Applied Mathematics (XI-XII)

(Code-241)

Session- 2022-23

Secondary School Education prepares students to explore future career options after graduating from schools. Mathematics is an important subject that helps students to choose various fields of their choices. Mathematics is widely used in higher studies as an allied subject in the field of Economics, Commerce, Social Sciences and many others. It has been observed that the syllabus of Mathematics in senior secondary grades meant for Science subjects may not be appropriate for the students who wish to pursue Commerce or Social Science-based subjects in university education. By keeping this in mind, one more elective course in the Mathematics syllabus is developed for Senior Secondary classes with an aim to provide students relevant experience in Mathematics that can be used in fields other than Physical Sciences.

This course is designed to develop substantial mathematical skills and methods needed in other subject areas. Topics covered in two years aim to enable students to use mathematical knowledge in the field of business, economic and social sciences. It aims to promote appreciation of mathematical power and simplicity for its countless applications in diverse fields. The course continues to develop mathematical language and symbolism to communicate and relate everyday experiences mathematically. In addition, it reinforces the logical reasoning skills of formulating and validating mathematical arguments, framing examples, finding counterexamples. It encourages students to engage in mathematical investigations and to build connections within mathematical topics and with other disciplines. The course prepares students to use algebraic methods as a means of representation and as a problem-solving tool. It also enables students to interpret two-dimensional geometrical figures using algebra and to further deduce properties of geometrical figures in a coordinate system. The course content will help students to develop a sound understanding of descriptive and inferential statistics which they can use to describe and analyze a given set of data and to further make meaningful inferences out of it. Data based case studies from the field of business, economics, psychology, education, biology and census data will be used to appreciate the power of data in contemporary society.

It is expected that the subject is taught connecting concepts to the applications in various fields. The objectives of the course areas are as follows:

Objectives:

a) To develop an understanding of basic mathematical and statistical tools and their applications in the field of commerce (business/ finance/economics) and social sciences.
b) To model real-world experiences/problems into mathematical expressions using numerical/algebraic/graphical representation.
c) To make sense of the data by organizing, representing, interpreting, analysing, and making meaningful inferences from real-world situations.
d) To develop logical reasoning skills and apply the same in simple problem-solving.
e) To reinforce mathematical communication by formulating conjectures, validating logical arguments and testing hypothesis.
f) To make connections between Mathematics and other disciplines.

Grade XI (2022-23)

Number of Paper: **1**

Total number of Periods: **240 (35 Minutes Each)**

Time: **3 Hours**

Max Marks: **80**

No.	Units	No. of Periods	Marks
I	Numbers, Quantification and Numerical Applications	25	09
II	Algebra	45	15
III	Mathematical Reasoning	15	06
IV	Calculus	35	10
V	Probability	25	08
VI	Descriptive Statistics	35	12
VII	Basics of Financial Mathematics	45	15
VIII	Coordinate Geometry	15	05
Total		240	80
Internal Assessment			20

CLASS- XI

Sl. No.	Contents	Learning Outcomes: Students will be able to	Notes / Explanation
UNIT – 1 NUMBERS, QUANTIFICATION AND NUMERICAL APPLICATIONS			
Numbers & Quantification			
1.2	Binary Numbers	● Express decimal numbers in binary system ● Express binary numbers in decimal system	● Definition of number system (decimal and binary) ● Conversion from decimal to binary system and vice - versa
1.4	Indices, Logarithm and Antilogarithm	● Relate indices and logarithm /antilogarithm ● Find logarithm and antilogarithms of given number	● Applications of rules of indices ● Introduction of logarithm and antilogarithm ● Common and Natural logarithm
1.5	Laws and properties of logarithms	● Enlist the laws and properties of logarithms ● Apply laws of logarithm	● Fundamental laws of logarithm
1.6	Simple applications of logarithm and antilogarithm	● Use logarithm in different applications	● Express the problem in the form of an equation and apply logarithm/ antilogarithm
Numerical Applications			
1.7	Averages	● Determine average for a given data	● Definition and meaning ● Problems on average, weighted average
1.8	Clock	● Evaluate the angular value of a minute ● Calculate the angle formed between two hands of clock at given time ● Calculate the time for which hands of clock meet	● Number of rotations of minute hand / hour hand of a clock in a day ● Number of times minute hand and hour hand coincides in a day
1.9	Calendar	● Determine Odd days in a month/ year/ century ● Decode the day for the given date	● Definition of odd days ● Odd days in a year/ century. ● Day corresponding to a given date
1.10	Time, Work and Distance	● Establish the relationship between work and time ● Compare the work done by the individual / group w.r.t. time ● Calculate the time taken/ distance covered/ Work done from the given data	● Basic concept of time and work ● Problems on time taken / distance covered / work done
1.11	Mensuration	● Solve problems based on surface area and volume of 2D and 3D shapes ● Calculate the volume/ surface area for solid formed using two or more shapes	● Comparison between 2D and 3D shapes ● Combination of solids ● Transforming one solid shape to another

1.12	Seating arrangement	● Create suitable seating plan/ draft as per given conditions (Linear/circular) ● Locate the position of a person in a seating arrangement	● Linear and circular seating arrangement ● Position of a person in a seating arrangement
UNIT – 2 ALGEBRA			
Sets			
2.1	Introduction to sets – definition	● Define set as well-defined collection of objects	● Definition of a Set ● Examples and Non-examples of Set
2.2	Representation of sets	● Represent a set in Roster form and Set builder form	● Write elements of a set in Set Builder form and Roster Form ● Convert a set given in Roster form into Set builder form and vice-versa
2.3	Types of sets and their notations	• Identify different types of sets on the basis of number of elements in the set • Differentiate between equal set and equivalence set	• Types of Sets: Finite Set, Infinite Set, Empty Set, Singleton Set
2.4	Subsets	• Enlist all subsets of a set • Find number of subsets of a given set • Find number of elements of a power set	• Subset of a given set • Familiarity with terms like Superset, Improper subset, Universal set, Power set
2.5	Intervals	• Express subset of real numbers as intervals	• Open interval, closed interval, semi open interval and semi closed interval
2.6	Venn diagrams	• Apply the concept of Venn diagram to understand the relationship between sets • Solve problems using Venn diagram	• Venn diagrams as the pictorial representation of relationship between sets • Practical Problems based on Venn Diagrams
2.7	Operations on sets	• Perform operations on sets to solve practical problems	• Operations on sets include i) Union of sets ii) Intersection of sets iii) Difference of sets iv) Complement of a set v) De Morgan's Laws
Relations			
2.8	Ordered pairs Cartesian product of two sets	• Explain the significance of specific arrangement of elements in a pair • Write Cartesian product of two sets • Find the number of	• Ordered pair, order of elements in an ordered pair and equality of ordered pairs • Cartesian product of two non-empty sets

		elements in a Cartesian product of two sets	
2.9	Relations	• Express relation as a subset of Cartesian product • Find domain and range of a relation	• Definition of Relation, examples pertaining to relations in the real number system
Sequences and Series			
2.11	Sequence and Series	● Differentiate between sequence and series	● Sequence:$a_1, a_2, a_3, \ldots, a_n$ ● Series: $a_1 + a_2 + a_3 + \cdots + a_n$
2.12	Arithmetic Progression	● Identify Arithmetic Progression (AP) ● Establish the formulae of finding n^{th}term and sum of *n* terms ● Solve application problems based on AP ● Find arithmetic mean (AM) of two positive numbers	● General term of AP: $t_n = a + (n-1)d$ ● Sum of n terms of AP : $S_n = \frac{n}{2}[2a + (n-1)d]$ AM of a and b= $\frac{a+b}{2}$
2.13	Geometric Progression	• Identify Geometric Progression (GP) ● Derive the n^{th}term and sum of n terms of a given GP ● Solve problems based on applications of GP ● Find geometric mean (GM) of two positive numbers ● Solve problems based on relation between AM and GM	● General term of GP: $t_n = ar^{n-1}$ ● Sum of n terms of a GP: $S_n = \frac{a(r^n-1)}{r-1}$ ● Sum of infinite term of GP = $\frac{a}{1-r}$, where $-1 < r < 1$ ● Geometric mean of *a* and *b* = $\sqrt{ab}$ ● For two positive numbers a and b, AM ≥GM i.e., $\frac{a+b}{2} \geq \sqrt{ab}$
2.14	Applications of AP and GP	● Apply appropriate formulas of AP and GP to solve application problems	Applications based on ● Economy Stimulation ● The Virus spread etc.
Permutations and Combinations			
2.15	Factorial	● Define factorial of a number ● Calculate factorial of a number	● Definition of factorial: n! = n(n-1)(n-2)…3.2.1 Usage of factorial in counting principles
2.16	Fundamental Principle of Counting	● Appreciate how to count without counting	● Fundamental Principle of Addition ● Fundamental Principle of Multiplication

2.17	Permutations	● Define permutation ● Apply the concept of permutation to solve simple problems	● Permutation as arrangement of objects in a definite order taken some or all at a time ● Theorems under different conditions resulting in ${}^{n}P_{r}=\frac{n!}{(n-r)!}$ or n^{r} or $\frac{n!}{n_1!n_2!\ldots n_k!}$ arrangements
2.20	Combinations	● Define combination ● Differentiate between permutation and combination ● Apply the formula of combination to solve the related problems	-The number of combinations of n different objects taken r at a time is given by ${}^{n}C_{r}=\frac{n!}{r!.(n-r)!}$ Some results on combinations: ● ${}^{n}C_{0}=1={}^{n}C_{n}$ ● ${}^{n}C_{a}={}^{n}C_{b}\Rightarrow a=b$ or $a+b=n$ ● ${}^{n}C_{r}={}^{n}C_{n-r}$ ● ${}^{n}C_{r}+{}^{n}C_{r-1}={}^{n+1}C_{r}$
UNIT -3 MATHEMATICAL REASONING			
3.2	Logical reasoning	● Solve logical problems involving odd man out, syllogism, blood relation and coding decoding	● Odd man out ● Syllogism ● Blood relations ● Coding Decoding
UNIT – 4 CALCULUS			
4.1	Functions	● Identify dependent and independent variables ● Define a function using dependent and independent variable	● Dependent variable and independent variable ● Function as a rule or law that defines a relationship between one variable (the independent variable) and another variable (the dependent variable)
4.2	Domain and Range of a function	● Define domain, range and co-domain of a given function	● Domain as a set of all values of independent variable ● Co-domain as a set of all values of dependent variable ● Range of a function as set of all possible resulting values of dependent variable
4.3	Types of functions	● Define various types of functions ● Identify domain, co-domain and range of the function	● Following types of functions with definitions and characteristics Constant function, Identity function, Polynomial function, Rational function, Composite function, Logarithm function, Exponential function, Modulus function, Greatest integer function, Signum function, Algebraic function
4.4	Graphical representation of functions	● Representation of function graphically	● Graph of some polynomial functions, Logarithm function, Exponential Function, Modulus function, Greatest integer

			function, Signum function
4.5	Concepts of limits and continuity of a function	● Define limit of a function ● Solve problems based on the algebra of limits ● Define continuity of a function	● Left hand limit, Right hand limit, Limit of a function, Continuity of a function
4.6	Instantaneous rate of change	● Define instantaneous rate of change	● The ratio $\frac{\Delta y}{\Delta x} = \frac{f(x+\Delta x)-f(x)}{\Delta x}$ as instantaneous rate of change, where Δy is change in y and Δx is change in x at any instant
4.7	Differentiation as a process of finding derivative	● Find the derivative of the functions	● Derivatives of functions (non-trigonometric only)
4.8	Derivatives of algebraic functions using Chain Rule	● Find the derivative of function of a function	● If $y = f(u)$ where $u = g(x)$ then differential coefficient of y w.r.t x is $\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$
UNIT – 5 PROBABILITY			
5.1	Introduction	● Appreciate the use of probability in daily life situations	● Probability as quantitative measure of uncertainty ● Use of probability in determining the insurance premium, weather forecasts etc.
5.2	Random experiment and sample space	● Define random experiment and sample space with suitable examples	● Sample space as set of all possible outcomes
5.3	Event	● Define an event ● Recognize and differentiate different types of events and find their probabilities	● Types of Event: Impossible and sure event, Independent and dependent event, mutually exclusive and exhaustive event
5.4	Conditional Probability	● Define the concept of conditional probability ● Apply reasoning skills to solve problems based on conditional probability	● Conditional Probability of event E given that F has occurred is: $P(E\|F) = \frac{P(E\cap F)}{P(F)}$, $P(F) \neq 0$
5.5	Total Probability	● Interpret mathematical information and identify situations when to apply total probability ● Solve problems based on application of total probability	● Total Probability: Let $E_1, E_2, \ldots, E_n$ be a partition of the sample space S, then probability of an event A associated with S is: $P(A) = \sum_{j=1}^{n} P(E_j)P(A\|E_j)$
5.6	Bayes' Theorem	● State Bayes' theorem ● Solve practical problems based on Bayes' Theorem	● Bayes' Theorem: If $E_1, E_2, \ldots, E_n$ be *n* non empty events which constitute a partition of a sample space S and A be any event with non zero probability,

			then: $P(E_i\|A) = \frac{P(E_i)P(A\|E_i)}{\sum_{j=1}^{n} P(E_j)P(A\|E_j)}$
UNIT- 6 DESCRIPTIVE STATISTICS			
6.4	Data Interpretation		
	Measure of Dispersion	● Understand meaning of dispersion in a data set ● Differentiate between range, quartile deviation, mean deviation and standard deviation ● Calculate range, quartile deviation, mean deviation and standard deviation for ungrouped and grouped data set ● Choose appropriate measure of dispersion to calculate spread of data	●Mean deviation around mean and median ●Standard deviation and variance ●Examples of different kinds of data helping students to choose and compare different measures of dispersion
	Skewness and Kurtosis	● Define Skewness and Kurtosis using graphical representation of a data set ● Interpret Skewness and Kurtosis of a frequency distribution by plotting the graph ● Calculate coefficient of Skewness and interpret the results	●Examples of symmetrical and asymmetrical data ●Visualization of graphical representation of data using Excel Spreadsheet or any other computer assisted tool
6.5	Percentile rank and Quartile rank	● Define Percentile rank and Quartile rank ● Calculate and interpret Percentile and Quartile rank of scores in a given data set	●Emphasis on visualizing, analysing and interpreting percentile and quartile rank scores
6.6	Correlation	● Define correlation in values of two data sets ● Calculate Product moment correlation for ungrouped and grouped data ● Calculate Karl Pearson's coefficient of correlation ● Calculate Spearman's rank correlation ● Interpret the coefficient of correlation	●Emphasis on application, analysis and interpreting the results of coefficient of correlation using practical examples
UNIT – 7 FINANCIAL MATHEMATICS			
7.1	Interest and Interest Rates	● Define the concept of Interest Rates ● Compare the difference between Nominal Interest Rate, Effective Rate and Real Interest Rate	● Impact of high interest rates and low interest rates on the business

		● Solve Practical applications of interest rate	
7.2	Accumulation with simple and compound interest	● Interpret the concept of simple and compound interest ● Calculate Simple Interest and Compound Interest	●Meaning and significance of simple and compound interest ●Compound interest rates applications on various financial products
7.3	Simple and compound interest rates with equivalency	● Explain the meaning, nature and concept of equivalency ● Analyze various examples for understanding annual equivalency rate	● Concept of Equivalency ● Annual Equivalency Rate
7.4	Effective rate of interest	● Define with examples the concept of effective rate of interest	● Effective Annual Interest Rate $= (1 + i/n)^n - 1$ where: i = Nominal Interest Rate n = No. of Periods
7.5	Present value, net present value and future value	●Interpret the concept of compounding and discounting along with practical applications ●Compute net present value ●Apply net present value in capital budgeting decisions	• Formula for Present Value: $PV = CF/(1 + r)^n$ Where: CF = Cash Flow in Future Period r = Periodic Rate of return or Interest (also called the discount rate or the required rate of return) n = no. of periods • Use of PVAF, FVAF tables for practical purposes • Solve problems based on Application of net present value
7.6	Annuities, Calculating value of Regular Annuity	●Explain the concept of Immediate Annuity, Annuity due and Deferred Annuity ●Calculate General Annuity	●Definition, Formulae and Examples
7.7	Simple applications of regular annuities (upto 3 period)	●Calculate the future value of regular annuity, annuity due ●Apply the concept of Annuity in real life situations	●Examples of regular annuity: Mortgage Payment, Car Loan Payments, Leases, Rent Payment, Insurance payouts etc.
7.8	Tax, calculation of tax, simple applications of tax calculation in Goods and service tax, Income Tax	●Explain fundamentals of taxation ●Differentiate between Direct and indirect tax ●Define and explain GST ●Calculate GST ●Explain rules under-State	●Computation of income tax Add Income from Salary, house property, business or profession, capital gain, other sources, etc. Less deductions PF, PPF, LIC, Housing loan, FD, NSC etc.

		Goods and Services Tax (SGST) Central Goods and Services Tax (CGST) and Union Territory Goods and Services Tax (UTGST)	• Assess the Individuals under Income Tax Act • Formula for GST Different Tax heads under GST
7.9	Bills, tariff rates, fixed charge, surcharge, service charge	• Describe the meaning of bills and its various types • Analyze the meaning and rules determining tariff rates • Explain the concept of fixed charge	• Tariff rates- its basis of determination • Concept of fixed charge service charge and their applications in various sectors of Indian economy
7.10	Calculation and interpretation of electricity bill, water supply bill and other supply bills	• To interpret and analyze electricity bills, water bills and other supply bills • Evaluate how to calculate units consumed under electricity bills/water bill	• Components of electricity bill/water supply and other supply bills: i) overcharging of electricity ii) water supply bills iii) units consumed in electricity bills
UNIT – 8 COORDINATE GEOMETRY			
8.1	Straight line	• Find the slope and equation of line in various form • Find angle between the two lines • Find the perpendicular from a given point on a line • Find the distance between two parallel lines	• Gradient of a line • Equation of line: Parallel to axes, point-slope form, two-points form, slope intercept form, intercept form • Application of the straight line in demand curve related to economics problems
8.2	Circle	• Define a circle • Find different form of equations of a circle • Solve problems based on applications of circle	• Circle as a locus of a point in a plane • Equation of a circle in standard form, central form, diameter form and general form
8.3	Parabola	• Define parabola and related terms • Define eccentricity of a parabola • Derive the equation of parabola	• Parabola as a locus of a point in a plane. • Equation of a parabola in standard form: • Focus, Directrix, Axis, Latus rectum, Eccentricity • Application in parabolic reflector, beam supported by wires at the end of the support, girder of a railway bridge, etc.

Practical: Use of spreadsheet

Calculating average, interest (simple and compound), creating pictographs, drawing pie chart, bar graphs, calculating central tendency visualizing graphs (straight line, circles and parabola using real-time data)

Suggested practical using spreadsheet

1. Plot the graph of functions on excel study the nature of function at various points, drawing lines of tangents
2. Create a budget of income and spending
3. Create and compare sheet of price & features to buy a product
4. Prepare the best option plan to buy a product by comparing cost, shipping charges, tax and other hidden costs
5. Smart purchasing during sale season
6. Prepare a report card using scores of the last four exams and compare the performance
7. Collect the data on weather, price, inflation, and pollution. Sketch different types of graphs and analyze the results