

**CLASS - XI**  
**MATHEMATICS**

**Time: 3 Hrs**

**Theory: 80 Marks**  
**Internal Assessment: 20 Marks**  
**Total: 100 Marks**

1. All the questions are compulsory.
2. The question paper consists of 36 questions divided into 4 sections A,B,C,and D.
3. Section A comprises of 20 questions of 1 mark each. Section B comprises of 6 questions of 2 marks each. Section C comprises of 6 questions of 4 marks each. Section D comprises of 4 questions of 6 marks each.
4. There is no overall choice. However, an internal choice has been provided in one question of 2 marks, two questions of 4 marks each and three questions of 6 marks each. You have to attempt only one of the alternatives in all such questions.
5. Use of calculators is not permitted.

Sr. No	Unit	Topic	Q. Carrying 1-Marks	Q. Carrying 2-Marks	Q. Carrying 4-Marks	Q. Carrying 6-Marks	Total Marks
1	SET AND FUNCTION	Sets	1	-	1	-	05
2		Relations & Functions	2	-	1	-	06
3		Trigonometric Functions	2	-	1	1	12
4	ALGEBRA	Principle of Mathematical Induction	-	-	1	-	04
5		Complex numbers & Quadratic Equations	2	-	-	1	08
6		Linear Inequalities	1	-	-	1	07
7		Permutations & Combinations	2	1	-	-	04
8		Binomial Theorem	1	1	-	-	03
9		Sequence & Series	2	1	-	-	04
10	CO-ORDINATE GEOMETRY	Straight lines	1	-	1	-	05
11		Conic Sections	1	1	-	-	03
12		Introduction to Three- dimensional Geometry	-	1	-	-	02
13	CALCULUS	Limits & Derivatives	1	-	1	-	05

14	MATHEMATICAL REASONING	Mathematical Reasoning	2	-	-	-	02
15	STATISTICS AND PROBABILITY	Statistics	1	1	-	-	03
16		Probability	1	-	-	1	07
<b>Total Questions</b>			<b>20</b>	<b>6</b>	<b>6</b>	<b>4</b>	<b>36</b>
<b>Total Marks</b>			<b>20</b>	<b>12</b>	<b>24</b>	<b>24</b>	<b>80</b>

## SYLLABUS

### Unit-I: Sets and Functions

#### 1. Sets

Sets and their representations. Empty set. Finite and Infinite sets. Equal sets. Subsets, Subsets of a 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.

#### 2. Relations & Functions

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 (upto  $R \times R \times R$ ).

Definition of relation, pictorial diagrams, domain, co-domain and range of a relation. Function as a special type of relation. 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, signum, exponential, logarithmic and greatest integer functions, with their graphs. Sum, difference, product and quotients of functions.

#### 3. Trigonometric Functions

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 and range of trigonometric functions and their graphs. Expressing  $\sin(x \pm y)$  and  $\cos(x \pm y)$  in terms of  $\sin x$ ,  $\sin y$ , and their single applications. Deducing the identities like following :

$$\tan(X \pm Y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y}, \cot(x \pm y) = \frac{\cot x \cdot \cot y \mp 1}{\cot y \pm \cot x}$$

$$\sin \alpha \pm \sin \beta = 2 \sin \frac{1}{2}(\alpha \pm \beta) \cos \frac{1}{2}(\alpha \mp \beta)$$

$$\cos \alpha + \cos \beta = 2 \cos \frac{1}{2}(\alpha + \beta) \cos \frac{1}{2}(\alpha - \beta)$$

$$\cos \alpha - \cos \beta = 2 \sin \frac{1}{2}(\alpha + \beta) \sin \frac{1}{2}(\alpha - \beta)$$

Identities related to  $\sin 2x$ ,  $\cos 2x$ ,  $\tan 2x$ ,  $\sin 3x$ ,  $\cos 3x$  and  $\tan 3x$ . General solution of trigonometric equations of the type  $\sin y = \sin a$ ,  $\cos y = \cos a$  and  $\tan y = \tan a$ .

## Unit-II: Algebra

### 4. Principle of Mathematical Induction

Process of the proof by induction, motivating the application of the method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications.

### 5. Complex Numbers and Quadratic Equations

Need for complex numbers, especially  $\sqrt{-1}$ , to be motivated by inability to solve some of the quadratic equations. Algebraic properties of complex numbers. Argand plane and polar representation of complex numbers. Statement of Fundamental Theorem of Algebra, solution of quadratic equations (with real coefficients) in the complex number system. Square root of a complex number.

### 6. 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. Graphical method of finding a solution of system of linear inequalities in two variables.

### 7. Permutations and Combinations

Fundamental principle of counting. Factorial  $n(n!)$  Permutations and combinations, derivation of Formulae for  $nP_r$  and  $nC_r$  and their connections, simple applications.

### 8. Binomial Theorem

History, statement and proof of the binomial theorem for positive integral indices. Pascal's triangle, General and middle term in binomial expansion, simple applications.

### 9. Sequence and Series

Sequence and Series. Arithmetic Progression (A. P.). Arithmetic Mean (A.M.) Geometric Progression (G.P.), general term of a G.P., sum of  $n$  terms of a G.P., infinite G.P. and its sum, geometric mean (G.M.), relation between A.M. and G.M. Formulae for the following special sums.

$$\sum_{k=1}^n k \quad \sum_{k=1}^n k^2 \quad \text{and} \quad \sum_{k=1}^n k^3$$

## Unit-III Coordinate Geometry

### 10. Straight Lines

Brief recall of two dimensional geometry from earlier classes. Shifting of origin. 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 and normal form. General equation of a line. Equation of family of lines passing through the point of intersection of two lines. Distance of a point from a line.

### 11. Conic Sections

Sections of a cone: circles, ellipse, parabola, hyperbola, a point, a straight line and a 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.

### 12. Introduction to Three-dimensional Geometry

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

### Unit-IV: Calculus

### 13. Limits and Derivatives

Derivative introduced as rate of change both as that of distance function and geometrically. Intuitive idea of limit. Limits of polynomials and rational functions trigonometric, exponential and logarithmic functions. 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.

### Unit-V: Mathematical Reasoning

### 14. 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 among contradiction, converse and contrapositive.

### Unit-VI: Statistics and Probability

### 15. Statistics

Measures of Dispersion: Range, Mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances.

### 16. Probability

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.

INTERNAL ASSESSMENT	20 Marks
Mathematics Activities	10 Marks
Periodic Tests (Best 2 out of 3 tests conducted)	8 Marks
Book Bank	2 Marks

Note : For activities NCERT Lab Manual may be referred.

## Conduct of Periodic Tests

1. Periodic Test is a Pen and Paper assessment which is to be conducted by the subject teacher.
2. In the entire Academic Year, three Periodic Tests in each subject may be conducted.

- Once schools complete the conduct of all three periodic tests, they will convert the weightage of each of the three tests into ten marks each for identifying best two tests. The best two will be taken into consideration and the average of the two shall be taken as the final marks for PT.
- The school will ensure simple documentation to keep a record of performance.

### **Assessment of Activity Work:**

**Time : 2hrs**

**10 Marks**

Throughout the year any 10 activities shall be performed by the student from the activities given in the NCERT Laboratory Manual for the respective class (XI or XII) which is available on the link : <http://www.ncert.nic.in/exemplar/labmanuals.html> A record of the same may be kept by the student. An year end test on the activity may be conducted at the School Level. The weightage are as under:

- The activities and one of the projects performed by the student through out the year and record keeping : **5 marks**
- Assessment of the activity performed during the year end test: **3 marks**
- Viva-voce : **2 marks**

### **ACTIVITIES**

- To find the number of subsets of a given set and verify that if a set has  $n$  number of elements, then the total number of subsets is  $2^n$ .
- To Verify that for two sets A and B,  $n(A \times B) = pq$  and the total number of relations from A to B is  $2^{pq}$ , where  $n(A) = p$  and  $n(B) = q$ .
- To represent set theoretic operations using Venn diagrams.
- To verify distributive law for three given non-empty sets A,B and C, that is,  $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
- To identify a relation and a function.
- To distinguish between a Relation and a Function.
- To verify the relation between the degree measure and the radian measure of an angle.
- To find the values of sine and cosine functions in second, third and fourth quadrants using their given values in first quadrant.
- To prepare a model to illustrate the values of sine functions and cosine functions for different angles which are multiples of  $\frac{\pi}{2}$  and  $\pi$ .
- To plot the graphs of  $\sin x$ ,  $\sin 2x$ ,  $2\sin x$  and  $\sin \frac{x}{2}$ , using same coordinate axes.
- To interpret geometrically the meaning of  $i = \sqrt{-1}$  and its integral powers.

12. To obtain a quadratic function with the help of linear functions graphically.
13. To verify that the graph of a given inequality, say  $5x + 4y - 40 < 0$ , of the form  $ax + by + c < 0, a, b > 0, c < 0$ , represents only one of the two half planes.
14. To find the number of ways in which three cards can be selected from given five cards.
15. To construct a Pascal's Triangle and to write binomial expansion for a given positive integral exponent.
16. To obtain formula for the sum of squares of first  $n$ -natural numbers.
17. An alternative approach to obtain formula for the sum of squares of first  $n$  natural numbers.
18. To demonstrate that the Arithmetic mean of two different positive numbers is always greater than the Geometric mean.
19. To establish the formula for the sum of the cubes of the first  $n$  natural numbers.
20. To verify that the equation of a line passing through the point of intersection of two lines  $a_1x + b_1y + c_1 = 0$  and  $a_2x + b_2y + c_2 = 0$  is of the form  $(a_1x + b_1y + c_1) + \lambda (a_2x + b_2y + c_2) = 0$ .
21. To construct different types of conic section.
22. To construct a parabola.
23. An alternative method of constructing a parabola.
24. To construct an ellipse using a rectangle.
25. To construct an ellipse with given major and minor axes.
26. To construct an ellipse when two fixed points are given.
27. To explain the concept of octants by three mutually perpendicular planes in space.
28. To find analytically  $\lim_{x \rightarrow c} f(x) = \frac{x^2 - c^2}{x - c}$
29. Verification of the geometrical significance of derivative.
30. To obtain truth values of compound statement of the type  $p \vee q$  by using switch connections in parallel.
31. To obtain truth values of compound statements of the types  $p \wedge q$  by using switch connections in series.
32. To write the sample space, when a die is rolled once, twice-----.
33. To write the sample space, when a coin is tossed once, two times, three times, four times.