Mathematics - CLASS XI

Sets, Relations and Functions

Unit 1 : Sets	**Sets and their representations, Empty set, Finite & Infinite sets. Equivalent and 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. Practical problems on union and intersection of sets.**

Contents	**Learning Outcomes:**
1.1 Sets and their represent-tations	• identify sets as well defined collections. • represent sets in roster and set builder form. • identify the symbols $\in$ and $\notin$ and understand the difference between the two. • Conversion from set builder form to roster form and vice versa.
1.2 Empty Set	• identify empty sets (null sets).
1.3 Singleton Set	• Identify singleton set and frame examples.
1.4 Finite and infinite Sets	• identify finite and infinite sets; and their respective representations.
1.5 Equivalent and Equal Sets	• understand meaning of equal and equivalent sets. • differentiate between equal and equivalent sets. • determine whether the given pair of sets is equal or not.
1.6 Subsets	• identify the subsets of a given set and its symbol ( ) understand that every set has two trivial subsets - null set and the set itself. • understand the difference between a subset and proper subset.
1.7 Power Set	• identify power set as set of subsets.
1.8 Universal Set	• identify universal set and its symbol ( )
1.9 Complement of a Set	• find the complement of a subset of a given set, within a given universe.
1.10 Intervals as	• closed interval, open interval, right half open interval, left half

Subsets of R	open interval.
1.11 Venn diagrams	• represent sets using venn diagrams.
1.12 Union and Intersection of Sets	• find the intersection of sets and union of sets. show the intersection and union of sets using Venn diagrams. identify disjoint sets and its representation using venn diagram.
1.13 Difference of sets	• find the difference of sets and their representation using venn diagram.
1.14 Laws of Operations on Sets	• apply the following laws of algebra on sets: - Laws of union of sets (commutative law, associative law, idempotent law, identity law) - laws of intersection of sets - distributive laws • De Morgan's law
1.15 Properties of Complement Sets	• apply properties of complement sets.
1.16 Practical Problems on union and Intersection of Sets	• solve practical problems on union and intersection of sets. apply results and solve problems on number of elements of sets using properties like • 1) • 2) $n(C) - n(A \cap B) - n(B \cap C) - n(C \cap$
Unit 2 : Relations and Functions	Ordered pairs, Cartesian product of sets. Number of elements in the Cartesian product of two finite sets. Cartesian product of the set of all reals with itself (upto R x R x 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 & range of a function. Real valued functions, domain and range of the functions: constant, identity, linear& quadratic polynomial, rational, modulus, signum and greatest integer functions with their graphs. Sum, difference, product and quotients of functions, Even and odd function

Contents	Learning Outcomes
2.1 Ordered Pairs	• **Students will be able to:** • identify an ordered pair. • identify the equality of two ordered pairs.
2.2 Cartesian Product of Sets	identify a cartesian product of two non empty sets. identify the two sets given their cartesian product. find the union and intersection on cartesian products. find ordered triplets (R R R). identify the number of elements in the cartesian product of two finite sets. identify cartesian product of set of all real numbers with itself.
2.3 Definition of Relation	• understand relation of two sets as a subset of their cartesian product.
2.4 Arrow Diagram	pictorial representation of a relation between two sets.
2.5 Domain, Co-domain and Range of a Relation	• identify domain, co-domain and range of a relation.
2.6 Function as a Special Kind of Relation from one Set to another	identify function as a special kind of relation from one set to another. determine when a relation is a function. describe and write functional relationships for given problem situations. understand that f R A X A.
2.7 Pictorial representation of a Function	• represent functions using graphs. • to understand that every graph does not represent a function.
2.8 Domain, Co-domain and Range of a Function	identify domain, co-domain and range of a function. finding domain and range of a given function. identify even and odd functions. find specific function values find the algebra of functions covering: (f g)(x) = f(x) g(x) = g(x) f(x) (fg)(x) = f(x).g(x)

	, g(x) 0
2.9 Real valued functions and their graphs	• recognise the following real valued functions o constant function o identity function o linear function o quadratic function o polynomial function o rational function o modulus function o signum function o greatest integer function
	Student is expected to draw the graphs of the above mentioned real valued functions
Unit 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. Trigonometric functions as periodic functions, their amplitude, argument period & graph. Expressing sin $(x \pm y)$ and cos $(x \pm y)$ in terms of sin x, sin y, cos x & cos y. Deducing identities like the following : $\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y}$ $\cot(x + y) = \frac{\cot x \cot y \pm 1}{\cot y \pm \cot x}$ $\sin x + \sin y = 2 \text{ six } \frac{x+y}{2} \cos \frac{x-y}{2}$, $\cos x + \cos y = 2 \cos \frac{x+y}{2} . \cos \frac{x-y}{2}$ $\sin x - \sin y = 2 \cos \frac{x+y}{2} . \sin \frac{x-y}{2}$, $\cos x - \cos y = 2 \sin \frac{x+y}{2} . \sin \frac{x-y}{2}$ Identities related to sin 2x, cos 2x, tan 2x, sin3x, cos3x and tan3x. General solution of trigonometric equations of the type $\sin\theta = \sin\theta$, $\cos\theta = \cos\alpha$ and $\tan\theta = \tan\theta$. Proof and simple application of sine and cosine rules only, law of sine, law of cosine and their applications.

Contents	Learning Outcomes
	Students will be able to:
3.1 Positive and negative angles	identify positive and negative angles.
3.2 Measuring angles in radians and in degrees and conversion from one measure to another	• measure angles in both degrees and in radians, and convert between these measures
3.3 Definition of trigonometric functions with the help of unit circle	define trigonometric functions with the help of unit circle.
3.4 Sign of trigono-metric functions	• identify the change of signs of trigonometric functions in different quadrants.
	develop and apply the value of trigonometric functions at 0, /6, /4, /3, /2 radians and their multiples*.
	• use the reciprocal and co-function relationships to find the values of the secant, cosecant and cotangent 0, $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$ radians value of trigonometric functions at $n\pi \pm \theta$, where n is a positive integer
3.5 Domain and range of trigonometric functions	identify the domain and range of trigonometric functions.
3.6 Trigonometric functions as periodic functions, their amplitude, argument, period and graph	• identify trigonometric functions as periodic functions with sine and cosine functions having a period of 2π, tangent and cotangent functions having a period of π, secant and cosecant functions having a period of 2π.
	construct the graphs of trigonometric functions and describe their behaviour, including periodicity, amplitude, zeros and symmetry.
3.7 Trigonometric functions of sum and difference of	• express sin (x ± y) and cos (x ± y) in terms of sin x, sin y, cos x and cos y. $\tan(x \pm y) = \dfrac{\tan x \pm \tan y}{1 \mp \tan x \tan y}$

two angles	$\cot(x \pm y) = \frac{\cot x \cot y \mp 1}{\cot y \pm \cot x}$
3.8 Express sum and difference of T-Functions as the product of T-ratios	sin x 2 cos 2 cos x 2 cos 2 sin x 2 sin 2 cos x 2 sin 2 use the above identities to simplify trigonometric equations.
3.9 Identities related to sin2x, cos2x, tan2x, sin3x, cos3x and tan3x	• deduce identities related to sin 2x, cos 2x, tan 2x, sin 3x, cos 3x and tan 3x, and apply them to simplify trigonometric equations.
3.10 General solution of trigonometric equations of the type sin = sin , cos = cos and tan = tan .	find the general solution of the trigonometric equations of the type sin = sin , cos = cos and tan = tan . finding general solutions of $\cos^2\theta = \cos^2\alpha$ $\tan^2\theta = \tan^2\alpha$
3.11 Proof and simple applications of sine and cosine rules	• prove the law of sines and law of cosine.
	solve for an unknown side or angle, using the law of sines or the law of cosine.
	• apply law of sines and law of cosine in various problems.
	determine the area of a triangle or parallelogram, given the measure of two sides and the included angle.

Algebra

UNIT 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.**
Contents	**Learning Outcomes**

	Students will be able to:
4.1 Process of proof by induction	apply the principle of mathematical induction to establish the validity of a general result involving natural numbers.
4.2 Principle of mathematical induction and its applications	• application of the principle of mathematical induction in solving problems
UNIT 5: Complex Numbers and Quadratic Equations	Need for complex numbers, especially , to be motivated by inability to solve some of the quadratic equations, standard form of a complex number Algebraic properties of complex numbers, Argand plane, the modulus and conjugate of a complex number and polar representation of complex numbers Statement of Fundamental Theorem of Algebra, solution of quadratic equations in the complex number system. Squareroot of a complex number. Cube roots of unity and their properties.
Contents	**Learning Outcomes**
	Students will be able to:
5.1 Need for complex number, especially iota to be motivated by inability to solve some of quadratic equation.	• understand the need of Imaginary Quantities • understand the concept of iota and its application
5.2 Standard form of complex number	define a complex number (z = a+ib) and identify its real and imaginary parts concept of purely real and purely imaginary complex number get familiar with equality of complex numbers understand the addition and subtraction of complex numbers and its properties
5.3 Modulus and conjugate of complex number	• identify the conjugate of a complex number and familiarized with its properties identify the modulus of a complex number and familiarized with its properties
5.4 Multiplication and division of complex numbers	• understand the multiplication of complex numbers and its properties • understand the division of complex numbers and its properties • identify the multiplicative inverse or reciprocal of a complex number

5.5 Polar represent-tation of complex number	understand the polar or trigonometrical form of a complex number find the modulus of a complex number find the argument of a complex number
5.6 Argand Plane	• geometrical representation of a complex number • understand different properties of complex numbers and its representation on argand plane • solve different mathematical problems using argand plane
5.7 Statement of Fundamental theorem of algebra	get familiar with fundamental theorem of algebra
5.8 Square root of a complex number	• find the square root of a complex number
5.9 Solution of quadratic equations in the complex number system	solve the quadratic equations in the complex number system
UNIT 6: Linear and Quadratic Inequalities	Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequality in two variables. Graphical solution of system of linear inequalities in two variables. Inequalities involving modulus function. Practical problems on linear inequality, algebraic solution of quadratic inequality.
Contents	**Learning Outcomes**
6.1 Linear inequations	understand linear inequalities
6.2 Algebraic solutions of linear inequations in one variable	find algebraic solutions of linear inequalities in one variable represent the solution of linear inequalities in one variable on a number line simultaneous solution of two linear inequalities algebraically as well as on number line
6.3 Algebraic solutions of linear	find algebraic solutions of linear inequalities in two variables

inequations in two variables	
6.4 Graphical solution of linear inequations in two variables	• Solution of linear inequality in two variables and the graph of its solution set • Solution of system of linear inequalities in two variables and the graph of its solution set
6.5 Inequations solving modulus functions	inequalities involving modulus function.
	• understand wavy curve method for 2nd degree and higher degree polynomials expressed in the form (x+a)(x+b) ...... (the number of such terms corresponding to the degree of the polynomial)
UNIT 7: Permutation and Combination	Fundamental principle of counting. Factorial n. (n!) Permutations and combinations. Properties of combination, derivation of formulae and their connections, simple applications.
Contents	**Learning Outcomes**
	Students will be able to:
7.1 Fundamental principles of counting	• know the fundamental addition principles of counting and apply it to find out number of ways particular event can occur • know the fundamental multiplication principles of counting and apply it to find out number of ways particular event can occur
7.2 Factorial n (n!)	know the meaning of factorial and its symbol know how to compute factorial know how to represent product of consecutive numbers in factorial know how to represent product of consecutive numbers in factorial
7.3 Permutation	• familiarity with the meaning of permutation • derive the formulae of a linear permutation $^nP_r = \frac{n!}{n-r\,!}$ • use the formula of permutation to find other results $p(n, n) = n!$ $0! = 1$
7.4 Combinations	familiar with the meaning of combination distinction between combination and permutation derive the formulas of combination ^nC_r n
7.5 Derivation of properties of combination	• familiarity and use of properties of combination ➢ For $0 \le$ [redacted] we have $^nC_r = {}^nC_{n-r}$

	➢ If n and r are non negative integers such that $1 \le r \le n$ Then, ${}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$ ➢ If $1 \le r \le n$, then $\frac{{}^nC_r}{{}^nC_{r-1}} = \frac{n-r+1}{r}$ ➢ ${}^nC_x = {}^nC_y \Rightarrow x = y$ or, $x + y = n$ • If n is an even natural number, then the greatest of the values ${}^nC_0, {}^nC_1, {}^nC_2, \ldots\ldots, {}^nC_n$ *is* ${}^nC_{n/2}$ • use the formula of combination to find other results ${}^nC_n = {}^nC_0 = 1$
7.6 Types of permutations	linear permutations circular permutation restricted permutation permutations when particular thing is to be included everytime permutations when particular thing is never to be included permutation of objects are not all different Permutation with repetition
7.7 Simple applications	• solve the simple practical problems on permutation • solve the simple practical problems on combination
UNIT 8: Binomial Theorem :	positive integral indices. General and middle term in binomial expansion, simple applications.
Contents	**Learning Outcomes**
	Students will be able to:
8.1 Pascal's Triangle	• get familiar with the Pascal's triangle • observe different patterns of numbers followed in pascals triangle
8.2 History, statement and proof of the binomial theorems for positive integral indices	know the binomial theorems for positive integral indices and their proof expand an expression using binomial theorem
8.3 General and middle term in binomial expansion	• get familiar with the general term in binomial expansion • get familiar with middle term in binomial expansion when number of terms are even/odd • get familiar with p^{th} term from the end
8.4 Application of binomial theorem	compute simple application problems using binomial theorems

UNIT 9: Sequences and Series :	Sequences 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., Sum to n terms of the special series $\sum n$, $\sum n^2$ and $\sum n^3$ Arithmetic Geometric Series. Harmonic Progression.
Contents	**Learning Outcomes**
	Students will be able to:
9.1 Arithmetic Progression, Geometric Progression	identify an arithmetic or geometric sequence. find the formula for the nth term of an arithmetic sequence find the formula for the nth term of a geometric sequence. prove a given sequence from an arithmetic progression or a geometric progression determine a specified term of an arithmetic sequence determine a specified term of a geometric sequence. generate or construct sequences from given recursive relationships
9.2 Arithmetic mean	• find the arithmetic mean. • insert 'n' arithmetic means between 2 given numbers
9.3 Geometric mean	find the geometric mean. i
9.4 Sum to n terms of an A.P.	• find the sum of finite terms of an arithmetic progression.
9.5 Sum to n terms of a G.P.	find the sum of finite terms of a geometric progression.
9.6 Infinite G.P. and its sum	• find the sum of an infinite geometric progression.
9.7 Relation between A.M. and G.M.	identify and apply the relation between arithmetic mean and geometric mean.
9.8 Sum to n terms of special series	• find the sum to n terms of the special series $\sum n, \sum n^2, \sum n^3$
	find the sum of n terms of a series given its nth term using results of .
9.9 Arithme-ticogeometric series	• identify arithmetico- geometric series.
9. 10 Harmonic Progression	identify harmonic progression. find the sum to n terms of harmonic progression.

Co-ordinate Geometry

Unit 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 axes, 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, distance between parallel lines.
Contents	**Learning Outcomes**
	Students will be able to:
10.1 Brief recall of two dimensional geometry from earlier classes	• distance between two points
	• area of triangle whose vertices are given
	• co-ordinates of a point divides the join of two given co-ordinates in the particular ratio
	• co-ordinates of midpoint of a line segment joining two co-ordinates • co-ordinates of centroid and incenter of a triangle
10.2 Shifting of origin	• comprehend the change in equation on shifting the point of origin
10.3 Slope of a line	• find the slope of a line when angle of inclination is given
	identify the slope of a line in terms of co-ordinates of any two points on it
	• familiar with condition of parallel lines and perpendicular lines in terms of slope
	use slopes of lines to investigate geometric relationships, including parallel lines, perpendicular lines.
10.4 Angle between two lines	• have a familiarity with the theorem that angle between two lines having slope m_1 and m_2 is given by $\tan\theta = \pm\left\lvert\frac{m_2 - m_1}{1 + m_1 m_2}\right\rvert$
10.5 Various forms of equation of a line: parallel to	equation of lines parallel to the co-ordinate axis

axis, point slop form, slop-intercept form, two point form, intercept form, and normal form	• form the equation of line when co-ordinates of point through which line passes and slope is given (point-slope form).
	form the equation of line when co-ordinates of two points through which line passes are given (two point form).
	• familiar with intercepts of a line on the axes.
	form the equation of line making slope m and making an intercept c on y/x axis (slope intercept form).
	• form the equation of line when a line cuts off intercepts a & b respectively on x and y axis (intercept form).
	form the equation of line when the length of the perpendicular on it and angle of that perpendicular is given (normal form of line). use different forms of a line to find out missing parameters of a line in symmetric form.
10.6 General equation of a line	• identify general equation and transform it in different standard forms.
10.7 Equation of family of lines passing through the point of intersection of two lines	find the point of intersection of two lines. understand the concept of family of lines passing through the intersection of lines l_1 and l_2 in terms of $l_1 + k\,l_2 = 0$.
	• give the equation of lines passing through the point of intersection of two lines under given conditions.
10.8 Distance of a point from a line	compute the distance of a point from a line.
10.9 Distance between parallel lines	• compute the distance between parallel lines.
Unit 11 : Conic Section	Sections of a cone: circle, ellipse, parabola, hyperbola, a point, a straight line and pair of intersecting lines as a degenerated case of a conic section. Standard equation of a circle; General equation of a circle, general equation of conic sections when its focus, directrix and eccentricity are given, standard equations and simple properties of parabola, ellipse and hyperbola.
Contents	**Learning Outcomes**
	Students will be able to
11.1 Introduction to	• identify the circle, parabola, ellipse and hyperbola as cross

section of a cone	sections of a double napped cone by a plane.
11.2 Circle (Standard form)	identify the equation of a circle in standard form having the Centre (h, k) and radius r. equation of a circle having centre at origin and radius r. equation of a circle when the end points of a diameter are given.
11.3 Circle (general form)	• general equation of a circle with centre at (-g, -f) and radius $\sqrt{g^2+f^2-c}$
	• find the equation of the circle using given conditions .
	• find the condition for a line to be a tangent to a circle
11.4 Parabola (standard form)	identify the standard parabola (right handed, left handed, upward and downward parabola)
	• find the axis, vertex, focus, directrix and the latus rectum of the standard parabola
11.5 Parabola (general form)	• identify the general equation of a parabola
	• reduction of general form of parabola to the standard form.
	find the axis, vertex, focus, directory and the latus rectum from the general equation of the parabola.
	• find the equation of parabola under given condition.
11.6 Ellipse (standard form) horizontal & vertical ellipse	• identify the vertical and horizontal ellipse.
	• find the vertices, major and minor axis, foci, directrix, centre, eccentricity and latus rectum of the vertical and horizontal ellipse.
11.7 Ellipse (general form)	• identify the general form of an ellipse (vertical & horizontal)
	• reduction of general form of ellipse to the standard form.
	find the vertices, major and minor axis, foci, directrix, centre, eccentricity and latus rectum from the general from of ellipse.
	• find the equation of an ellipse under given conditions.
11.8 Hyperbole (standard form)	identify the hyperbola in standard form (also conjugate hyperbola)

	• find the centre, vertices, foci, directrix, transverse and conjugate axes, eccentricity and length of latus rectum.
11.9 Hyperbole (general form)	• identify the general form of hyperbole.
	• reduction of general form of hyperbola to standard form.
	find the centre, vertices, foci directrix, transverse and conjugate axes, eccentricity & latus rectum from the general equation of hyperbola
	• find the equation of hyperbole under given condition
11.10 Application of conic section	apply the concepts of parabola, ellipse and hyperbola in the given problems.
Unit 12: Introduction to Three dimensional Geometry	Co-ordinate axes and co-ordinate planes in three dimensions. Co-ordinates of a point in space. Distance between two points and section formula, direction cosines of a line, direction ratios of line, angle between two lines.
Contents	**Learning Outcomes**
	Students will be able to:
12.1 Co-ordinate axes and co-ordinate planes in three dimensions	identify co-ordinate axes in three dimensions.
	• identify co-ordinate planes in three dimensions.
	• find co-ordinates of a point in space.
12.2 Distance between two points and section formula	• find distance between two points.
	apply section formula.
12.3 Some results on line in space	• direction cosines of a line
	• direction ratios of a line
	• angle between two lines.

Calculus

Unit 13 : Limits and Continuity	**Intuitive idea of Limit of a function. Derivative introduced as rate of change of distance function and its Geometric meaning, Definition of derivative, relate it to slops of tangent of the curve, derivative of sum,**

	difference, product and quotient of function, Derivative of polynomials and trigonometric function.
Contents	**Learning Outcomes**
	Students will be able to:
13.1 Limit of function	understand the meaning of x a understand the limit of function at a point
13.2 Fundam-ental theorem on limits	• apply fundamental theorems on limits 1) $\lim_{x\to a} [f(x)+g(x)] = \lim_{x\to a} f(x) + \lim_{x\to a} g(x)$ 2) $\lim_{x\to a} [f(x)-g(x)] = \lim_{x\to a} f(x) - \lim_{x\to a} g(x)$ 3) $\lim_{x\to a} [f(x).g(x)] = \lim_{x\to a} f(x) . \lim_{x\to a} g(x)$ 4) $\lim_{x\to a} \left\{\frac{f(x)}{g(x)}\right\} = \frac{\lim_{x\to a} f(x)}{\lim_{x\to a} g(x)}$, provided $\lim_{x\to a} g(x) \neq 0$ 5) $\lim_{x\to a} c.f(x) = c\lim_{x\to a} f(x)$ 6) if $f(x) \leq g(x)$ then $\lim_{x\to a} f(x) \leq \lim_{x\to a} g(x)$
13.3 Standard results on limits and their application	• $\lim_{x} x^n$ where a 0
	• $\lim_{x\to 0} \frac{e^x-1}{x} = 1$
	• $\lim_{x} a^x$
	• $\lim_{x\to 0} \frac{\log(1+x)}{x} = 1$
	• $\lim_{x}$ 1
13.4 Trigono-metric limits	• $\lim_{x\to 0} \frac{\sin x}{x} = 1$
	$\lim_{x} \tan x$ where x is in radius

13.5 Infinite limits	• $\lim_{x \to a} f(x)$
	• $\lim_{x} f(x)$
13.6 One sided limit	• Right hand limit • $\lim_{x \to a+} f(x)$
	Left hand limit $\lim_{x} f(x)$
	• existence of limit of function.
13.7 Continuity	understand the meaning of continuity of a function determine the continuity of a given function at a point when the function on both the sides of the given point is same determine the continuity of a given function at a point when the function on both the sides of the given point is different determine the value of a constant given in the definition of a function when it is continuous at an indicated point apply the algebra of continuous functions: If f and g are continuous function at $x=a$ then (i) $f+g$ is continuous at $x=a$ (ii) $f \quad g$ is continuous at $x=a$ (iii) fg is continuous at $x=a$ (iv) g is continuous at $x=a$ (v) f/g is continuous at $x=a$ when $g(a) \quad 0$

Probability

Unit 14 : 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 the theories of earlier classes. Probability of an event, probability of 'not', 'and' & 'or' events.**

Contents	Learning Outcomes
	Students will be able to:
14.1 Random experiment: outcomes, sample spaces (set representation).	learn the concept of random experiment, outcomes of random experiment and sample spaces • list the sample spaces of a random experiment
14.2 Events: occurrence of events, 'or', 'and', & 'not' events	understand the term event as a subset of sample space write events/sample space for a given experiment • recognise 'or', 'and' & 'not' events
14.3 Exhaustive events, mutually exclusive events Axiomatic (set theoretic) probability	identify impossible events and sure events Identify simple and compound events • identify mutually exclusive events • identify exhaustive events • get familiar with independent events, equally likely events, and complementary events*
14.4 Probability of an event	find the probability of occurrence of an event
14.5 Odds of an event	• Odds in favour of an event • Odds against an event.
14.6 Probability of occurrence of a complementary events	Find the probability of complement of an event using the relation P(E) = 1 P(E)
14.7 Results on probability	• $P(E) \geq 0, P(\emptyset) = 0, P(S) = 1$ • $0 \leq P(E) \leq 1$ • If $E_1 \subseteq E_2$ then $p(E_1) \leq P(E_2)$ • $P(E_1 - E_2) = P(E_1) - P(E_1 \cap E_2)$
14.8 Addition theorem	Addition theorem for two events P(A B) = P (A) + P (B) P(A B) Addition theorem for three events P(A B C) = P (A) + P (B)+P(C) P(A B) -P(B C) - P(C A)+P(A B C) Addition theorem for mutually exclusive events.

Mathematics - CLASS XII

Relations and Functions

Unit 1: Relations and Functions	**Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and on to function, composite functions, inverse of a function. Binary operations. Concept of exponential and logarithmic function to the base *e*, logarithmic function as inverse of exponential function and graphs.**
Contents	**Learning Outcomes**
	Students will be able to:
1.1 Types of relations : reflexive, symmetric, transitive and equivalence relations	identify reflexive relation, illustrate reflexive relation. identify symmetric relation identify transitive relation identify anti symmetric relation understand the conditions for an equivalence relation determine a relation is equivalence
1.2 One to one and on to functions	• identify one - one functions • identify on to functions • identify bijective functions
1.3 Composite functions	define composition of two functions understand that given two functions f and g, fog may not be equal to gof
1.4 Inverse of a function and binary operations	• define the inverse of a given function, if exists. • understand the definition of binary operation on a set • determine if a given operation is a binary operation on a given set • determine the total number of binary operations on a given finite set • determine if a given binary operation is commutative • determine if a given binary operation is associative • determine if a given binary operation is distributive • determine the identity element for a binary operation • determine the inverse element of a given element
1.5 Concept of exponential and logarithmic function to the base e,	understand the properties of looking at its graph. understand the properties of logarithmic function looking at its graph define logarithmic function as inverse of exponential function sketch the graph of exponential function

logarithmic function as inverse of exponential function and their graphs	
Unit 2: Inverse trigonometric functions	**Definition of inverse trigonometric function in unit circles, range, domain principal value branches. Graphs of inverse trigonometric functions, Elementary properties of inverse trigonometric functions.**
Contents	**Learning Outcomes**
	Students will be able to:
2.1 Definition of inverse trigonometric function in a unit circle	define all inverse trigonometric function using a unit circle
2.2 Range, domain, principal value branches	• state the domain and range of inverse trigonometric functions • state the principal value branch of inverse trigonometric functions and neighbouring branches.
2.3 Graphs of inverse trigonometric functions	sketch the graphs of six inverse trigonometric functions.
2.4 Elementary properties of inverse trigonometric functions	• prove the properties of inverse trigonometric functions
2.5 Problems based on properties	use the trigonometric properties to solve trigonometric equations and to prove trigonometric identities.

Matrices and Determinants

Unit 3: Matrices	Concept, notation, order, equality, types of matrices: zero matrix, transpose of 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 matrix and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of orders). 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)
Contents	**Learning Outcomes**
	Students will be able to:
3.1 Matrices	define matrices use matrix notation determine the order of a matrix identify types of matrices: - Row matrix - Column matrix - Square matrix - Diagonal matrix - Scalar matrix - Identity or unit - Null (zero) matrix - Upper triangular matrix - Lower triangular matrix
3.2 Equality of matrices	• understand the condition for the equality of matrices
3.3 Operation on matrices	perform addition and subtraction of matrices understand the properties of addition of matrices
3.4 Multiplication of matrices	• perform multiplication of a matrix by a scalar • identify the properties of scalar multiplication • understand the conditions order of matrices to multiply them • perform multiplication of matrices, wherever possible • identify properties of matrix multiplication • can illustrate non zero matrices whose product is the zero matrix • solve problems based on application of matrices
3.5 Transpose of	write the transpose of a matrix

matrix	verify the properties of transpose
3.6 Symmetric and skew-symmetric matrices	• identify symmetric matrices • identify skew-symmetric matrices • understand that for a symmetric matrix $a_{ij}=a_{ji}$ • understand that in a skew symmetric matrix, diagonal elements are zero. • construct a symmetric and skew –symmetric matrix. • prove that every square matrix can be expressed uniquely as sum of symmetric and skew symmetric matrix. • write a given square matrix as sum of symmetric and skew symmetric matrix.
3.7 Concept of elementary row and column transformations	apply elementary row and column transformations on a matrix of order 2 2 and 3 3 invertible matrices (AB=BA= I). find the inverse of a matrix using column or row transformations
Unit 4: Determinants (10 Periods)	**Determinant of a square matrix (upto 3×3 matrices) properties of determinants, minors, cofactors and applications of determinants in finding the area of a triangle, collinearity of points. 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. Cramer's Rule and its applications on word problems.**
Contents	**Learning Outcomes**
	Students will be able to:
4.1 Determinant of a square matrix (up to 3×3 matrices)	find the value of a determinant of order determine the minor of an element of a square matrix determine the cofactor of an element of a square matrix determine the determinant of a square matrix of order 3x3
4.2 Application of determinant	• use determinants to find the area of a triangle • use determinants to determine the collinearity of three points
4.3 Properties of determinants	verify the properties of determinants apply the properties of determinants to solve problems
4.4 Cramer's Rule	• solve system of linear equations using Cramer's Rule

Unit 5: Adjoint and Inverse of a matrix	**Adjoint of a square matrix of order 2 2 and 3 3. Properties of adjoint of a matrix. Inverse of a square matrix. Consistency, in consistenc and number of solutions of a system of linear equations by examples. Solving the system of linear equations in two and three variables by matrix method and its application in word problem.**
Contents	**Learning Outcomes**
	Students will be able to:
5.1 Adjoint of a matrix	• find the adjoint of a square matrix upto order 3×3 • verify the properties of adjoint : • $A(\text{adj } A)=(\text{adj } A).A=\lvert A\rvert I_n$ for a matrix A of order n. • $\text{adj}(AB)=(\text{adj } B)(\text{adj } A)$ • $(\text{adj } A)^T=\text{adj } A^T$ • $\lvert\text{adj } A\rvert=\lvert A\rvert^{n-1}$
5.2 Singular and Non singular matrix	understand the definition of singular and non singular matrices. identify singular and non singular matrix.
5.3 Invertible matrices	• understand the condition for a matrix in order to be invertible • prove that every invertible matrix possesses a unique inverse • find the inverse of a matrix using definition • find the inverse of a matrix when it satisfies some matrix equation. • verify results on invertible matrices
5.4 Solving a system of linear equations by Matrix method	solve a system of linear equation in two variables (having unique solution) using inverse of a matrix understand the conditions for consistency and inconsistency of system of linear equations solve a system of linear equations in three variables (having uniqu solution) using inverse of a matrix solve a system of linear equations when the inverse of coefficient matrix is obtained from some given relation solve problems on application of simultaneous linear equations

Calculus

Unit 6 : Differentiability	**Differentiability, Derivative introduced as rate of change of distance function and its Geometric meaning, Definition of derivative relate it to slops of tangent of the curve, derivative of sum, difference, product and quotient of function, Derivative of polynomials and trigonometric function. Derivative of composite functions, chain rule, derivates of inverse trigonometric functions derivate of implicit functions.**

	Derivatives of logarithmic and exponential functions. **Logarithmic differentiation derivative of functions expressed in parametric forms seconds order derivatives.**
Contents	**Learning Outcomes**
	Students will be able to:
6.1 Differentia-bility	understand the meaning of differentiability of a function determine the differentiability of a function at a given point determine relation between continuity and differentiability. derivative at a point geometrical significance of derivative as slope of tangent. physical significance of derivative as a rate of change of y with respect to x. derivative of a function by first principle. derivative of algebraic functions derivative of scalar multiple of a function derivative of sum and difference of functions derivative of a polynomial.
6.2 Product Rule	• derivative of product of function
6.3 Quotient Rule	derivative of quotient of function
6.4 Derivatives of implicit functions	• differentiable given an implicit function
6.5 Derivative of logarithmic and exponential functions	determine the derivatives of logarithmic and exponential function
6.6 Derivative of Infinite Series	• find the derivative of the given Infinite series
6.7 Logarithmic differen-tiation	differentiate the functions of the using logarithmic differentiation
6.8 Differen-tiation of one function with respect	• differentiate one function with respect to another function

to another.	
6.9 Derivatives of functions expressed in parametric form	differentiate functions given in parametric form
6.10 Second order derivative	• determine second order derivative of a given function
Unit 7 : Applications of Derivatives	**Applications of derivatives rate of change increasing/decreasing tangents and normal approximation, maxima and minima (first derivative test Local Maxima /Local Minima and second derivative test Absolute Maxima / Absolute Minima). Simple problems (that illustrate basic principles and understanding to the subject as well as real-life situations).**
Contents	**Learning Outcomes**
	Students will be able to:
7.1 Rate of change	• solve problems on rate of change of y with respect to x where $y = f(x)$ is a function of x
7.2 Increasing/ decreasing functions	determine if a function is strictly increasing in a given interval determine if a function is strictly decreasing in a given interval determine if a function is increasing/ decreasing identify the necessary and sufficient condition for montonicity of a function find an interval in which a function is increasing or decreasing prove the monotonicity of a function on a given interval
7.3 Rolle's theorem, Lagrange's mean value theorem (without proof) and their geometrical interpretation and simple	• understand the statement of Rolle's theorem • understand the geometrical interpretation of Rolle's theorem • check the applicability of Rolle's theorem for a given function in a given interval • verify Rolle's theorem for a given function in a given interval • apply Rolle's theorem to solve a problem • understand the statement of Lagrange's mean value theorem • understand the geometrical interpretation of Lagrange's mean value

	application	theorem • verify Lagrange's mean value theorem for a given function • apply Lagrange's mean value theorem to solve problems
7.4	**Tangents and normals**	determine the slope of tangents and normals to a given curve at a given point determine points on a given curve at which tangent is parallel to a given line determine points on a given curve at which tangent is perpendicular to a given line determine the equation of the tangent to a given curve at a given point determine the equation of the normal to a given curve at a given point determine the angle of intersection of two curves i.e. the angle between the tangents to the two curves
7.5	**Approxim-ations**	• understand the terms absolute error, relative error, percentage error • solve problems based on application of differentiation under approximation.
7.6	**Maxima and minima (local maxima/ local minima and absolute maxima/ absolute minima), first derivative test, second derivative test, simple problems (that**	understand the definition of local maxima and minima understand the definition of absolute maxima and minima understand the algorithm for the first derivative test for local maxima and minima determine the points of local maxima and local minima for a given function determine the points of inflexion for a given function understand the algorithm for second derivative test determine the maximum and minimum values of a function in a closed interval determine the points of absolute maxima and minima solve practical problems on maxima and minima

illustrate basic principles and understanding of the subject as well as real life situations)	
Unti 8 : Indefinite Integrals	**Integration as inverse process of differentiation, integration of a variety of functions by substitution;** $\int \frac{dx}{a^2-x^2}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{dx}{ax^2+bx+c},$ $\int \frac{(px+q)dx}{ax^2+bx+c}, \int \frac{dx}{\sqrt{x^2-a^2}}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{dx}{\sqrt{ax^2+bx+c}}, \int \frac{(px+q)dx}{\sqrt{ax^2+bx+c}}, \int$, $\int \sqrt{ax^2-x^2}\,dx, \int \sqrt{ax^2+bx+c}\,dx, \int (px+q)\sqrt{ax^2+bx+c}\,dx, \int \frac{dx}{a+b\cos x}, \int \frac{dx}{a+}$ sin , **Integration by parts, integration by partial factions**
Contents	**Learning Outcomes**
	Students will be able to:
8.1 Integration as an inverse process of differentiation	• define the terms: primitive or anti derivative and indefinite integrals • identify the fundamental integration formulas • understand integration as inverse process of differentiation
8.2 Integration of a variety of functions by substitution	• evaluate integrals by using $\int x^n dx = \frac{x^{n+1}}{n+1} + C$ and $\int \frac{1}{x} dx = \log x + C$ • understand the geometrical interpretation of indefinite integrals

	• evaluate integrals of the form $\int f(ax+b)\,dx$ using substitution method • evaluate integrals of the form $\int \frac{f'(x)}{f(x)}dx$ • evaluate integrals of the form $\int [f(x)]^n f'(x)\,dx$ • $\int(\emptyset(x))\,\emptyset(x)dx$ • $\int \frac{\sin x \text{ or } \cos x}{\sin x \pm \cos x}dx$ • integration using trigonometric identities • integral of the form $\int \sin^n x\,dx$, $\int \cos^n x\,dx$ when n is odd • $\int \sin^m x \cos^n x\,dx$ Where at least one of m or n is odd • evaluate $\int \frac{dx}{a\sin x + b\cos x}$ • by putting a = r cosθ b = r sinθ evaluate $\int \frac{a\sin x + b\cos x}{c\sin x + d\cos x}dx.$
8.3 Integration by parts	• evaluate the integration by parts: • evaluate $\int e^x [f(x)+f'(x)]\,dx$ • evaluate $\int e^{kx} [kf(x)+f'(x)]\,dx$ • evaluate $\int e^{ax}\sin(bx+c)\,dx$

	• and $\int e^{ax}\cos(bx+c)\,dx$
8.4 Some special integrals	• evaluate the integrals of the form $\int\frac{dx}{a^2-x^2}, \int\frac{dx}{x^2-a^2}, \int\frac{dx}{a^2+x^2}$ (with proofs) • evaluate the integral $\int\frac{dx}{ax^2+bx+c}, \int\frac{(px+q)dx}{ax^2+bx+c}$ • evaluate the integral $\int\frac{dx}{a+b\cos^2 x}, \int\frac{dx}{a+b\sin^2 x}, \int\frac{dx}{a\sin^2 x+b\cos^2 x}, \int\frac{dx}{a+b\sin^2 x+c\cos^2 x}$, $\int\frac{dx}{(a\sin x+b\cos x)^2}, \int\frac{dx}{a\cos^2 x+b\sin x\cos x+c\sin^2 x+d}$ • evaluate the integral $\int\frac{dx}{a\sin x+b\cos x}, \int\frac{dx}{a+b\sin x}, \int\frac{dx}{a+b\cos x}, \int\frac{dx}{a\sin x+b\cos x+c}$ (using half angle formula) • evaluate the integrals $\int\frac{dx}{x^4+kx^2+1}, \int\frac{(x^2+1)dx}{x^4+kx^2+1}, \int\frac{(x^2-1)dx}{x^4+kx^2+1}$ and reducible to this form • evaluate $\int\frac{dx}{\sqrt{a^2-x^2}}, \int\frac{dx}{\sqrt{x^2-a^2}}, \int\frac{dx}{\sqrt{x^2+a^2}}$ (with proofs) and reducible to this from • evaluate the integrals of the form $\int\frac{dx}{\sqrt{ax^2+bx+c}}$ and $\int\frac{(px+q)\,dx}{\sqrt{ax^2+bx+c}}$ • evaluate the integral $\int\sqrt{a^2-x^2}\,dx, \int\sqrt{x^2-a^2}\,dx, \int\sqrt{a^2+x^2}\,dx$ (with proofs) and reducible to this form. • evaluate integrals $\int\sqrt{ax^2+bx+c}\,dx, \int(px+q)\sqrt{ax^2+bx+c}\,dx$

	• evaluate integrals of the form $\int \frac{\phi(x)}{P\sqrt{Q}}dx$, Where P is Q both are linear functions of x • evaluate integrals of the form $\int \frac{\phi(x)}{P\sqrt{Q}}dx$, Where P is a quadratic expression and Q is a linear expression • evaluate integrals of the form $\int \frac{\phi(x)}{P\sqrt{Q}}dx$, Where P is a linear expression and Q is a quadratic expression • evaluate integrals of the form $\int \frac{\phi(x)}{P\sqrt{Q}}dx$, Where P is a quadratic expression and Q is a quadratic expression x i.e P ax^2+ b and q=cx^2 +d
8.5 Integration by partial fraction	evaluate the integral of a rational function $\frac{f(x)}{g(x)}$, $g(x)$ when g(x) is a product of non repeated linear factors when g(x) has linear and repeated factors. when g(x) contains quadratic factors.
Unit 9: Definite integrals	**Learning Outcomes** **The students will be able to:**
9.1 Fundam-ental theorem of calculus (without proof)	understand the fundamental theorem of integral calculus (without proof)
9.2 Definite integral by substitution	• evaluate definite integrals by suitable substitution.

9.3 Basic properties of definite integrals and evaluation of definite integrals	identify the basic properties of definite integrals property I $b \quad b$., Integration is independent of the change $a \quad a$ of variable. property II $b \quad a$ $a \quad b$ i.e., if the limits of a definite are interchanged then its value changes by minus sign only. property III $b \quad c \quad b$. $a \quad a \quad c$ property IV If is a continuous function defined on a,b , then $b \quad b$ $a \quad a$
	• property V If $f(x)$ is a continuous function defined on $[0,a]$, then $\int_0^a f(x)\,dx = \int_0^a f(a-x)\,dx$
	property VI If $f(x)$ is a continuous function defined on then a x *is an even function* , *if* $f(x)$ *is an odd function*
	• property VII If $f(x)$ is a continuous function defined on $[0,2a]$,

	$\int_0^{2a} f(x)\,dx = \begin{cases} 2\int_0^{a} f(x)\,dx, & \text{if } f(2a-x) = f(x) \\ 0, & \text{if } f(2a-x) = -f(x) \end{cases}$
9.4 Definite integrals as a limit of sum.	evaluate the definite integrals using above mentioned properties. understand the concept of limit of sum. evaluate definite integral as a limit of sum (linear, quadratic, cubic and exponential functions)
Unit 10 : Application of the integrals	**Applications in finding the area bounded by a curve and a line. Area bounded between lines. Areas bounded between two curves. Areas of circles / ellipses (in standard form only). Area under the curve $y = \sin x$, $y = \cos x$ (the region should be clearly identifiable)**
Contents	**Learning Outcomes**
	Students will be able to:
10.1 Finding the areas of circles/ parabolas/ ellipses (in standard form only)	determine the area enclosed in a circle determine the area enclosed in an ellipse
10.2 Area bounded by a curve and a line	• determine the area bounded by a curve and a line • a line and the axes • two lines and an axis • determine the area of a triangle • determine the area bounded by modules function and given lines
10.3 Area bounded between two curves	determine the area bounded between two curves • determine the area under the curve '$y = \sin x$' • find the area under the curve '$y = \cos x$' • find the area bounded by y = sin x & y = cos x under given conditions
Unit 11 : Differential Equations	**Definition order and degree, general and particular solutions of a differential equation, Formation of differential equation whose general solution is given Solution is 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: $\frac{dy}{dx}+py=q$ **where** p **and** q **are functions of** x **and** $\frac{dx}{dy}+px=q$ **where** p **and** q **are functions of** y
Contents	**Learning Outcomes**
	Students will be able to:
11.1 Definition, order and degree	• identify a differential equation • tell the order and degree of a differential equation • verify that the given solution is solution of a given differential equation
11.2 General and particular solutions of a differential equation	• form a differential equation given its general solution
11.3 Formation of differential equation	• solve differential equations in variable separable form • determine particular solution, when initial values are given • solve differential equations that are reducible to variable separable form
11.4 Homog-enous differential equation of first order and first degree	• identify homogenous differential equation of first degree and first order • solve the homogenous differential equation of first degree and first order
11.5 Linear equation of first order	• solve linear differential equation of the type $\frac{dy}{dx}+py=q$, where p and q are functions of x • solve linear differential equation of the type $\frac{dx}{dy}+px=q$, where p and q are functions of y
11.6 Applications of differential equation	• solve problems of application on growth and decay • solve problems on velocity, acceleration, distance and time • solve population based problems on application of differential equations • solve problems of application on co- ordinate geometry

Vectors and Three Dimensional Geometry

Unit 12 : Vectors	Vectors and Scalars, Magnitude and direction of a vector. Representation of vectors, types of vectors, position vector of a point, components of a vector, Addition of vectors (properties of addition, laws of addition), 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.
Contents	**Learning Outcomes**
	Students will be able to:
12.1 Vectors and Scalars	differentiate Scalar and Vectors quantities. represent a vector.
	• find magnitude of vector. • represent negative of a vector.
12.2 Magnitude and direction of a vector	define and illustrate various type of vectors, e.g. parallel vector, coinitial vectors, coterminous collinear vectors, like and unlike vectors, equal vectors
12.3 Position vector of a point	• write the position vector of a point
12.4 Compon-ents of a vector	identify components of a vector in two dimension identify components of a vector in three dimension identify components of a vector in terms of coordinates of its end points
12.5 Addition of vectors	• understands and can use triangle law of vector addition. • understands and can use parallelogram law of addition of vectors
12.6 Properties of addition of vectors	prove commutative property under addition prove associative property under addition find additive identity find additive inverse of a given vector.
	• solve problems based on vector addition

12.7 Multiplication of a vector by a scalar	multiply the vector by a scalar appreciate the following properties of multiplication of vectors a , b by a scalar m,n (i) n (ii) (iii) $m \quad na$ (iv) m (v) $m \quad a$ prove the section formula for internal division and external division of vectors use the appropriate section formula to find the position vector of a point dividing the given line segment in given ratio.
12.8 Position vector of a point dividing a line segment in a given ratio	• find the position vector of a point dividing the line segment (internally and externally)
12.9 Direction cosines and direction ratios of vector	find direction ratios of a vector • determine the direction cosines of a vector • find the unit vector in the direction of given vector
12.10 Scalar (dot product) of vectors	define scalar product understand the geometrical interpretation of scalar product find the scalar product of two given vectors apply the scalar product (i) to check the perpendicularity of two vectors (ii) to determine the angle between two vectors (iii) to find the projection of a vector on a line (iv) to find the work done by a given force in direction of displacement

	• understand and apply the following properties of scalar product (i) commutativity (ii) distributivity of scalar product over vector addition (iii) $\vec{a}\,.\,\vec{b}=0 \Leftrightarrow \vec{a}$ is perpendicular to $\vec{b}$ where $\vec{a}$ and $\vec{b}$ are non zero vectors (iv) For any vector $\vec{a}$, $\vec{a}\,.\,\vec{a}=\lvert\vec{a}\rvert^{2}$ (v) $m\vec{a}\,.\,\vec{b}=m(\vec{a}\,.\,\vec{b})=\vec{a}.\,m\vec{b}$ Where $\vec{a}$, $\vec{b}$ are vectors and m is scalar (vi) $m\vec{a}.\,n\vec{b}=mn(\vec{a}\,.\,\vec{b})=mn\vec{a}\,.\,\vec{b}=\vec{a}.\,mn\vec{b}$ Where $\vec{a}$, $\vec{b}$ are vectors and m, n are scalars (vii) $\vec{a}.\,(-\vec{b})=-(\vec{a}.\vec{b})=(-\vec{a})\,.\,\vec{b}$ (viii) $\lvert\vec{a}+\vec{b}\rvert^{2}=\lvert\vec{a}\rvert^{2}+\lvert\vec{b}\rvert^{2}+2\vec{a}\,.\,\vec{b}$ $\lvert\vec{a}-\vec{b}\rvert^{2}=\lvert\vec{a}\rvert^{2}+\lvert\vec{b}\rvert^{2}-2\,\vec{a}\,.\,\vec{b}$ $(\vec{a}+\vec{b})\,.\,(\vec{a}-\vec{b})=\lvert\vec{a}\rvert^{2}-\lvert\vec{b}\rvert^{2}$
12.11 Projection of a vector on a number line	
12.12 Vector product	• define the vector product of given vectors • understand the geometrical interpretation of the vector product find the vector product of given vectors • understand and apply the properties of vector product • Let $\vec{a}$ and $\vec{b}$ be vectors and m, n be scalars (i) $\vec{a}\times\vec{b}=-(\vec{b}\times\vec{a})$ (ii) $m\vec{a}\times\vec{b}=m(\vec{a}\times\vec{b})=\vec{a}\times m\vec{b}$ (iii) $m\vec{a}\times n\vec{b}=mn(\vec{a}\times\vec{b})=m(\vec{a}\times n\vec{b})=n(m\vec{a}\times\vec{b})$ (iv) $\vec{a}\times(\vec{b}+\vec{c})=(\vec{a}\times\vec{b})+(\vec{a}\times\vec{c})$ $(\vec{b}+\vec{c})\times\vec{a}=(\vec{b}\times\vec{a})+(\vec{c}\times\vec{a})$

	(v) $\vec{a} \times \vec{b} - \vec{c} = \vec{a} \times \vec{b} - \vec{a} \times \vec{c}$ (vi) $\vec{a} \times \vec{b} = \vec{0} \Leftrightarrow \vec{a} \parallel \vec{b}$, $\vec{a}$ and $\vec{b}$ are non zero vectors • use the vector product to • check the collinearity of two vectors • find unit vector perpendicular to vectors $\vec{a}$ & $\vec{b}$ both • find moment of a force in direction of displacement • find area of parallelogram formed by adjacent vectors $\vec{a}$ & $\vec{b}$ • find the area of triangle with adjacent sides $\vec{a}$ & $\vec{b}$ • find the area of quadrilateral with diagonals $\vec{d}_1$ & $\vec{d}_2$
12.13 Scalar triple product	define scalar triple product. • understand geometrical interpretation of scalar triple product • find the scalar triple product. • find the volume of the parallelepiped having adjacent edges using scalar triple product find the volume of the parallelepiped with the given vertices use scalar triple product to show that three vectors are coplanar.
Unit 13 : Three-dimensional Geometry	**Direction cosines and direction ratios of a line joining two points. Cartesian and vector equation of a line. Coplanar and skew lines. Shortest distance between two lines. Cartesian and vector equation of a plane. Angle between two lines. Angle between two planes. Angle between a line and a plane. Distance of a point from a plane**
Contents	**Learning Outcomes**
	Students will be able to:
13.1 Brief recall of direction cosines and direction ratios of a line	recall the direction ratios of a line passing through two points recall the direction cosines of a line passing through two points find the angle between two vectors in terms of their directions cosines find the angle between two vectors in terms of their direction ratios

13.2 Cartesian and vector equation of a straight line	• find the vector and Cartesian equation of a straight line through a given point and parallel to given vector • find the vector and Cartesian equation of a line passing through two given points • conversion of equation of a line from vector form to Cartesian form and vice versa • find equation of a line passing through a given point and perpendicular to two given lines • find the foot and length of perpendicular from a given point on a given line • intersecting lines and their point of intersection • condition for two given lines to intersect
13.3 Angle between two lines	find angle between two lines
13.4 Shortest distance between two lines	• define skew lines • define line of shortest distance • find the shortest distance (S.D.) between two lines • understand that if S.D. = 0 lines are intersecting and can find the point of intersection of two lines.
13.5 Distance between parallel lines	find the distance between two parallel lines
13.6 Equation of a plane in normal form	• find equation of a plane when the normal to the plane and distance $\neq 0$ of the plane from the origin are given (both vector and Cartesian form)

13.7 Equation of a plane passing through a given point	find equation of plane passing through a given point and perpendicular to a given vector (both vector and Cartesian form) find equation of plane passing through two points and parallel to a given line (both vector and Cartesian form) find equation of a plane through a given point and parallel to two given lines find equation of a plane containing two lines (both vector and Cartesian form) find equation of a plane passing through three points (both vector and Cartesian form)
13.8 Equation of plane in intercept form	• find equation of a plane whose intercepts on coordinate axes are given
13.9 Equation of plane in general form	general equation of the plane and its reduction to normal form
13.10 Equation of plane through the intersection of two planes	• find equation of a plane passing through intersection of two given planes (both vector and Cartesian form)
13.11 Angle between two planes	find angle between two planes find angle between a line and a plane
13.12 Distance of a point from a plane	• find the distance of a point from a plane in (Cartesian form and vector form)
13.13 Image of a point in plane	find the image of the point in a given plane
13.14 Coplanar lines	• condition for the coplanarity of two lines and equation of the plane containing them.

Probability

Unit 14 : 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) trials and Binomial distribution.**
Contents	**Learning Outcomes**
	Students will be able to:
14.1 Conditional Probability	• understand the meaning of conditional probability
	• derive the formula of conditional probability using multiplication theorem $P(A/B)=\frac{P(A\cap B)}{P(B)}$ assume that $P(B)\neq 0$ or $P(B/A)=\frac{P(A\cap B)}{P(A)}$ assume that $P(A)\neq 0$
	• understand and use the properties of conditional probability. • solve the problems based on conditional probability.
14.2 Multiplication theorem on probability	• understand that if A and B are two events associated with a random experiment, then $P(A\cap B)=P(A).P(B/A)=P(B).P(A/B)$, *given that* $P(A)\neq 0, P(B)\neq 0$
	• understand the extension of multiplication theorem that if $A_1, A_2, A_3, ...A_n$ are n events associated with a random experiment, then $P(A_1\cap A_2\cap A_3 .....A_n) = P(A_1)P(A_2/A_1)P(A_3/A_1\cap A_2)......P(A_n/A_1\cap A_2\cap ....A_{n-1})...$
14.3 Independent Events	• Identify the independence or dependence of events
	• use the formula $P(A\cap B)=P(A)P(B)$ for independent events • understand that P(A/B)=P(A), P(B) $\neq$0 & P(B/A)= P(B), P(A) $\neq$0 } for independent events A&B
	• find the probability of simultaneous occurrence for independent events
	• find probability of occurrence of at least one event for independent

	events
14.4 Total Probability	• find the probability of an event when certain conditional probabilities of that event are given.
14.5 theorem	• use the conditional probability to make predictions in reverse
14.6 Random variable and its probability distribution	• understand the meaning of random variable
	• write probability distribution of random variables
14.7 Mean and variance of random variable	• find mean of a discrete random variable
	find mean of continuous random variable
	• find variance of discrete random variable
14.8 Repeated independent (Bernoulli) trials and Binomial distribution	• know the definition of Bernoulli trial.
	• find the probabilities for Bernoulli trials using binomial probability formula