Applied Mathematics (XI-XII)

(Code-241)

Session- 2021-22

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 (2021-22)

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			
1.1	Prime Numbers, Encryptions using Prime Numbers	● Identify prime numbers ● Encrypt or Decrypt the message using prime numbers	● Definition and meaning ● Introduction to encryption /decryption using prime numbers by RSA algorithm
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
1.3	Complex Numbers (Preliminary Idea Only)	● Define complex numbers and explain basic notions of complex numbers ● Perform basic operations on the complex numbers ● Find additive inverse and multiplicative inverse of a complex number ● Find conjugate and modulus of complex numbers	• Definition and representation of Complex Numbers • Basic operations (addition, subtraction, multiplication and division) on two or more complex numbers ● Properties of Conjugate and Modulus of complex numbers
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 elements in a Cartesian product of two sets	• Ordered pair, order of elements in an ordered pair and equality of ordered pairs • Cartesian product of two non-empty 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
2.10	Types of relations	• Define and illustrate different types of relations: Empty relation and universal relation • Examine whether the relation is equivalence or not • Define function as a special type of relation • Categorize relations that are functions and non-functions	• Types of relations: Empty relation, universal relation, reflexive relation, symmetric relation, transitive relation, equivalence relation • Introducing a function as a special type of relation • Examples and non-examples of functions
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	• General term of AP: $t_n = a + (n-1)d$ • Sum of n terms of AP : $S_n = \frac{n}{2}[2a + (n-1)d]$

		● Solve application problems based on AP ● Find arithmetic mean (AM) of two positive numbers	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 $^nP_r=\frac{n!}{(n-r)!}$ or n^r or $\frac{n!}{n_1!n_2!\ldots n_k!}$ arrangements
2.18	Circular permutation	●Define circular permutation ●Solve problems based on circular permutation	● (n-1)! as the number of permutations of n distinct objects in a circle ● Number of arrangements as $\frac{(n-1)!}{2}$, when clockwise and anticlockwise arrangement of objects are indistinguishable
2.19	Permutations	● Solving problems based	● Permutations in which some

	with restrictions	on permutations with restrictions	objects come together or come at designated places. ● Permutations in which some objects are always included or excluded
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 ${}^nC_r = \frac{n!}{r!.(n-r)!}$ Some results on combinations: ● ${}^nC_0 = 1 = {}^nC_n$ ● ${}^nC_a = {}^nC_b \Rightarrow a=b$ or $a+b=n$ ● ${}^nC_r = {}^nC_{n-r}$ ● ${}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$
2.21	Combination with repetition	● Solve problems using combination with repetitions	● Combination of n distinct objects taken r at a time if repetition is allowed
UNIT -3 MATHEMATICAL REASONING			
3.1	Mathematical reasoning	● Identify mathematically acceptable statements ● Express the implications of the compound statement ● Validate mathematical statements	● Meaning of mathematical statements ● Negation ● Compound statements ● Quantifiers ● Converse and Contrapositive of the statement ● Implications ● Validating statements
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 $\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$
4.9	Tangent line and Equation of tangent	● Define tangent line ● Find the gradient of a tangent ● Find equation of tangent to the curve $y = f(x)$ at a given point	● The slope (gradient) of the tangent to the curve $y = f(x)$ at the given point ● The equation of the tangent to the curve at the given point
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			
6.1	Types of data	• Identify real life situations for collecting data • Categorize data based on nature of data (Primary and Secondary Data, Raw and Organized Data) • Identify and differentiate univariate, bivariate and multi-variate data • Identify and differentiate discrete data and continuous data • Collect raw data from practical examples	• Examples of raw data from different surveys, sports • Multi-variate data from not more than three variables • Collection of data up to three variables from real life examples, such as, data of students (age, weight, height)
6.2	Data on various scales	• Describe nominal, ordinal, interval and ratio scale of data collection • Collect and classify data on different scales of measurement	• Examples and non-examples of data on different scales • Benefit and limitations of collecting data on various scales
6.3	Data representation and data visualization	• Organize raw data in discrete and continuous form • Represent data on nominal and ordinal scales of measurement using pie chart and bar graphs	• Data organization in increasing/decreasing order, using frequency table and in class intervals of various length • Graphical representation of data using pie-chart/bar graphs/histogram using class interval of equal and unequal length

		● Represent data on interval and ratio scale using histogram and frequency polygon ● Represent bivariate continuous data using line graph ● Choose appropriate graph to represent data of various kinds	●Visualization of data using Excel Spreadsheet or any other computer assisted tool
6.4	Data Interpretation		
	Measure of Central Tendency	● Define central tendency of a data set ● Differentiate between mean, median and mode ● Calculate mean, median and mode for ungrouped and grouped data ● Choose appropriate measure to calculate central tendency	●Mean using direct method, assumed mean method and step deviation method ●Median and Mode ●Examples of different kinds of data helping students to choose and compare different measures of central tendency
	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	●Emphasis on application, analysis

		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	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 ● Solve Practical applications of interest rate	● Impact of high interest rates and low interest rates on the business
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 Goods and Services Tax (SGST) Central Goods and Services Tax (CGST) and Union Territory Goods and Services Tax (UTGST)	● 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. ● 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	● 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

		lines	
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

Grade XII (2021-22)

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Time: **3 Hours**

Max Marks: **80**

No.	Units	No. of Periods	Marks
I	Numbers, Quantification and Numerical Applications	30	09
II	Algebra	20	10
III	Calculus	50	15
IV	Probability Distributions	35	10
V	Inferential Statistics	10	05
VI	Index Numbers and Time-based data	30	10
VII	Financial Mathematics	50	15
VIII	Linear Programming	15	06
Total		240	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			
1.1	Modulo Arithmetic	• Define modulus of an integer • Apply arithmetic operations using modular arithmetic rules	• Definition and meaning • Introduction to modulo operator • Modular addition and subtraction
1.2	Congruence Modulo	●Define congruence modulo ●Apply the definition in various problems	●Definition and meaning ●Solution using congruence modulo ●Equivalence class
1.3	Simple Arithmetic Functions	• Define arithmetic function • Enlist different arithmetic functions • Apply the arithmetic functions on given number	Properties and Examples of: i) Euler totient function ii) Number of divisor function iii) Divisor sum function iv) Mobius function
1.4	Alligation and Mixture	●Understand the rule of alligation to produce a mixture at a given price ●Determine the mean price of a mixture ●Apply rule of alligation	●Meaning and Application of rule of alligation ●Mean price of a mixture
1.5	Numerical Problems	Solve real life problems mathematically	
	Boats and Streams (upstream and downstream)	●Distinguish between upstream and downstream ●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
	Partnership	●Differentiate between active partner and sleeping partner ●Determine the gain or loss to be divided among the partners in the ratio of their investment with due consideration of the time	●Definition, Profit division among the partners
	Scheduling	●Define scheduling ●Differentiate between FCFS & SJF ●Solve problems based on FCFS	●Definition and meaning ●Use of Gantt chart Simple problems based on FCFS (First come First serve)

		and SJF	and SJF (shortest job first)
1.6	Numerical Inequalities	● Describe the basic concepts of numerical inequalities ● Understand and write numerical inequalities	● Comparison between two statements/situations which can be compared numerically ● Application of the techniques of numerical solution of algebraic inequations
UNIT-2	**ALGEBRA**		
2.1	Matrices and types of matrices	● Define matrix ● Identify different kinds of matrices ● Find the size / order of matrices	● The entries, rows and columns of matrices ● 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 ● Write transpose of given matrix ● Define symmetric and skew symmetric matrix	● Examples of transpose of matrix ● A square matrix as a sum of symmetric and skew symmetric matrix ● 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 ● Perform multiplication of two matrices of appropriate order ● Perform multiplication of a scalar with matrix	● Addition and Subtraction of matrices ● Multiplication of matrices (It can be shown to the students that Matrix multiplication is similar to multiplication of two polynomials) ● Multiplication of a matrix with a real number
2.4	Determinants	● Find determinant of a square matrix ● Use elementary properties of determinants	● Singular matrix, Non singular matrix ● $\|AB\|=\|A\|\|B\|$ ● Simple problems to find determinant value
2.5	Inverse of a matrix	● Define the inverse of a square matrix ● Explain elementary row operations and use to it find the inverse of a matrix ● Apply properties of inverse of matrices	● Inverse of a matrix using: a) cofactors b) elementary row operations ● If A and B are invertible square matrices of same size, i) $(AB)^{-1}=B^{-1}A^{-1}$ ii) $(A^{-1})^{-1}=A$ iii) $(A^T)^{-1}=(A^{-1})^T$
2.6	Solving system of simultaneous equations using matrix method, Cramer's rule and row reduction method	● Solve the system of simultaneous equations using i) Cramer's Rule ii) Inverse of coefficient matrix iii) Row reduction method ● Formulate real life problems into a system of simultaneous linear equations and solve it using these methods	● Solution of system of simultaneous equations upto three variables only (non- homogeneous equations)

2.7	Simple applications of matrices and determinants including Leontiff input output model for two variables	• Apply simple applications of matrices and determinants in different areas of mathematics, physics, coding, encryption etc. • Apply real life applications particularly for Leontiff input output model for two variables in economics	• Real life applications of Matrices and Determinant • Leontiff Input–output model that represents the interdependencies between different sectors of a national economy or different regional economies
UNIT- 3 CALCULUS			
Differentiation and its Applications			
3.1	Higher Order Derivatives	• Determine second and higher order derivatives • Understand differentiation of parametric functions and implicit functions	• Simple problems based on higher order derivatives • Differentiation of parametric functions and implicit functions (upto 2^{nd} order)
3.2	Application of Derivatives	• Determine the rate of change of various quantities • Understand the gradient of tangent and normal to a curve at a given point • Write the equation of tangents and normal to a curve at a given point	• To find the rate of change of quantities such as area and volume with respect to time or its dimension • Gradient / Slope of tangent and normal to the curve • The equation of the tangent and normal to the curve (simple problems only)
3.3	Marginal Cost and Marginal Revenue using derivatives	• Define marginal cost and marginal revenue • 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 • 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 • Find the point(s) of local maxima and local minima and corresponding local maximum and local minimum values • Find the absolute maximum and absolute minimum value of a function • Solve applied problems	• 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 • To find local maxima and local minima by: i) First Derivative Test ii) Second Derivative Test • Contextualized real life problems
Integration and its Applications			
3.5	Integration	• Understand and determine indefinite integrals of simple functions as anti-derivative	• Integration as a reverse process of differentiation • Vocabulary and Notations

			related to Integration
3.6	Indefinite Integrals as family of curves	• Evaluate indefinite integrals of simple algebraic functions by method of: i) substitution ii) partial fraction iii) by parts	• Simple integrals based on each method (non-trigonometric function)
3.7	Definite Integrals as area under the curve	• Define definite integral as area under the curve • Understand fundamental theorem of Integral calculus and apply it to evaluate the definite integral • Apply properties of definite integrals to solve the problems	• Evaluation of definite integrals using properties
3.9	Application of Integration	• Identify the region representing C.S. and P.S. graphically • Apply the definite integral to find consumer surplus-producer surplus	Problems based on finding • Total cost when Marginal Cost is given • Total Revenue when Marginal Revenue is given • Equilibrium price and equilibrium quantity and hence consumer and producer surplus
Differential Equations and Modeling			
3.10	Differential Equations	• Recognize a differential equation • Find the order and degree of a differential equation	• Definition, order, degree and examples
3.11	Formulating and Solving Differential Equations	• Formulate differential equation • Verify the solution of differential equation • Solve simple differential equation	• Formation of differential equation by eliminating arbitrary constants • Solution of simple differential equations (direct integration only)
3.12	Application of Differential Equations	• Define Growth and Decay Model • Apply the differential equations to solve Growth and Decay Models	• Growth and Decay Model in Biological sciences, Economics and business, etc.
UNIT- 4 PROBABILITY DISTRIBUTIONS			
4.1	Probability Distribution	• Understand the concept of Random Variables and its Probability Distributions • 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

4.4	Binomial Distribution	● Identify the Bernoulli Trials and apply Binomial Distribution ● Evaluate Mean, Variance and S.D of a binomial distribution	• Characteristics of the binomial distribution • Binomial formula: $P(r) = {}^{n}C_{r}\ p^{r} q^{n-r}$ Where n = number of trials P = probability of success q = probability of failure Mean =np Variance = npq Standard Deviation = $\sqrt{npq}$
4.5	Poison Distribution	● Understand the Conditions of Poisson Distribution ● Evaluate the Mean and Variance of Poisson distribution	• Characteristics of Poisson Probability distribution Poisson formula: $P(x) = \frac{\lambda^{x} \cdot e^{-\lambda}}{x!}$ • Mean = Variance = λ
4.6	Normal Distribution	● Understand normal distribution is a Continuous distribution ● Evaluate value of Standard normal variate ● Area relationship between Mean and Standard Deviation	• Characteristics of a normal probability distribution • Total area under the curve = total probability = 1 • Standard Normal Variate: $Z = \frac{x-\mu}{\sigma}$ where x = value of the random variable μ = mean σ = S.D.
UNIT - 5 INFERENTIAL STATISTICS			
5.1	Population and Sample	• Define Population and Sample • Differentiate between population and sample • Define a representative sample from a population • Differentiate between a representative and non-representative sample • Draw a representative sample using simple random sampling • Draw a representative sample using and systematic random sampling	• Population data from census, economic surveys and other contexts from practical life • Examples of drawing more than one sample set from the same population • Examples of representative and non-representative sample • Unbiased and biased sampling • Problems based on random sampling using simple random sampling and systematic random sampling (sample size less than 100)
5.2	Parameter and Statistics and Statistical Interferences	• Define Parameter with reference to Population • Define Statistics with reference to Sample • Explain the relation between Parameter and Statistic • Explain the limitation of Statistic to generalize the estimation for	• Conceptual understanding of Parameter and Statistics • Examples of Parameter and Statistic limited to Mean and Standard deviation only • Examples to highlight limitations of generalizing results from sample to

		population • Interpret the concept of Statistical Significance and Statistical Inferences • State Central Limit Theorem • Explain the relation between Population-Sampling Distribution-Sample	population • Only conceptual understanding of Statistical Significance/Statistical Inferences • Only conceptual understanding of Sampling Distribution through simulation and graphs
5.3	t-Test (one sample t-test and two independent groups t-test)	● Define a hypothesis ● Differentiate between Null and Alternate hypothesis ● Define and calculate degree of freedom ● Test Null hypothesis and make inferences using t-test statistic for one group / two independent groups	● Examples and non-examples of Null and Alternate hypothesis (only non-directional alternate hypothesis) ● Framing of Null and Alternate hypothesis ● Testing a Null Hypothesis to make Statistical Inferences for small sample size ● *(for small sample size: t- test for one group and two independent groups* ● Use of t-table
UNIT – 6	**INDEX NUMBERS AND TIME BASED DATA**		
6.1	Index Numbers	● Define Index numbers as a special type of average	● Meaning and Definition ● Utility of Index Numbers
6.2	Construction of Index numbers	● Construct different type of index numbers	● Simple Index numbers ● Weighted index numbers
6.3	Test of adequacy of Index numbers	• Apply unit test and time reversal test	● Unit test ● Time reversal test
6.4	Time Series	● Identify time series as chronological data	● Meaning and Definition
6.5	Components of Time Series	● Distinguish between different components of time series	● Secular trend ● Seasonal variation ● Cyclical variation ● Irregular variation
6.6	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
6.7	Secular Trend	● Understand the long term tendency	● The tendency of the variable to increase or decrease over a long period of time
6.8	Methods of Measuring trend	● Demonstrate the techniques of finding trend by different methods	● Moving Average method ● Method of Least Squares
UNIT - 7	**FINANCIAL MATHEMATICS**		
7.1	Perpetuity, Sinking Funds	• Explain the concept of perpetuity and sinking fund • Calculate perpetuity • Differentiate between sinking fund and saving account	• Meaning of Perpetuity and Sinking Fund • Real life examples of sinking fund • Advantages of Sinking Fund

			• Sinking Fund vs. Savings account
7.2	Valuation of Bonds	• Define the concept of valuation of bond and related terms • Calculate value of bond using present value approach	• Meaning of Bond Valuation • Terms related to valuation of bond: Coupon rate, Maturity rate and Current price • Bond Valuation Methods: i) Present Value Approach ii) Relative Price Approach
7.3	Calculation of EMI	• Explain the concept of EMI • Calculate EMI using various methods	• Methods to calculate EMI: i) Flat-Rate Method ii) Reducing-Balance Method • Real life examples to calculate EMI of various types of loans, purchase of assets, etc.
7.4	Calculation of Returns, Nominal Rate of Return	• Explain the concept of rate of return and nominal rate of return • Calculate rate of return and nominal rate of return	• Formula for calculation of Rate of Return, Nominal Rate of Return
7.5	Compound Annual Growth Rate	• Understand the concept of Compound Annual Growth Rate • Differentiate between Compound Annual Growth Rate and Annual Growth Rate • Calculate Compound Annual Growth Rate	• Meaning and use of Compound Annual Growth Rate • Formula for Compound Annual Growth Rate
7.6	Stock, Shares and Debentures	• Explain the concept of stock, shares and debentures • Enlist features related to equity shares and debentures • Interpret case studies related to shares and debentures (Simple Case studies only)	• Meaning of Stock, shares and debentures • Types of Shares and Debentures • Features and advantages of equity shares and debentures • Real life examples of shares & debentures
7.7	Linear method of Depreciation	• Define the concept of linear method of Depreciation • Interpret cost, residual value and useful life of an asset from the given information • Calculate depreciation	• Meaning and formula for Linear Method of Depreciation • 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 • Definition of Decision Variable, Constraints, Objective function, Optimization and Non Negative conditions
8.2	Mathematical formulation of Linear	• Formulate Linear Programming Problem	• Set the problem in terms of decision variables, identify the objective function, identify the

	Programming Problem		set of problem constraints, 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, Transportation 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 ●Iso-cost/ Iso-profit Method
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 ● Find optimal feasible solution	●Problems based on optimization ●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.htm 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

Assessment Plan

1. Overall Assessment of the course is out of 100 marks.
2. The assessment plan consists of an External Exam and Internal Assessment.
3. External Exam will be of 03 hours duration Pen/ Paper Test consisting of 80 marks.
4. The weightage of the Internal Assessment is 20 marks. Internal Assessment can be a combination of activities spread throughout the semester/ academic year. Internal Assessment activities include projects and excel based practical. Teachers can choose activities from the suggested list of practical or they can plan activities of a similar nature. For data-based practical, teachers are encouraged to use data from local sources to make it more relevant for students.
5. Weightage for each area of internal assessment may be as under:

Sl. No.	Area and Weightage	Assessment Area	Marks allocated
1	Project work (10 marks)	Project work and record	5
		Year-end Presentation/ Viva of the Project	5
2	Practical work (10 marks)	Performance of practical and record	5
		Year-end test of any one practical	5
		Total	20