MATHEMATICS
CURRICULUM FOR SECONDARY COURSE

RATIONALE

Mathematics is an important discipline of learning at the secondary stage. It helps the learners in acquiring decision-making ability through its applications to real life both in familiar and unfamiliar situations. It predominately contributes to the development of precision, rational and analytical thinking, reasoning and scientific temper. One of the basic aims of teaching Mathematics at the Secondary stage is to inculcate the skill of quantification of experiences around the learner. Mathematics helps the learners to understand and solve the day to day life problems faced by them including those from trade, banking, sales tax and commission in transaction. It also helps them to acquire the skill of representing data in the form of tables/graphs and to draw conclusions from the same.

The present curriculum in Mathematics includes the appreciation of the historical development of mathematical knowledge with special reference to the contribution of Indian mathematicians particularly in the introduction of zero, the decimal system of numeration in the international form (popularly known as Hindu – Arabic numerals). The learners are encouraged to enhance their computational skills using Vedic Mathematics.

OBJECTIVES

The main objectives of teaching Mathematics at the Secondary stage are to enable the learners to :

- acquire knowledge and understanding of the terms, concepts, symbols, principles and processes.
- acquire the skill of quantification of experiences around them.
- acquire the skill of drawing geometrical figures, charts and graphs representing given data.
- interpret tabular/graphical representation of the data.
- articulate logically and use the same to prove results.
- translate the word problems in the mathematical form and solve them.
- appreciate the contribution of Indian mathematicians towards the development of the subject.
- develop interest in Mathematics.

DESCRIPTION OF COURSE

The present syllabus in Mathematics has been divided into six modules namely **Algebra ,Commercial Mathematics ,Geometry, Mensuration ,Trigonometry** and **Statistics .**

The marks allotted , number of lessons and suggested study time for each module are as under :

Name of the module	**Number of lessons**	**Study time** (in hours)	**Marks**
1. Algebra	8	50	26
2. Commercial Mathematics	4	35	15
3. Geometry	10	75	25
4. Mensuration	2	25	10
5. Trigonometry	2	20	12
6. Statistics	4	35	12
Total	**30**	**240**	**100**

There will be three Tutor Marked Assignments **(TMA's)** to be attempted by the learner. The awards/grades of the best two TMA's will be reflected in the Mark sheet.

DETAILED DESCRIPTION OF EACH MODULE IS AS FOLLOWS :

Module 1 : Algebra

Study time : 50 Hours **Marks : 26**

Scope and Approach : Algebra is generalized form of arithmetic. Here we would deal with unknowns in place of knowns as in arithmetic. These knowns are, in general, numbers. It may be recalled that the study of numbers begin with natural numbers without which we would not be able to count. The system of natural numbers is extended to rational number system. To be able to measure all lengths in terms of a given unit, the rational numbers have to be extended to real numbers. Exponents and indices would simplify repeated multiplication and their laws would be introduced. These would be used to write very large and very small numbers in the scientific notation.

Algebraic expressions and polynomials would be introduced with the help of four fundamental operations on unknowns. Equating two algebraic expressions or polynomials leads to equations. In the module a study of linear and quadratic equations would be taken up to solve problems of daily life.

The learners would be acquainted with different number patterns. One such pattern, namely Arithmetic Progression would be studied in details.

1.1 Number Systems

Review of natural numbers ,integers and rational numbers, rational numbers as terminating or non – terminating decimals. Introduction of irrational numbers as non-terminating and non – recurring decimals.
Rounding of rational numbers and irrational numbers. Real numbers.
Representation of irrational numbers such as $\sqrt{2}$, $\sqrt{3}$ and $\sqrt{5}$ on the number line.
Operations on rational and irrational numbers.

1.2 Indices (Exponents)

Exponential notation ,meaning of exponent ,laws of exponents. Applications of laws of exponents. Expressing numbers as product of powers of prime numbers. Scientific notation.

1.3 Radicals(Surds)

Meaning of a radical, index and radicand. Laws of radicals. Simplest form of a radical. Rationalising a radical in the denominator. Simplification of expressions involving radicals.

1.4 Algebraic Expressions and Polynomials

Introduction to variables. Algebraic expressions and polynomials. Operations on algebraic expressions and polynomials. Degree of a polynomial. Value of an algebraic expression .

1.5 Special Products and Factorisation

Special products of the type $(a \pm b)^2$, $(a + b)(a – b)$, $(a \pm b)^3$.
Application of these to calculate squares and cube of numbers.
Factorisation of the algebraic expressions.
Factorisation of expressions of the form $a^2 – b^2$, $a^3 \pm b^3$.
Factorisation of the polynomial of the form $ax^2 + bx + c$ ($a \neq 0$) by splitting the middle term.

H.C.F and L.C.M of two polynomials in one variable only by factorisation.

Rational expressions. Rational expression in the simplest form.
Operations on rational expressions.

1.6 Linear Equations

Linear equations in one variable and in two variables. Solution of a linear equation in one variable.
System of linear equations in two variables. Graph of a linear equation in two variables.
Solution of a system of linear equations in two variables (graphical and algebraic methods).
Solving word problems involving linear equations in one or two variables.

1.7 Quadratic Equations

Standard form of a quadratic equation : $ax^2 + bx + c = 0$, $a \neq 0$.
Solution of $ax^2 + bx + c = 0$, $a \neq 0$ by (i) factorization (ii) quadratic formula.
Formation of quadratic equation with given roots. Application of quadratic equations to solve word problems.

1.8 Number Patterns

Recognition of number patterns. Arithmetic and Geometric progressions. n^{th} term and sum to n terms of an Arithmetic Progression.

Module 2 : Commercial Mathematics

Study time : 35 Hours **Marks : 15**

Scope and Approach : After passing Secondary level examination ,some learners may work in banks, business, houses, insurance companies dealing with sales tax ,income tax , excise duty etc. Some other may enter business and industry. Some may go for higher studies. All of them will need mathematics of finance. In any case ,every citizen has to deal with problems involving interest , investment , purchases etc. It is in this context ,the present module would be developed.

In this module , applications of compound interest in the form of rate of growth (appreciation) and depreciation(decay) will be dealt. In solving problems related to all the stated areas , the basic concepts of direct and inverse proportion (variation) ,and percentage are all pervading.

2.1 Ratio and Proportion

Review of ratio and proportion. Application of direct and inverse proportion (variation).

2.2 Percentage and its Applications

Concept of percentage. Conversion of percents to a decimal (fraction) and vice - versa. Computations involving percentage.
Applications of percentage to (i) profit and loss (ii) simple interest
(iii) discount (rebate) (iv) sales tax
(v) commission in transaction (vi) instalment buying

2.3 Compound Interest

Compound interest and its application to rate of growth and depreciation.
(conversion periods not more than 4)

2.4 Banking

Concept of Banking. Types of accounts : (a) Saving (b) Fixed/term deposit
Calculation of interest in saving account and on fixed deposit with not more than 4 conversion periods.

Module 3 : Geometry

Study time : 75 Hours **Marks : 25**

Scope and Approach : Looking at the things around him , the learner sees the corners ,edges , top of a table , circular objects like rings or bangles and similar objects like photographs of different sizes made from the same negative which arouse his curiosity to know what they represent geometrically.

To satisfy the learners curiosity and to add to his knowledge about the above things, the lessons on *Lines and Angles*, congruent and similar triangles and circles will be introduced. Some of the important results dealing with above concepts would be verified experimentally while a few would be proved logically. Different types of quadrilaterals would also be introduced under the lessons on *Quadrilaterals and Areas*.

The learners would also be given practice to construct some geometrical figures using geometrical instruments. In order to strengthen graphing of linear equations , the basic concept of coordinate geometry has been introduced.

Note : Proofs of only " * " marked propositions and riders based on " * " marked propositions using unstarred propositions may be asked in the examination.
However direct numerical problems based on unstarred propositions may also be asked in the examination.

3.1 Lines and Angles

Basic geometrical concepts : point ,line ,plane,parallel lines and intersecting lines in a plane. Angles made by a transversal with two or more lines.

If a ray stands on a line, the sum of the two angles so formed is 180^{o}.

If two lines intersect, then vertically opposite angles are equal.
If a transversal intersects two parallel lines then corresponding angles are equal.

If a transversal intersects two parallel lines then
(a) alternate angles are equal
(b) interior angles on the same side of the transversal are supplementary.

If a transversal intersects two lines in such a way that
(a) alternate angles are equal ,then the two lines are parallel.
(b) interior angles on the same side of the transversal are supplementary ,then the two lines are parallel.

*Sum of the angles of a triangle is 180^{o}.
An exterior angle of a triangle is equal to the sum of the interior opposite angles.
Concept of locus (daily life examples may be given)
The locus of a point equidistant from two given :
(a) points (b) intersecting lines.

3.2 Congruence of Triangles

Concept of congruence through daily life examples . Congruent figures.
Criteria for congruence of two triangles namely : SSS,SAS,ASA,RHS

*Angles opposite to equal sides of a triangle are equal.
*Sides opposite to equal angles of a triangle are equal.
*If two sides of a triangle are unequal ,then the longer side has the greater angle opposite to it.

In a triangle , the greater angle has the longer side opposite to it.

Sum of any two sides of a triangle is greater than the third side.

3.3 Concurrent Lines

Concept of concurrent lines.
Angle bisectors of a triangle pass through the same point.
Perpendicular bisectors of the sides of a triangle pass through the same point.
In a triangle the three altitudes pass through the same point.

Medians of a triangle pass through the same point which divides each of the medians in the ratio 2 : 1.

3.4 Quadrilaterals

Quadrilateral and its types.
Properties of special quadrilaterals viz. trapezium ,parallelogram ,rhombus , rectangle ,square.

In a triangle , the line segment joining the mid points of any two sides is parallel to the third side and is half of it.

The line drawn through the mid point of a side of a triangle parallel to another side bisects the third side.

If there are three or more parallel lines and the intercepts made by them on a transversal are equal, the corresponding intercepts on any other transversal are also equal.

A diagonal of a parallelogram divides it into two triangles of equal area.
*Parallelograms on the same or equal bases and between the same parallels are equal in area.
Triangles on the same or equal bases and between the same parallels are equal in area.
Triangles on equal bases having equal areas have their corresponding altitudes equal.

3.5 Similarity of Triangles

Similar figures ,concept of similarity in geometry. Basic proportionality theorem and its converse.

If a line is drawn parallel to one side of a triangle , the other two sides are divided in the same ratio.

If a line divides any two sides of a triangle in the same ratio , it is parallel to the third side.

Criteria for similarity of triangles : AAA, SSS and SAS .

If a perpendicular is drawn from the vertex of the right angle of a triangle to its hypotenuse , the triangles on each side of the perpendicular are similar to the whole triangle and to each other.
The internal bisector of an angle of a triangle divides the opposite side in the ratio of the sides containing the angle.
Ratio of the areas of two similar triangles is equal to the ratio of the squares on their corresponding sides.
*In a right triangle ,the square on the hypotenuse is equal to the sum of the squares on the other two sides **(Baudhayan / Pythagoras theorem)**

In a triangle ,if the square on one side is equal to the sum of the squares on the remaining two sides ,the angle opposite to the first side is a right angle
(converse of Baudhayan /Pythagoras theorem)

3.6 Circles

Definition of a circle and related concepts. Concept of concentric circle.
Congruent circles :
Two circles are congruent if and only if they have equal radii.
Two arcs of a circle(or congruent circles) are congruent , if the angles subtended by them at the centre(s) are equal and its converse.
Two arcs of a circle(or congruent circles)are congruent ,if their corresponding chords are equal , and its converse.

Equal chords of a circle(or congruent circles) subtend equal angles at the centre(s) and conversely , if the angles subtended by the chords at the centre of a circle are equal , then the chords are equal.

Perpendicular drawn from the centre of a circle to a chord bisects the chord.
The line joining the centre of a circle to the mid point of a chord is perpendicular to the chord.
There is one and only one circle passing through three given non collinear points.

Equal chords of a circle (or of congruent circles) are equidistant from the centre (centres) and its converse.

3.7 Angles in a Circle and Cyclic Quadrilateral

The angle subtended by an arc at the centre is double the angle subtended by it at any point on the remaining part of the circle.

*Angles in the same segment of a circle are equal.

Angle in a semi circle is a right angle.

Concyclic points.
*Sum of the opposite angles of a cyclic quadrilateral is 180^o.
If a pair of opposite angles of a quadrilateral is supplementary , then the quadrilateral is cyclic.

3.8 Secants , Tangents and their Properties

Intersection of a line and a circle. Point of contact of a line and a circle.
A tangent at any point of a circle is perpendicular to the radius through the point of contact.
Tangents drawn from an external point to a circle are of equal length.

If two chords AB and CD of a circle intersect at P (inside or outside the circle), then $PA \times PB = PC \times PD$

If PAB is a secant to a circle intersecting the circle at A and B, and PT is a tangent to the circle at T, then $PA \times PB = PT^2$.

If a chord is drawn through the point of contact of a tangent to a circle , then the angles which this chord makes with the given tangent are equal respectively to the angles formed by the chord in the corresponding alternate segments.

3.9 Constructions

Division of a line segment internally in a given ratio.

Construction of triangles with given data:

(a) Construction of a triangle with given data : SSS , SAS , ASA , RHS
(b) perimeter and base angles (c) its base , sum and difference of the other two sides and one base angle.(d) its two sides and a median corresponding to one of these sides.

Construction of parallelograms , rectangles, squares , rhombuses and trapeziums.

Constructions of quadrilaterals given :
(a) four sides and a diagonal (b) three sides and both diagonals
(c) two adjacent sides and three angles (d) three sides and two included angles
(e) four sides and an angle

Construction of a triangle equal in area to a given quadrilateral.

Construction of tangents to a circle from a point
(a) outside it
(b) on it using the centre of the circle .

Construction of circumcircle and incircle of a triangle.

3.10 Coordinate Geometry

Coordinate system. Distance between two points. Section formula (internal division only). Coordinates of the centroid of a triangle.

Module 4 : Mensuration

Study time : 25 Hours **Marks : 10**

Scope and Approach : In this module an attempt would be made to answer the following questions arising in our daily life.

How do you find the length of the barbed wire needed to enclose a rectangular kitchen garden ?
What is the cost of constructing two perpendicular concrete rectangular paths ?
What is the area of the four walls of a room with given dimensions ?
How much plywood is needed to be fixed on the top of a rectangular table ?
The formulae for areas of plane figures would be taught in the first lesson.

In the second lesson , the surface and volume of the different solids (three dimensional figures) would be taken up and formulae given. Their applications to daily life situations would then be taken up.

4.1 Area of Plane Figures

Rectilinear figures. Perimeter and area of a square , rectangle ,triangle, trapezium , quadrilateral , parallelogram and rhombus.
Area of a triangle using Hero's formula. Area of rectangular paths .
Simple problems based on the above.

Non rectilinear figures : Circumference and area of a circle.
Area and perimeter of a sector.
Area of circular paths. Simple problems based on the above.

4.2 Surface Area and Volume of Solids

Surface area and volume of a cube , cuboid , cylinder , cone , sphere and hemisphere.
(combination of two solids should be avoided).
Area of four walls of a room.

Module 5 : Trigonometry

Study time : 20 Hours **Marks : 12**

Scope and Approach : In astronomy one often encounters the problems of predicting the position and path of various heavenly bodies ,which in turn requires the way of finding the remaining sides and angles of a triangle provided some of its sides and angles are known. The solutions of these problems has also numerous applications to engineering and geographical surveys ,navigation etc. An attempt has been made in this module to solve these problems. It is done by using ratios of the sides of a right triangle with respect to its acute angle called trigonometric ratios. The module will enable the learners to find other trigonometric ratios provided one of them is known. It also enables the learners to establish well known identities and to solve problems based on trigonometric ratios and identities.

Measurement of accessible lengths and heights (e.g. height of a pillar, height of a house etc.) and inaccessible heights (e.g. height of a hill top, height of a lamp post on the opposite bank of a river (without bridge),celestial objects etc.) is a routine requirement. The learners will be able to distinguish between angles of elevation and depression and use trigonometric ratios for solving simple real life problems based on heights and distances , which do not involve more than two right triangles.

5.1 Introduction to Trigonometry

Trigonometric ratios of an acute angle of a right triangle.
Relationships between trigonometric ratios.
Trigonometric identities : $\sin^2\theta + \cos^2\theta = 1$, $\sec^2\theta = 1 + \tan^2\theta$, $\operatorname{cosec}^2\theta = 1 + \cot^2\theta$
Problems based on trigonometric ratios and identities.

5.2 Trigonometric Ratios of Some Special Angles

Trigonometric ratios of 30^o,45^o and 60^o.
(Results for trigonometric ratios of 30^o,45^o and 60^o to be proved geometrically)
Trigonometric ratios of complementary angles.

Application of these trigonometric ratios for solving problems such as heights and distances(problems on heights and distances should not involve more than two right triangles)

Module 6 : Statistics

Study time : 35 Hours **Marks :12**

Scope and Approach : Since ancient times, it has been the practice by the householders , shopkeepers , individuals etc to keep records of their receipts, expenditures and other resources. To make the learners acquainted with the methods of recording, condensing and culling out relevant information from the given data, the learners would be exposed to the lesson on *Data and their Representation.*

Everyday we come across data in the form of tables, graphs, charts etc on various aspects of economy, advertisements which are eye catching. In order to read and understand these, the learners would be introduced to the lesson on *Graphical Representation of Data.*

Sometimes we are required to describe data arithmetically like average age of a group median score of a group or modal collar size of a group. To be able to do this, the learners would be introduced to the lesson on *Measures of Central Tendency*. They would also be taught characteristics and limitation of these measures.

'*It will rain today*', '*India will win the match against England*', are statements that involve the chance factor. The learners would be introduced to the study of elementary probability as measure of uncertainty, through games of chance- tossing a coin, throwing a die , drawing a card at random from a well shuffled pack etc.

6.1 Data and their Representation

Introduction to Statistics. Statistics and statistical data. Primary and secondary data. Ungrouped/raw and grouped data. Class marks ,class intervals , class limits and true class limits. Frequency, frequency distribution table. Cumulative frequency. Cumulative frequency table.

6.2 Graphical Representation of Data

Drawing of Bar charts, Histograms and frequency polygons.
Reading and interpretation of Bar charts and Histograms. Reading and construction of graphs related to day to day activities ;temperature – time graph ,pressure – volume graph and velocity – time graph etc.

6.3 Measures of Central Tendency

Mean of ungrouped (raw) and grouped data. Mode and median of raw data.
Properties of mean and median .

6.4 Introduction to Probability

Elementary idea of probability as a measure of chance of occurrence of an event (for single event only) Problems based on tossing a coin ,throwing a die, drawing a card from a well shuffled pack .