

Syllabus
Course Title: Applied Mathematics
(Code-241)
Grade XI-XII

Applied Mathematics

Grade XI-XII

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

This course is designed to develop substantial mathematical skills and methods needing 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 counter examples. 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 coordinate system. The course content will help students to develop sound understanding of descriptive and inferential statistics which they can use to describe and analysis a give 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 application 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 from the data by organizing, representing, interpreting, analysing, and to make meaningful inferences from the 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

One Paper
Each)

Total Period–240 (35 Minutes

Three Hours

Max Marks: 80

No.	Units	No. of Periods	Marks
I.	Numbers, Quantification and Numerical Applications	20	09
II.	Algebra	35	10
III.	Mathematical Reasoning	15	06
IV.	Calculus	30	10
V.	Probability	30	10
VI.	Descriptive Statistics	35	12
VII	Basics of Financial Mathematics	55	18
VIII	Coordinate Geometry	20	05
	Total	240	80
	Internal Assessment		20

Unit I Numbers, Quantification and Numerical Applications

- Prime Numbers, Encryptions using Prime Numbers
- Binary Numbers
- Complex Numbers (Preliminary idea only)
- Indices, Logarithm and Antilogarithm
- Laws and properties of logarithms
- Simple applications of logarithm and antilogarithm
- Numerical problems on averages, calendar, clock, time, work and distance, mensuration, seating arrangement

Unit II Algebra

- Sets
- Types of sets
- Venn diagram
- De Morgan's laws
- Problem solving using Venn diagram

- Relations and types of relations
- Introduction of Sequences, Series
- Arithmetic and Geometric progression
- Relationship between AM and GM
- Basic concepts of Permutations and Combinations
- Permutations, Circular Permutations, Permutations with restrictions
- Combinations with standard results

Unit III Mathematical and Logical Reasoning

- Mathematically acceptable statements
- Connecting words/ phrases in Mathematical statement consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics
- Problems based on logical reasoning (coding-decoding, odd man out, blood relation, syllogism etc)

Unit IV Calculus

- Introducing functions
- Domain and Range of a function
- Types of functions (Polynomial function; Rational function; Composite function; Logarithm function; Exponential function; Modulus function; Greatest Integer function, Signum function)
- Graphical representation of functions
- Concept of limits and continuity of a function
- Instantaneous rates of change
- Differentiation as a process of finding derivative
- Derivatives of algebraic functions using Chain rule
- Tangent line and equations of tangents

Unit V Probability

- Random experiment, sample space, events, mutually exclusive events
- Independent and Dependent Events
- Law of Total Probability
- Bayes' Theorem

Unit VI Descriptive Statistics

- Types of data (raw data, univariate data, bivariate and multi-variate data)
- Data on various scales (nominal, ordinal, interval and ratio scale)
- Data representation and visualization
- Data interpretation (central tendency, dispersion, deviation, variance, skewness and kurtosis)
- Percentile rank and quartile rank
- Correlation (Pearson and Spearman method of correlation)
- Applications of descriptive statistics using real time data

Unit VII Basics of Financial Mathematics

- Interest and interest rate
- Accumulation with simple and compound interest
- Simple and compound interest rates with equivalency
- Effective rate of interest
- Present value, net present value and future value
- Annuities, calculating value of regular annuity
- Simple applications of regular annuities (up to 3 period)
- Tax, calculation of tax and simple applications of tax calculation in Goods and service tax, Income Tax
- Bills, tariff rates, fixed charge, surcharge, service charge
- Calculation and interpretation of electricity bill, water supply bill and other supply bills

(Comparing interest rates on various types of savings; calculating income tax; electricity bills, water bill; service surcharge using realistic data)

Unit VIII Coordinate Geometry

- Straight Line
- Circles
- Parabola
(only standard forms and graphical representation on two-dimensional plane)

Practical: Use of spread sheet

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 spread sheet

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

Grade XII

One Paper
Each)

Total Period–240 (35 Minutes

Three Hours

Max Marks: 80

No.	Units	No. of Periods	Marks
I.	Numbers, Quantification and Numerical Applications	20	06
II.	Algebra	20	10
III.	Inferential Statistics	10	06
IV.	Index Numbers and Time-based data	30	10
V.	Calculus	60	15
VI.	Financial Mathematics	40	15
VII	Linear Programming	25	08
VIII	Probability	35	10
	Total	240	80
	Internal Assessment		20

Unit I Numbers, Quantification and Numerical Applications

- Modulo Arithmetic
- Congruence modulo
- Simple arithmetic functions
- Allegation or Mixture
- Numerical problems on boats and streams; partnership; pipes and cistern; races and games, scheduling
- Numerical inequalities

Unit II Algebra

- Solution of simultaneous linear equations using elimination method (up to 3 variables)
- Matrices and types of matrices
- Algebra of matrices
- Determinants
- Inverse of a matrix
- Cramer's rule and its application

- Simple applications of matrices and determinants including Leontiff input output model for two variables

Unit III Calculus

- Application of derivatives
- Increasing/Decreasing functions
- Maxima and Minima
- Marginal cost and marginal revenue using derivatives
- Integration
- Indefinite integral as family of curves
- Definite integral as area under the curve
- Integration of simple algebraic functions (primitive, by substitution, by parts)
- Application of Integration (consumer surplus-producer surplus)
- Differential equation (definition, order, degree)
- Formulating and solving linear differential equation
- Application of differential equation (Growth and Decay Model)

Unit IV Probability

- Probability Distribution
- Mathematical Expectation
- Variance
- Binomial Distribution
- Poisson distribution
- Normal distribution
- Basic applications and inferences

Unit V Inferential Statistics

- Population and sample
- Parameter, statistic and statistical inferences
- t-Test (one sample t-test and two independent groups t-test)

Unit VI Index numbers and Time-based data

- Index numbers, uses of index numbers
- Construction of index numbers (simple and weighted)
- Tests of adequacy of index numbers (unit test and time reversal test)
- Time series, Time series analysis for univariant data sets
- Trend analysis by moving average method
- Trend analysis by fitting of linear trend line using least squares

Unit VII Financial Mathematics

- Perpetuity, Sinking funds
- Valuation of Bonds (Present value approach and Relative price approach)
- Calculation of EMI

- Calculation of returns, nominal rate of return, effective rate of interest
- Compound annual growth rate
- Stock, shares and debentures
- Linear method of depreciation

Unit VIII Linear Programming

- Introduction and related terminologies (constraints, objective function, optimization)
- Mathematical formulation of linear programming problems
- Different types of linear programming problems (Transportation and assignment problem)
- Graphical method of solution for problems in two variables
- Feasible and infeasible regions (bounded and unbounded)
- Feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints)

Practical: Use of spread sheet

Graphs of 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

1. Plot the graphs of functions on excel and study the graph to find out point of maxima/minima;
2. Probability and dice roll simulation;
3. Matrix multiplication and inverse of a matrix;
4. Stock Market data sheet on excel;
5. Collect the data on weather, price, inflation, and pollution; analyze the data and make meaningful inferences;
6. Collect data from newspapers on traffic, sports activities and on market trends and use excel to study future trends.

List of Suggested projects (class XI /XII)

Use of prime numbers in coding and decoding of messages;

Prime numbers and divisibility rules;

Logarithms for financial calculations such as interest, present value, future value, profit/loss etc with large values);

Cardinality of a set and orders of infinity;

Comparing sets of Natural numbers, rational numbers, real numbers and others;

Use of Venn Diagram in solving practical problems;

Fibonacci Sequence: Its' history and presence in nature;

Testing the validity of mathematical statements and framing truth tables;

Investigating graphs of functions for their properties;

Visit the census site of India

[http://www.censusindia.gov.in/Census_Data_2001/Census_Data_Online/Language/State ment3.htm](http://www.censusindia.gov.in/Census_Data_2001/Census_Data_Online/Language/State%20ment3.htm) Depict the information given there in a pictorial form;

Prepare a questionnaire to collect information about money spent by your friends in a month on activities like traveling, movies, recharging of the mobiles, etc. and draw interesting conclusions;

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;

Analysis of population migration data – positive and negative influence on urbanization;

Each day newspaper tells us about the maximum temperature, minimum temperature, 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;

Analysis 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;

Vehicle registration data – correlating with pollution and number of accidents;

Visit a village near Delhi and collect data of various crops over 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;

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 amount of rainfall for the current year;

Weather prediction (prediction of monsoon from past data);

Visit Kirana shops near your home and collect the data of sale 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;

Stock price movement ;

Risk assessments by insurance firms from data;

Predicting stock market crash;

Predicting outcome of election – exit polls;

Predicting mortality of infants.

Assessment Plan

1. Overall Assessment of the course is out of 100 marks.
2. Assessment plan consists of External Exam and Internal Assessment.
3. External Exam will be of 03 hours duration Paper/Pencil Test consisting of 80 marks.
4. Weightage of Internal Assessment is of 20 marks. Internal Assessment can be a combination of activities spread throughout 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 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:

Sr.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
		Yearend test of any one practical	5
Total			20