**Applied Mathematics**

**Subject Code – 241**

**Classes XI-XII**

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:

**Course Objectives:**

- To develop an understanding of essential mathematical and statistical concepts that are relevant to areas such as business, economic and social sciences.
- To enable students to interpret real-life situations into structured numerical, algebraic and graphical representations for analysis and decision making.
- To develop ability to organise, analyse and interpret data, and to draw meaningful conclusions in practical contexts.
- To strengthen logical thinking and reasoning by engaging students in problem-solving situations that require nuance understanding of qualification and relative change.
- To develop clarity in mathematical communication, including the ability to justify solutions, examine assumptions and validate results.
- To help students recognise connections between mathematics and other disciplines, and to use these connections meaningfully.

## Grade XI (2026-27)

**Number of Paper:** 1
**Time:** 3 Hours
**Max Marks:** 80

| No. | Units | Marks |
|---|---|---|
| I | Numbers, Quantification and Numerical Applications | 10 |
| II | Algebra | 18 |
| III | Calculus | 12 |
| IV | Combinatorics and Probability | 10 |
| V | Descriptive Statistics | 10 |
| VI | Basics of Financial Mathematics | 15 |
| VII | Coordinate Geometry | 05 |
| **Total** | | **80** |
| **Internal Assessment** | | **20** |

| CLASS- XI | | | |
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| **Sl. No.** | **Unit and Chapter** | **Details of content** | **Learning Outcomes** |
| **UNIT – 1 NUMBERS, QUANTIFICATION AND NUMERICAL APPLICATIONS** | | | |
| **Numbers & Quantification** | | | |
| 1.1 | Binary Numbers | • Introduction to Binary Number System<br>• Conversion of decimal numbers to binary system and vice-versa and its applications. | Students will be able to<br>• Understand the relation between decimal and binary number system.<br>• Able to convert from one system to another.<br>• Understand the application of Binary number system in programming, coding, machine learning etc. |
| 1.2 | Indices, Logarithm and Antilogarithm | • Indices and its properties<br>• Common and Natural logarithm<br>• Laws of logarithms<br>• Logarithm and exponential as inverse operations<br>• Procedure of finding logarithm and antilogarithms of given number<br>• Applications of logarithms | Students will be able to<br>• Apply rules of indices to simplify expressions and solve problems involving powers<br>• Define logarithms and antilogarithms as inverse operations<br>• Distinguish between common logarithms and natural logarithms<br>• Apply logarithmic and antilogarithmic techniques to simplify complex calculations, and solve practical problems |
| 1.3 | Introduction To Bhartiya System of Numeration | • Introduction To Bhartiya System of Numeration | Students will be able to<br>• Gain acquaintance with traditional way of expressing numbers |
| **Numbers in day-to-day Life** | | | |
| 1.4 | Clocks | • Evaluate the angular value of a minute<br>• Measure of angle formed between two hands of clock at given time<br>• Calculation of the time for which hands of clock meet | Students will be able to<br>• Calculate the angular displacement of hour and minute hands<br>• Find the exact time when clock hands coincide, are opposite, or form a specific angle<br>• Understand the practical utility of calendar |
| 1.5 | Calendar | • Odd days in a month/ year/ century<br>• Decode the day for the given date | Students will be able to<br>• Calculate odd days in any given month, year, or century<br>• Find the day of the week for any given date |

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| 1.6 | Time and Work | • Relationship between work and time<br>• Comparison of the work done by the individual / group w.r.t. time | Students will be able to<br>• Solve time-work problems<br>• Represent time-work relationship graphically |
| 1.7 | Speed, Distance and Time | • The time taken/ distance covered from the given data. | Students will be able to<br>• Represent distance-time relationship graphically |
| 1.8 | Seating arrangement | • Creation of seating plan/ draft as per given conditions (Linear/circular).<br>• Locating the position of a person in a seating arrangement. | Students will be able to<br>• Design and create seating plans in linear and circular arrangements<br>• Determine the exact position of any person in a seating arrangement by analysing the given conditions and applying logical reasoning<br>• Apply seating arrangement concepts to real-life situations |
| **UNIT – 2 ALGEBRA** | | | |
| **Sets** | | | |
| 2.1 | Introduction to Sets – Sets and their representation | • Set as well-defined collection of objects.<br>• Representation of a set in Roster form and Set builder form<br>• Different types of sets on the basis of number of elements in the set<br>• Differentiate between equal set and equivalent set | Students will be able to<br>• understand the systematic development of set theory.<br>• represent sets accurately using both roster form and set-builder form<br>• differentiate between the two methods of expressing the same set. |
| 2.2 | Subsets, Intervals as subsets | • Subsets<br>• Power set and its elements<br>• Universal Set<br>• Subset of real numbers as intervals | Students will be able to<br>• list all possible subsets of a given set, calculate the total number of subsets<br>• justify why the empty set is a subset of every set through logical reasoning.<br>• define power sets, construct the power set of a given set by identifying all its subsets<br>• Get an idea about the special sets i.e., intervals which have vide utility in the study of analysis. |
| 2.3 | Venn Diagrams and Operations on Sets | • Concept of Venn diagram to understand the relationship between sets<br>• Problems using Venn diagram | Students will be able to<br>• Use set operations to solve problems in various fields, such as probability, and data analysis.<br>• Develop problem-solving skills using set theory and Venn diagrams. |

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| | | • Operations on sets | • Perform operations on sets to solve practical problems |
| **Relations** | | | |
| 2.4 | Ordered pairs<br><br>Cartesian product of two sets | • Significance of specific arrangement of elements in a pair<br>• Cartesian product of two sets | Students will be able to<br>• Understand the concept of ordered pairs<br>• Find the Cartesian product of two finite sets<br>• Calculate the number of elements in a Cartesian product |
| 2.5 | Relations | • Expressing relation as a subset of Cartesian product<br>• Domain and range of a relation | Students will be able to<br>• Identify and express relations as subsets of Cartesian products<br>• Determine the domain and range of any relation<br>• Create and analyse custom relations from everyday situations |
| **Mathematical Logic** | | | |
| 2.6 | Mathematical Logic | • Logical problems involving odd man out, syllogism, blood relation and coding-decoding | Students will be able to<br>• Identify patterns and solve odd man out problems<br>• Draw valid conclusions using syllogism<br>• Decode blood relations and solve coding-decoding problems<br>• Apply logical reasoning skills to real-life decision-making situations |
| **Sequences and Series** | | | |
| 2.7 | Sequence and Series | • Differentiate between sequence and series | Students will be able to<br>• Distinguish between sequences and series |
| 2.8 | Arithmetic Progression | • Arithmetic mean (AM) of two positive numbers | Students will be able to<br>• Calculate and apply arithmetic mean (AM) of two positive numbers to find average values in real-life situations |
| 2.9 | Geometric Progression | • Introduction of Geometric Progression (GP)<br>• $n^{th}$ term of a GP<br>• sum of n terms and sum of infinite terms of a GP<br>• Problems based on applications of GP<br>• Geometric mean (GM) of two positive numbers<br>• Relation between AM and GM and related problems<br>• Application problems based on AP and GP | Students will be able to<br>• Identify and construct geometric progressions<br>• Calculate geometric mean (GM) of two positive numbers<br>• Analyse and prove the AM-GM inequality relationship<br>• Apply formulas of arithmetic and geometric progressions strategically to solve real-world problems |

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| **UNIT – 3 CALCULUS** | | | |
| **Functions** | | | |
| 3.1 | Functions and their graphs | • Dependent and independent variables<br>• Definition of function using dependent and independent variable<br>• Domain, range and co-domain of a given function<br>• Types of functions<br>• Graphical representation of function | Students will be able to<br>• Define dependent and independent variables<br>• Define and differentiate between domain, co-domain, and range of functions<br>• Classify and define various types of functions<br>• Determine domain, co-domain, and range of given functions<br>• Represent functions graphically on coordinate planes<br>• Apply function concepts to solve real-life problems involving mapping relationships like student enrolment systems, profit-loss calculations, and designing input-output models for business. |
| **Limits, Continuity and Derivatives** | | | |
| 3.2 | Limits and continuity of functions | • Limit of a function<br>• Continuity of a function | Students will be able to<br>• Define and understand the concept of limit of a function by analysing the behaviour of functions.<br>• Solve problems based on the algebra of limits.<br>• Define continuity of a function at a point and over an interval |
| 3.3 | Differentiation | • Instantaneous rate of change<br>• Finding the derivative of the functions | Students will be able to<br>• Define the derivative of a function and relate it to the slope of the tangent to a curve. |
| 3.4 | Algebra of derivatives | • Differentiation of addition, subtraction, multiplication and division of two or more functions<br>• Differentiation of a function of a function | Students will be able to<br>• state and apply the fundamental rules of differentiation for sum, difference, product, and quotient of two or more functions<br>• understand the chain rule as the method for differentiating composite functions. |
| **UNIT – 4 PERMUTATIONS AND COMBINATIONS & PROBABILITY** | | | |
| **Combinatorics** | | | |
| 4.1 | Combinatorics | • Factorial of a number<br>• Fundamental Principle of Counting<br>• Concept of Permutation<br>• Simple problems based on permutations | Students will be able to<br>• Understand and calculate factorials of numbers<br>• Appreciate how to count without counting<br>• Define permutation and apply the |

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| | | • Define combination<br>• Difference between permutation and combination<br>• Problems based on Combinations | concept to solve problems<br>• Define combination and differentiate it from permutation<br>• Apply permutation and combination formulas strategically<br>• Model complex counting situations using permutation and combination concepts |
| **Probability** | | | |
| 4.2 | Probability | • Random experiment and sample space with suitable examples<br>• Event and its Types<br>• Concept of Probability<br>• Problems based on calculating probabilities in real life situations<br>• Concept of conditional probability | Students will be able to<br>• Define random experiment and sample space with suitable examples<br>• Recognize and differentiate different types of events and find their probabilities<br>• Appreciate the use of probability in daily life situations<br>• Apply reasoning skills to solve problems based on conditional probability |
| **UNIT- 5 DESCRIPTIVE STATISTICS** | | | |
| **Measures of Dispersion and Percentiles** | | | |
| 5.1 | Measures of Dispersion | • Meaning of dispersion in a data set<br>• Range, mean deviation, standard deviation and variance | Students will be able to<br>• Understand the meaning of dispersion in a data set<br>• Differentiate between range, mean deviation and standard deviation<br>• Calculate range, range standard deviation and variance, and standard deviation for ungrouped and grouped data set<br>• Choose appropriate measure of dispersion to calculate spread of data |
| 5.2 | Percentiles | • Concept of Percentile rank<br>• Calculate and interpret Percentile rank of scores in a given ungrouped data set. | Students will be able to<br>• Calculate, analyze and interpret Percentile rank of scores in a given ungrouped data set. |
| **Correlation** | | | |
| 5.3 | Correlation | • Concept of Correlation<br>• Karl Pearson's coefficient of Correlation for ungrouped data<br>• Spearman's Rank Correlation for ungrouped data | Students will be able to<br>• Analyze relationships between variables by calculating and interpreting Karl Pearson's coefficient of correlation and Spearman's rank correlation coefficient for ungrouped data. |
| **Regression** | | | |
| 5.4 | Regression | • Concept of Regression analysis<br>• Dependent and | Students will be able to<br>• Distinguish between correlation and regression analysis. |

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| | | Independent variables<br>• Regression Coefficients<br>• Regression Equations<br>• Properties of Regression Equations | • Compute regression coefficients.<br>• Solve real-world problems by selecting and applying appropriate correlation or regression techniques. |
| **UNIT – 6 FINANCIAL MATHEMATICS** | | | |
| **Interests and Annuities** | | | |
| 6.1 | Interest and Interest Rates | • Concept of Interest Rates<br>• Comparison between Nominal Interest Rate, Effective Rate and Real Interest Rate<br>• Practical applications of interest rate w.r.t simple and compound interest<br>• Concept of effective rate of interest | Students will be able to<br>• Understand the concept of interest rates<br>• Differentiate between nominal interest rate, effective rate, and real interest rate<br>• Calculate and compare simple and compound interest<br>• Apply interest rate concepts to solve real-life financial problems<br>• Define with examples the concept of effective rate of interest<br>• Analyze and evaluate financial products and investment schemes |
| 6.2 | Annuities | • Meaning of Immediate Annuity, Annuity due and Deferred Annuity<br>• Future and present value of ordinary annuity, annuity due (up to 3 period)<br>• Concept of Annuity in real life situations | Students will be able to<br>• Understand and differentiate between immediate annuity, annuity due, and deferred annuity<br>• Calculate the future and present value of regular annuity and annuity due<br>• Apply annuity concepts to real-life financial situations |
| **Tax and Utility Bills** | | | |
| 6.3 | Taxes and Utility Bills | • Concept of Income tax and GST w.r.t. tax new tax guidelines<br>• Utility bills and its various types – Electricity, Water and PNG Bills | Students will be able to<br>• Understand the concept of income tax and GST<br>• Calculate income tax and GST liabilities using applicable tax brackets<br>• Analyse and calculate types of utility bills – Electricity and Water Bills<br>• Apply taxation and utility billing concepts to real-life situations. |
| **UNIT – 7 COORDINATE GEOMETRY** | | | |
| **Straight Lines** | | | |
| 7.1 | Straight lines | • Concept of slope of a line<br>• Various forms of equation of line | Students will be able to<br>• Understand the gradient as the measure of steepness and calculate it using coordinates<br>• Derive and apply various algebraic forms to represent lines in a Cartesian plane. |

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| | | | • Apply linear equations to model real-world scenarios like demand and supply curves in economics. |
| **Circles and Parabola** | | | |
| 7.2 | Circles and Parabola | • Determination of the equations of circle and parabola as a locus of a point in a plane under certain conditions<br>• Different form of equations of a circle<br>• Solve problems based on applications of circle | Students will be able to<br>• Define circles and parabolas as sets of points satisfying specific geometric conditions in a plane.<br>• Formulate and solve equations of circles in standard, central, diameter, and general forms.<br>• Identify the properties of a parabola and express its standard form equation based on its focus and directrix.<br>• Utilize the properties of circles to solve practical and coordinate-based mathematical problems. |

**Suggested Practicals using spreadsheet**

1. Visualizing Functions and Their Properties: Plotting graphs of functions in GeoGebra to observe how coefficients change the graph's shape and to find out their domain and range graphically.
2. Understanding Derivatives: Constructing a tangent line to a curve in GeoGebra and observing its slope as the point moves and demonstrating the derivative as the instantaneous rate of change.
3. Personal Budgeting: Designing a comprehensive monthly budget tracker in a spreadsheet to manage income and expenditures using summation and percentage formulas.
4. Comparative Cost-Benefit Analysis: Building a decision-making model to identify the most economical purchase for a high-value product by comparing cost, shipping charges, tax and other hidden costs.
5. Descriptive Measures of Data: Using spreadsheet functions (e.g., AVERAGE, STDEV.P etc.) to compute the mean, median, mode, variance, and standard deviation of a raw dataset.
6. Interest Growth Analysis: Developing a comparative sheet for Simple vs. Compound Interest to track the growth of an investment over time.
7. Environmental & Economic Data Modelling: Analysing real-world datasets regarding local weather, inflation or AQI by generating and interpreting scatter plots, histograms, bar graphs etc. to identify correlations and seasonal trends.

## Grade XII (2026-27)

**Number of Paper:** **1**

**Time:** **3 Hours**

**Max Marks:** **80**

| No. | Units | Marks |
|---|---|---|
| I | Numbers, Quantification and Numerical Applications | 11 |
| II | Algebra | 10 |
| III | Calculus | 15 |
| IV | Probability Distributions | 10 |
| V | Inferential Statistics | 05 |
| VI | Time-based data | 06 |
| VII | Financial Mathematics | 15 |
| VIII | Linear Programming | 08 |
| **Total** | | **80** |
| **Internal Assessment** | | **20** |

| CLASS- XII | | | |
|---|---|---|---|
| **Sl. No.** | **Contents** | **Learning Outcomes: Students will be able to** | **Notes / Explanation** |
| **UNIT – 1 NUMBERS, QUANTIFICATION AND NUMERICAL APPLICATIONS** | | | |
| **Numbers & Quantification** | | | |
| 1.1 | Modulo Arithmetic | • Define modulus of an integer<br>• Apply arithmetic operations using modular arithmetic rules | • Definition and meaning<br>• Introduction to modulo operator<br>• Modular addition and subtraction |
| 1.2 | Congruence Modulo | • Define congruence modulo<br>• Apply the definition in various problems | • Definition and meaning<br>• Solution using congruence modulo<br>• Equivalence class |
| 1.3 | Alligation and Mixture | • Understand the rule of alligation to produce a mixture at a given price<br>• Determine the mean price of a mixture<br>• Apply rule of allegation | • Meaning and Application of rule of alligation<br>• Mean price of a mixture |
| 1.4 | Numerical Problems | Solve real life problems mathematically | |
| | Boats and Streams (upstream and downstream) | • Distinguish between upstream and downstream<br>• Express the problem in the form of an equation | • Problems based on speed of stream and the speed of boat in still water |
| | Pipes and Cisterns | • Determine the time taken by two or more pipes to fill or empty the tank | • Calculation of the portion of the tank filled or drained by the pipe(s) in unit time |
| | Races and Games | • Compare the performance of two players w.r.t. time, distance | • Calculation of the time taken/ distance covered / speed of each player |
| 1.5 | Numerical Inequalities | • Describe the basic concepts of numerical inequalities<br>• Understand and write numerical inequalities | • Comparison between two statements/situations which can be compared numerically<br>• Application of the techniques of numerical solution of algebraic inequations |

| UNIT-2 ALGEBRA | | | |
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| 2.1 | Matrices and types of matrices | • Define matrix<br>• Identify different kinds of matrices. Find the size / order of matrices | • The entries, rows and columns of matrices<br>• Present a set of data in a matrix form |
| 2.2 | Equality of matrices, Transpose of a matrix, Symmetric and Skew symmetric matrix | • Determine equality of two matrices<br>• Write transpose of given matrix<br>• Define symmetric and skew symmetric matrix | •Examples of transpose of matrix<br>•A square matrix as a sum of symmetric and skew symmetric matrix<br>•Observe that diagonal elements of skew symmetric matrices are always zero |
| 2.3 | Algebra of Matrices | • Perform operations like addition & subtraction on matrices of same order<br>• Perform multiplication of two matrices of appropriate order<br>• Perform multiplication of a scalar with matrix | • Addition and Subtraction of matrices<br>• Multiplication of matrices (It can be shown to the students that Matrix multiplication is similar to multiplication of two polynomials)<br>• Multiplication of a matrix with a real number |
| 2.4 | Determinants | • Find determinant of a square matrix | • Singular matrix, Non-singular matrix<br>• \|AB\|=\|A\|\|B\|<br>• Simple problems to find determinant value |
| 2.5 | Inverse of a matrix | • Define the inverse of a square matrix<br>• Apply properties of inverse of matrices | •Inverse of a matrix using cofactors<br>•If A and B are invertible square matrices of same size,<br>i) $(AB)^{-1} = B^{-1}A^{-1}$<br>ii) $(A^{-1})^{-1} = A$<br>iii) $(A')^{-1} = (A^{-1})'$ |
| 2.6 | Solving system of simultaneous equations using matrix method and Cramer's rule | • Solve the system of simultaneous equations using<br>i) Cramer's Rule<br>ii) Inverse of coefficient matrix<br>• Formulate real life problems into a system of simultaneous linear equations and solve it using these methods | • Solution of system of simultaneous equations up to three variables only (non- homogeneous equations) |

| UNIT- 3 CALCULUS | | | |
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| **Differentiation and its Applications** | | | |
| 3.1 | Derivatives up to second order | • Determine derivatives up to second order<br>• Understand differentiation of parametric functions and implicit functions | • Simple problems based on up to second order derivatives<br>• Differentiation of parametric functions and implicit functions (upto 2nd order) |
| 3.2 | Application of Derivatives | • Determine the rate of change of various quantities | • To find the rate of change of quantities such as area and volume with respect to time or its dimension |
| 3.3 | Marginal Cost and Marginal Revenue using derivatives | • Define marginal cost and marginal revenue<br>• Find marginal cost and marginal revenue | • Examples related to marginal cost, marginal revenue, etc. |
| 3.4 | Increasing /Decreasing Functions | • Determine whether a function is increasing or decreasing<br>• Determine the conditions for a function to be increasing or decreasing | • Simple problems related to increasing and decreasing behaviour of a function in the given interval |
| 3.5 | Maxima and Minima | • Determine critical points of the function<br>• Find the point(s) of local maxima and local minima and corresponding local maximum and local minimum values<br>• Find the absolute maximum and absolute minimum value of a function<br>• Solve applied problems related to optimization of cost, revenue and profit only. | • A point $x = c$ is called the critical point of f if f is defined at $c$ and $f'(c) = 0$ or f is not differentiable at $c$<br>• To find local maxima and local minima by:<br>i) First Derivative Test<br>ii) Second Derivative Test<br>• Contextualized real life problems |
| **Integration and its Applications** | | | |
| 3.6 | Integration | • Understand and determine indefinite integrals of simple functions as anti-derivative | • Integration as a reverse process of differentiation<br>• Vocabulary and Notations related to Integration |

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| 3.7 | Indefinite Integrals as family of curves | • Evaluate indefinite integrals of simple algebraic functions by method of:<br>i) substitution<br>ii) partial fraction<br>iii) by parts | • Simple integrals based on each method (non-trigonometric function) |
| 3.8 | Definite Integrals as area under the curve | • Define definite integral as area under the curve<br>• Understand fundamental theorem of Integral calculus and apply it to evaluate the definite integral | • Evaluation of area under simple algebraic curves up to 2nd degree. |
| 3.9 | Application of Integration | • Identify the region representing consumer surplus and producer surplus graphically<br>• Apply the definite integral to find consumer surplus-producer surplus | Problems based on finding<br>• Total cost when Marginal Cost is given<br>• Total Revenue when Marginal Revenue is given<br>• Equilibrium price and equilibrium quantity and hence consumer and producer surplus |
| **Differential Equations and Modeling** | | | |
| 3.10 | Differential Equations | • Recognize a differential equation<br>• Find the order and degree of a differential equation | • Definition, order, degree and examples |
| 3.11 | Formulating and Solving Differential Equations | • Formulate differential equation<br>• Verify the solution of differential equation<br>• Solve simple differential equation using variable separable method only | • Formation of differential equation by eliminating arbitrary constants<br>• Solution of simple differential equations (direct integration only) |
| **UNIT- 4 PROBABILITY DISTRIBUTIONS** | | | |
| 4.1 | Probability Distribution | • Understand the concept of Random Variables and its Probability Distributions<br>• Find probability distribution of discrete random variable | • Definition and example of discrete and continuous random variable and their distribution |
| 4.2 | Mathematical Expectation | • Apply arithmetic mean of frequency distribution to find the expected value of a random variable | • The expected value of discrete random variable as summation of product of discrete random variable by the probability of its occurrence. |
| 4.3 | Variance | • Calculate the Variance and S.D. of a random variable | • Questions based on variance and standard deviation |

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| 4.4 | Binomial Distribution | • Identify the Bernoulli Trials and apply Binomial Distribution<br>• Evaluate Mean, Variance and S.D of a binomial distribution | • Characteristics of binomial distribution<br>• Binomial formula:<br>$P(r) = n_{C_r} p^r q^{n-r}$<br>Where $n$ = number of trials<br>$p$ =probability of success<br>$q$ = probability of failure<br>Mean $= np$<br>Variance $= npq$<br>Standard deviation $= \sqrt{npq}$ |
| 4.5 | Poison Distribution | • Understand the Conditions of Poisson Distribution<br>• Evaluate the Mean and Variance of Poisson distribution | • Characteristics of Poisson Probability distribution<br>Poisson formula: $P(X) = \frac{\lambda^x e^{-\lambda}}{x!}$<br>• Mean = Variance $= \lambda$ |
| 4.6 | Normal Distribution | • Understand normal distribution is a Continuous distribution<br>• Evaluate value of Standard normal variate<br>• Area relationship between Mean and Standard Deviation | • Characteristics of a normal probability distribution<br>• Total area under the curve = total probability = 1<br>• Standard Normal Variate:<br>$Z = \frac{x-\mu}{\sigma}$,<br>where $x$ = value of random variable,<br>$\mu$ = mean,<br>$\sigma$ = S.D |
| **UNIT - 5 INFERENTIAL STATISTICS** | | | |
| 5.1 | Population and Sample | • Define Population and Sample<br>• Differentiate between population and sample<br>• Define a representative sample from a population<br>• Differentiate between a representative and non-representative sample<br>• Draw a representative sample using simple random sampling<br>• Draw a representative sample using and systematic random sampling | • Population data from census, economic surveys and other contexts from practical life<br>• Examples of drawing more than one sample set from the same population<br>• Examples of representative and non-representative sample<br>• Unbiased and biased sampling<br>• Problems based on random sampling using simple random sampling and systematic random sampling (sample size less than 100) |

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| 5.2 | Parameter and Statistics and Statistical Interferences | • Define Parameter with reference to Population<br>• Define Statistics with reference to Sample<br>• Explain the relation between Parameter and Statistic<br>• Explain the limitation of Statistic to generalize the estimation for population<br>• Interpret the concept of Statistical Significance and Statistical Inferences<br>• State Central Limit Theorem<br>• Explain the relation between Population-Sampling Distribution-Sample | • Conceptual understanding of Parameter and Statistics<br>• Examples of Parameter and Statistic limited to Mean and Standard deviation only<br>• Examples to highlight limitations of generalizing results from sample to population<br>• Only conceptual understanding of Statistical Significance/Statistical Inferences<br>• Only conceptual understanding of Sampling Distribution through simulation and graphs |
| 5.3 | t-Test (one sample t-test and for a small group sample) | • Define a hypothesis<br>• Differentiate between Null and Alternate hypothesis<br>• Define and calculate degree of freedom<br>• Test Null hypothesis and make inferences using t-test statistic for one group | • Examples and non-examples of Null and Alternate hypothesis (only non- directional alternate hypothesis)<br>• Framing of Null and Alternate hypothesis<br>• Testing a Null Hypothesis to make Statistical Inferences for small sample size *(for small sample size: t-test for one group*) |
| **UNIT – 6 TIME-BASED DATA** | | | |
| 6.1 | Time Series | • Identify time series as chronological data | • Meaning and Definition |
| 6.2 | Components of Time Series | • Distinguish between different components of time series | • Secular trend<br>• Seasonal variation<br>• Cyclical variation<br>• Irregular variation |
| 6.3 | Time Series analysis for univariate data | • Solve practical problems based on statistical data and interpret the result | • Fitting a straight-line trend and estimating the value |
| 6.4 | Secular Trend | • Understand the long-term tendency | • The tendency of the variable to increase or decrease over a long period of time |
| 6.5 | Methods of Measuring trend | • Demonstrate the techniques of finding trend by different methods | • Moving Average method<br>• Method of Least Squares |

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| **UNIT - 7 FINANCIAL MATHEMATICS** | | | |
| 7.1 | Perpetuity, Sinking Funds | • Explain the concept of perpetuity and sinking fund<br>• Calculate perpetuity<br>• Differentiate between sinking fund and saving account | • Meaning of Perpetuity and Sinking Fund<br>• Real life examples of sinking fund<br>• Advantages of Sinking Fund<br>• Sinking Fund vs. Savings account |
| 7.2 | Valuation of Bonds | • Define the concept of valuation of bond and related terms.<br>• Calculate value of bond using present value approach | • Meaning of Bond Valuation<br>• Terms related to valuation of bond: Coupon rate, Maturity rate and Current price.<br>• Bond Valuation Method: Present Value Approach |
| 7.3 | Calculation of EMI | • Explain the concept of EMI<br>• Calculate EMI using various methods | • Methods to calculate EMI:<br>i) Flat-Rate Method<br>ii) Reducing-Balance Method<br>• Real life examples to calculate EMI of various types of loans, purchase of assets, etc. |
| 7.4 | Compound Annual Growth Rate | • Understand the concept of Compound Annual Growth Rate<br>• Differentiate between Compound Annual Growth Rate and Annual Growth Rate<br>• Calculate Compound Annual Growth Rate | • Meaning and use of Compound Annual Growth Rate<br>• Formula for Compound Annual Growth Rate |
| 7.5 | Linear method of Depreciation | • Define the concept of linear method of Depreciation<br>• Interpret cost, residual value and useful life of an asset from the given information<br>• Calculate depreciation | • Meaning and formula for Linear Method of Depreciation<br>• Advantages and disadvantages of Linear Method |
| **UNIT - 8 LINEAR PROGRAMMING** | | | |
| 8.1 | Introduction and related terminology | • Familiarize with terms related to Linear Programming Problem | • Need for framing linear programming problem<br>• Definition of Decision Variable, Constraints, Objective function, Optimization and Non negative constraints |

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| 8.2 | Mathematical formulation of Linear Programming Problem | • Formulate Linear Programming Problem upto 3 non-trivial constraints | • Set the problem in terms of decision variables, identify the objective function, identify the set of problem constraints,<br>• express the problem in terms of inequations |
| 8.3 | Different types of Linear Programming Problems | • Identify and formulate different types of LPP | • Formulate various types of LPP's like Manufacturing Problem, Diet Problem etc. |
| 8.4 | Graphical method of solution for problems in two variables | • Draw the Graph for a system of linear inequalities involving two variables and to find its solution graphically | • Corner Point Method for the Optimal solution of LPP |
| 8.5 | Feasible and Infeasible Regions | • Identify feasible, infeasible, bounded and unbounded regions | • Definition and Examples to explain the terms |
| 8.6 | Feasible and infeasible solutions, optimal feasible solution | • Understand feasible and infeasible solutions<br>• Find optimal feasible solution | • Problems based on optimization<br>• Examples of finding the solutions by graphical method |

**Practical: Use of spreadsheet**

Graphs of an exponential function, demand and supply functions on Excel and study the nature of function at various points, maxima/minima, Matrix operations using Excel

**Suggested practical using the spreadsheet**

i) Plot the graphs of functions on excel and study the graph to find out the point of maxima/minima
ii) Probability and dice roll simulation
iii) Matrix multiplication and the inverse of a matrix
iv) Stock Market data sheet on excel
v) Collect the data on weather, price, inflation, and pollution analyze the data and make meaningful inferences
vi) Collect data from newspapers on traffic, sports activities and market trends and use excel to study future trends

**List of Suggested projects (Class XI /XII)**

i) Use of prime numbers in coding and decoding of messages
ii) Prime numbers and divisibility rules
iii) Logarithms for financial calculations such as interest, present value, future value, profit/loss etc. with large values)
iv) The cardinality of a set and orders of infinity
v) Comparing sets of Natural numbers, rational numbers, real numbers and others
vi) Use of Venn diagram in solving practical problems
vii) Fibonacci sequence: Its' history and presence in nature
viii) Testing the validity of mathematical statements and framing truth tables

ix) Investigating Graphs of functions for their properties
x) Visit the census site of India http://www.censusindia.gov.in/Census_Data_2001/Census_Data_Online/Language/State ment3.html Depict the information given there in a pictorial form
xi) Prepare a questionnaire to collect information about money spent by your friends in a month on activities like travelling, movies, recharging of the mobiles, etc. and draw interesting conclusions
xii) Check out the local newspaper and cut out examples of information depicted by graphs. Draw your own conclusions from the graph and compare it with the analysis given in the report
xiii) Analysis of population migration data – positive and negative influence on urbanization
xiv) Each day newspaper tells us about the maximum temperature, minimum temperature, and humidity. Collect the data for a period of 30 days and represent it graphically. Compare it with the data available for the same time period for the previous year
xv) Analysis of career graph of a cricketer (batting average for a batsman and bowling average for a bowler). Conclude the best year of his career. It may be extended for other players also – tennis, badminton, athlete
xvi) Vehicle registration data – correlating with pollution and the number of accidents
xvii) Visit a village near Delhi and collect data of various crops over the past few years from the farmers. Also, collect data about temperature variation and rain over the period for a particular crop. Try to find the effect of temperature and rain variations on various crops
xviii) Choose any week of your ongoing semester. Collect data for the past 10 – 15 years for the amount of rainfall received in Delhi during that week. Predict the amount of rainfall for the current year
xix) Weather prediction (prediction of monsoon from past data)
xx) Visit Kirana shops near your home and collect the data regarding the sales of certain commodities over a month. Try to figure out the stock of a particular commodity which should be in the store in order to maximize the profit
xxi) Stock price movement
xxii) Risk assessments by insurance firms from data
xxiii) Predicting stock market crash
xxiv) Predicting the outcome of an election – exit polls
xxv) Predicting mortality of infants