCERT, New Delhi.

REFERENCE BOOKS :

1. A Textbook of Mathematics Book-I for Class XI
By : S.N. Chhibber, G.D. Dhall & J.C. Nijhawan.
Published by : Macmillan Publishers India Pvt. Ltd.

2. Modern's abc of Mathematics for Class XI
By : J.P. Mohindru
Published by : Modern Publishers, Jalandhar.

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DESIGN OF QUESTION PAPER

Subject : MATHEMATICS
Class : XI
Time : 3 Hours
Full Marks : 100

I — WEIGHTAGE TO OBJECTIVE

Objectives	Marks	percentage
Knowledge	25	25
Understanding	55	55
Application	15	15
Skill	05	05
Total :	**100**	**100**

II — WEIGHTAGE TO FORM OF QUESTIONS:

Form of Questions	No. of question	Time (in minute)	Marks	percentage
Essay/Long Answer (E/LA)	6	65	36	36
Short Answer (SA-I)	8	58	32	32
Short Answer (SA-II)	9	32	18	18
Very Short Answer (VSA)	10	18	10	10
MCQ	4	7	4	4
Total:	**37**	**180 m**	**100**	**100**

III — WEIGHTAGE TO CONTENT:

		CONTENTS	Marks	percentage
I	1.1	Sets, Relations and Functions	13	13
	1.2	Trigonometric functions	16	16
II	2.1	Complex Numbers, Quadratic Equations and Linear Inequalities	13	13
	2.2	Permutations & Combinations, Mathematical Induction and Binomial Theorem	15	15
	2.3	Sequence and Series	9	9
III	3.1	Straight lines	6	6
	3.2	Circle, Conic Section and Introduction to Three-dimensional Geometry	7	7
IV	4.1	Limits and Derivatives	6	6
V	5.1	Mathematical Reasoning	3	3
VI	6.1	Statistics and Probability	12	12
		Total :	**100**	**100**

IV — SCHEME OF SECTIONS: Nil

V — SCHEME OF OPTIONS: Internal option in Essay type only may be given

VI — DIFFICULTY LEVEL:

Difficulty:	20%
Average	50%
Easy:	30%

Abbreviation : K(Knowledge), U(Understanding), A(Application), S(Skill), E(Essay Type), SA (Short Answer Type), VSA (Very Short Answer Type), O(Objective Type), MCQ (Multiple Choice Question).

MATHEMATICS

CLASS - XII

One Paper *Time : 3 Hours* *100 Marks*

Units	Unitwise Weightage	Marks	Periods
I.	**Relations and Functions [10 marks]**		
	1. Relations and Functions	5	9
	2. Inverse Trigonometric Functions	5	9
II.	**Algebra [13 marks]**		
	1. Matrices	7	13
	2. Determinants	6	11
III.	**Calculus [44 marks]**		
	1. Continuity and Differentiability	10	18
	2. Applications of Derivatives	8	14
	3. Integrals	14	26
	4. Applications of Integrals	4	7
	5. Differential Equations	8	14
IV.	**Vectors and Three Dimensional Geometry [17 marks]**		
	1. Vectors	8	14
	2. Three dimensional Geometry	9	16
V.	**Linear Programming [06 marks]**	6	11
VI.	**Probability [10 marks]**	10	18
	Total :	**100**	**180**

Unit-I: Relations and Functions [10 marks]

1. Relations and Functions :

Relation in a set. Types of relations, reflexive, symmetric, transitive and equivalence relations. Types of functions, injective (one-one), subjective (onto), bijective functions. Inverse of a function, Composite of functions. Binary operations.

2. Inverse Trigonometric Functions :

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

Unit-II: Algebra **[13 marks]**

Matrices :

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) Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists : (Here all matrices will have real entries).

Determinants :

Determinant of a square matrix (upto 3x3 matrices), properties of determinants, 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 **[44 marks]**

1. Continuity and Differentiability :

Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function. Concept of exponential and logarithmic functions and their derivatives. Logarithmic differentiation. Derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretations and simple applications.

$\int \frac{dx}{x^2 \pm a^2}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{dx}{\sqrt{a^2 - x^2}}, \int \frac{dx}{ax^2 + bx + c}, \int \frac{dx}{\sqrt{ax^2 + bx + c}}$,

2. Applications of Derivatives :

Applications of derivatives : rate of change, increasing/decreasing functions, tangents & normals, approximation, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

3. Integrals :

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

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

$$\int \sqrt{ax^2+bx+c}\,dx, \int (px+q)\sqrt{ax^2+bx+c}\,dx$$

to be evaluated.

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

4. Applications of Integrals :

Application in finding the area under simple curves, especially lines, areas of circles, parabolas/ellipses (in standard form only), area under the curves $y = \sin x$, $y = \cos x$, etc. area between the two above said curves (the region should be clearly identifiable).

5. 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 equations of the type :

$\frac{dy}{dx} + p(x)y = q(x)$, where $p(x)$ and $q(x)$ are functions of x and

$\frac{dx}{dy} + p(y) = q(y)$, where $p(y)$ and $q(y)$ are functions of y.

Unit-IV: Vectors and Three dimensional Geometry [17 marks]

1. Vectors

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. Scalar triple product.

2. Three-dinensional Geometry :

Direction cosines, direction ratios. Cartesian and Vector equation of a line, Coplanar lines, 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. Conditions for perpendicularity and parallelism. Distance of a point from a plane.

Unit-V: Linear Programming [6 marks]

1. Linear Programming :

Introduction, definition of related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution of problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (upto three non-trivial constraints).

Unit-VI: Probability [10 marks]

1. Probability :

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

Appendix :

1. Proofs in Mathematics :

Through a variety of examples related to mathematics & already familiar to the learner, bring out different kinds of proofs : direct, contrapositive, by contradiction, by counter example.

2. Mathematical Modelling :

Modelling real-life problems where many constraints may really need to be ignored (continuing from Class XI). However, now the models concerned would use techniques/results of matrices, calculus and linear programming.

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Class : XII
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Full Marks : 100

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	Application				15	15
	Skill				05	05
				Total :	**100**	**100**
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	Form of Questions		**No. of question**	**Time (in minute)**	**Marks**	**Percentage**
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	Total:		**37**	**180 m**	**100**	**100**
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	CONTENTS				**Marks**	**Percentage**
	I	1.1	Relations and Functions		5	5
		1.2	Inverse Trigonometric Functions		5	5
	II	2.1	Matrices		7	7
		2.2	Determinants		6	6
	III	3.1	Continuity and Differentiability		10	10
		3.2	Applications of Derivatives		8	8
		3.3	Integrals		14	14
		3.4	Applications of Integral		4	4
		3.5	Differential Equation		8	8
	IV	4.1	Vectors		8	8
		4.2	Three -dimensional Geometry		9	9
	V	5.1	Linear Programming		6	6
	VI	6.1	Probability		10	10
				Total :	**100**	**100**
IV	**SCHEME OF SECTIONS: Nil**					
V	**SCHEME OF OPTIONS: Internal option in Essay type only may be given**					
VI	**DIFFICULTY LEVEL:** Difficulty: 20% Average 50% Easy: 30%					

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