

4. MATHEMATICS

(CODE NO. 041)

The curriculum at Secondary stage primarily aims at enhancing the capacity of students to employ Mathematics in solving day-to-day life problems and studying the subject as a separate discipline. It is expected that students should acquire the ability to solve problems using algebraic methods and apply the knowledge of simple trigonometry to solve problems of heights and distances. Carrying out experiments with numbers and forms of geometry, framing hypothesis and verifying these with further observations form inherent part of Mathematics learning at this stage. The proposed curriculum includes the study of Arithmetical concepts, number system, algebra, geometry, trigonometry, mensuration, statistics, graphs and coordinate geometry etc.

The teaching of Mathematics should be imparted through activities which may involve the use of concrete materials, models, patterns, charts, pictures posters, games, puzzles and experiments.

OBJECTIVES

The broad objectives of teaching of Mathematics at secondary stage are to help the learners to:

- consolidate the Mathematical knowledge and skills acquired at the upper primary stage;
- acquire knowledge and understanding of the terms, symbols, concepts, principles, processes, proofs etc.
- develop mastery of basic algebraic skills;
- develop drawing skills;
- apply mathematical knowledge and skills to solve real life problems by developing abilities to analyze, to see interrelationship involved, to think and reason;
- develop the ability to articulate logically;
- develop awareness of the need for national unity, national integration, protection of the environment, observance of small family norms, removal of social barriers, elimination of sex biases;
- develop necessary skills to work with modern technological devices such as calculators, computers etc;
- develop interest in Mathematics as a problem-solving tool in various fields for its beautiful structures and patterns, etc;
- develop reverence and respect towards great Mathematicians, particularly towards the Indian Mathematicians for their contributions to the field of Mathematics.

**COURSE STRUCTURE
CLASS IX**

One Paper	Time: Three Hours	Marks : 100
Unit		Marks
Number system		06
Algebra		24
Commercial Mathematics		16
Geometry		24
Trigonometry		08
Mensuration		10
Statistics		12
Total		100

UNIT I NUMBER SYSTEM (10 Periods)

Introduction to Irrational Numbers

Irrational numbers as non-terminating and non-repeating decimals. Real numbers and the real number line. Surds and Rationalization of surds. (Irrational numbers may be introduced by recalling rational numbers as terminating or non-terminating recurring decimals.) Problems of proving a number to be irrational number should be avoided. Representing an irrational number on the number line should be avoided for numbers other than $\sqrt{2}$, $\sqrt{3}$ and $\sqrt{5}$. Rationalization of only those surds are to be included which involve square roots and are binomials or trinomials),

UNIT II ALGEBRA (42 Periods)

Factorisation of Polynomials

Review of factorisation of algebraic expressions done in earlier classes. Factorisation of polynomials of the form ax^2+bx+c , $a \neq 0$, by splitting the middle term, where a, b and c are real numbers. Factorisation of algebraic expressions of the type x^3+y^3 , x^3-y^3 , $x^3+y^3+z^3-3xyz$. Remainder theorem, factor theorem and factorisation of polynomials of degree not exceeding three. (While factorisation of the polynomial ax^2+bx+c , $a \neq 0$, a,b,c, should be rationals or square root of rationals only. (1) If $a+b+c=0$, then $a^3+b^3+c^3=3abc$, Questions involving above concept will be included. (2) Simple expressions reducible to the form $a^3+b^3+c^3-3abc$ may be included).

Ratio and Proportion

Recall of the concepts of ratio and proportion. Continued proportion, invertendo, alternendo, componendo and dividendo.

Linear Equations in Two Variables

Review of Linear equations in one variable. Co-ordinates of a point and plotting of points with given integral co-ordinates in cartesian plane. Introduction to linear equations in two variables. Graph of a linear equation in one/two variables in cartesian plane. (For the graph of linear equation in two variables, equation should be so chosen so as to get as far as possible integral valued coordinates.)

UNIT III COMMERCIAL MATHEMATICS

(22 Periods)

Percentage

Further problems on percentage.

Profit and Loss

Further problems on profit and loss.

Discount

Discount/rebate including successive discounts. (Not more than three successive discounts should be taken).

Compound Interest

Compound interest when the interest is compounded yearly, half yearly and quarterly. Rate of growth and depreciation. Conversion period not more than four (Rate should be 4%, 5% or 10%)

Cost of Living Index

Cost of living index and its computation (weighted aggregate method only).

Sales Tax

Computation of sales tax including inverse problems.

Banking

- (i) Different types of accounts in a bank.
- (ii) Calculation of interest on savings bank account from a pass book.
- (iii) Calculation of interest on FD accounts. (Teacher may take the students to a bank to show the various facilities available to the customers and process of calculation of interest thereon.)

UNIT IV GEOMETRY

(60 Periods)

A number of propositions in Geometry are listed below. Most of them have already been learnt at the upper primary stage through activities/experiments. At this stage, the purpose is to acquaint the pupil with the nature and method of a geometrical proof. In order to ensure that the burden on the pupil is not much, only proofs of some selected propositions may be asked in the examination. These propositions may be selected in such a way that they reflect different types of proofs such as direct proof, proof by contradiction, proof by exhaustion, proof by various applications of the previous propositions. Keeping this in view, some propositions have been marked with '*'. In view of the above:

- (i) The truth of the unstarred propositions should be brought home to the pupils by either recalling them from earlier classes or by verifying them experimentally in the present class. (As far as possible riders should be given with figures). For the verification of geometrical results, teacher may use different types of activities such as models, paper cutting, paper folding, measurement etc. The students should also be encouraged to perform these activities themselves.
- (ii) **The proofs of only the '*’ marked propositions may be asked in the examination.**

(iii) **The riders only on ‘*’ marked propositions may be asked in the examination. However they may involve the use of unstarred propositions.**

(iv) The unstarred propositions should not be asked as riders/exercises in the examination.

Lines and Angles

1. Given any two distinct points in a plane, there exists one and only one line containing them.
2. Two distinct lines cannot have more than one point in common.
3. Given a line and a point, not on the line, there is one and only one line which passes through the given point and is parallel to the given line.
4. If a ray stands on a line, then the sum of the two adjacent angles so formed is 180° , and its converse.
5. If two lines intersect, the vertically opposite angles are equal.
6. If a transversal intersects two parallel lines, then (a) Each pair of alternate angles is equal (b) The interior angles on the same side of the transversal are supplementary.
- *7. If a transversal intersects two parallel lines, then (a) Each pair of alternate angles is equal. (b) The interior angles on the same side of the transversal are supplementary.
8. Converse of (7).
9. Lines which are parallel to a given line are parallel to each other.
- *10. The sum of the angles of a triangle is 180° .
11. If a side of a triangle is produced, the exterior angle so formed is equal to the sum of two interior opposite angles.

Congruence of Triangles

1. Two triangles are congruent if any two sides and the included angle of the one triangle are equal to any two sides and the included angle of the other triangle.
- *2. Two triangles are congruent if any two angles and the included side of one triangle are equal to any two angles and the included side of the other triangle.
3. Two triangles are congruent if the three sides of one triangle are equal to the three sides of the other triangle.
- *4. The angles opposite to equal sides of a triangle are equal.
5. The sides opposite to equal angles of a triangle are equal.
- *6. Two right triangles are congruent if the hypotenuse and a side of one triangle are respectively equal to the hypotenuse and a side of the other triangle.

Inequalities in a Triangle

1. If two sides of a triangle are unequal, the larger side has the greater angle opposite to it.
- *2. In a triangle, the greater angle has a larger side opposite to it.
3. The sum of any two sides of a triangle is greater than its third side.
4. Of all the line segments that can be drawn to a given line from a point not lying on it, the perpendicular segment is the shortest.

Loci

1. The locus of a point equidistant from two fixed points is the perpendicular bisector of the segment joining the two points.
2. The locus of a point equidistant from two intersecting lines is the pair of bisectors of the angles formed by the given lines.

Concurrent Lines in a Triangle

1. The angle bisectors of a triangle pass through the same point.
2. The perpendicular bisectors of the sides of a triangle pass through the same point.
- *3. Medians of a triangle pass through the same point which divides each of the medians in the ratio 2:1
4. In a triangle, the three altitudes pass through the same point.

Parallelograms

1. A diagonal of a parallelogram divides it into two congruent triangles.
2. In a parallelogram, the opposite sides are of equal length and its converse.
3. In a parallelogram, the opposite angles are equal and its converse.
- *4. A quadrilateral is a parallelogram if a pair of its opposite sides is parallel and is of equal length.
5. In a parallelogram, the diagonals bisect each other and its converse.
6. A parallelogram is a rectangle if its diagonals have equal length and its converse.
7. A parallelogram is a rhombus if its diagonals are perpendicular and its converse.
8. A parallelogram is a square if its diagonals are equal and are at right angles and its converse.
- *9. 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.
- *10. The line drawn through the mid point of one side of a triangle parallel to another side bisects the third side.
- *11. 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.

Areas

- *1. Parallelograms on the same base and between the same parallels are equal in area.
2. Triangles on the same base and between the same parallels are equal in area.
3. Triangles with equal areas and equal bases have equal corresponding altitudes.

Constructions

1. Construction of a triangle given its base, sum of the other two sides and one base angle.
2. Construction of a triangle given its base, difference of the other two sides and one base angle.
3. Construction of a triangle of given perimeter and base angles.

4. Construction of a triangle given its two sides and a median corresponding to one of these sides.
5. Construction of a triangle equal in area to a given quadrilateral.
 - [(i) Proofs of constructions not required.
 - [(ii) Constructions using ruler and compasses only.]

UNIT V TRIGONOMETRY

(16 Periods)

Trigonometric Ratios

Formation of angles through rotation of a ray. Idea of positive and negative angles. Trigonometric ratios of an acute angle of a right angled triangle. Trigonometric ratio of 0° , 30° , 45° , 60° , 90° . Geometric proofs of trigonometric ratios of 30° , 60° , 45° . Given a trigonometric ratio, to find all other trigonometric ratios. Given a side and an angle of a right triangle, to find other sides and angles.

UNIT VI MENSURATION

(15 Periods)

Plane Figures

Area of a triangle using Hero's formula. Area of a quadrilateral. Area of sector of a circle. Area of segment of a circle. Further problems based on areas and perimeter/circumference of the above said plane figures. (In calculating area of segment of a circle, problems should be restricted to central angle of 60° , 90° , and 120° only). Plane figures involving square, rectangle, triangle, trapezium, quadrilateral, parallelogram, rhombus and circle should be taken).

Solids

Recognition of some more solids: Prism, pyramid/tetrahedron and octahedron.

Volume and surface area of (a) Right triangular prism (b) Right pyramid with equilateral triangle as base (tetrahedron). (simple problems of volume and surface area of right triangular prism and right pyramid with equilateral triangle as base should be taken).

UNIT VII STATISTICS

(15 Periods)

Statistics and Statistical Data

Introduction to statistics. Primary and secondary data. Raw/ungrouped and grouped data. (In case of raw data, the number of observations should not exceed 30).

Frequency Table

Class marks, class intervals, frequency, frequency table, cumulative frequency, cumulative frequency table. (In grouped data, only equal intervals should be taken).

Graphical Representation of Data

Drawing of histogram. Reading and construction of temperature-time graph, pressure-volume graph, velocity-time graph, etc.

Measures of Central Tendency

Mean of raw and ungrouped data. Median and mode of raw data. [(i) Properties of mean, median and mode may be given to highlight their significance and use. (ii) Not more than 10 observations should be taken for calculation of median and mode.]

CLASS X

One Paper **Time: Three Hours** **Marks : 100**

Unit	Marks
Algebra	26
Commercial Mathematics	12
Geometry	22
Trigonometry	10
Mensuration	10
Statistics	12
Coordinate Geometry	08
Total:	100

UNIT I ALGEBRA (55 Periods)

Linear Equations in Two Variables

System of linear equations in two variables. Solution of the system of linear equations (i) Graphically. (ii) By algebraic methods : (a) Elimination by substitution (b) Elimination by equating the co-efficients. (c) Cross multiplication. Applications of Linear equations in two variables in solving simple problems from different areas. (Restricted upto two equations with integral values as a point of solution. Problems related to life to be incorporated).

Polynomials

HCF and LCM of polynomials by factorisation.

Rational Expressions

Meaning of rational expressions. Reduction of rational expressions to lowest terms using factorisation. Four fundamental operations on rational expressions. (Properties like commutativity, associativity, distributive law etc. not to be discussed. Cases involving Factor theorem may also be given).

Quadratic Equations

Standard form of a quadratic equation $ax^2+bx+c=0$, ($a \neq 0$). Solution of $ax^2+bx+c=0$ by (i) factorisation (ii) quadratic formula. Application of quadratic equations in solving word-problems from different areas. (Roots should be real) (Problems related to day-to-day activities to be incorporated).

Arithmetic Progression (AP)

Introduction to AP by pattern of number. General term of an AP, Sum to n-terms of an AP. Simple problems. (Common difference should not be irrational number).

UNIT II COMMERCIAL MATHEMATICS (15 Periods)

Instalments

Instalment payments and instalment buying (Number of instalments should not be more than 2 in case of buying). (Only equal instalments should be taken. In case of payments through equal instalments, not more than three instalments should be taken).

Income Tax

Calculation of Income Tax for salaried class. (In case of income tax problems, annual salary should be exclusive of HRA).

UNIT III (55 Periods)

GEOMETRY

A number of propositions in Geometry are listed below. Some of them have already been learnt at the upper primary stage through activities/experiments. At this stage, the purpose is to acquaint the pupil with the nature and method of a geometrical proof. In order to ensure that the burden on the pupil is not much, only proofs of some selected propositions may be asked in the examination. These propositions may be selected in such a way that they reflect different types of proofs such as direct proof, proof by contradiction, proof by exhaustion, proof by various applications of previous propositions. Keeping this in view, some propositions have been marked with '*'. (For the verification of geometrical results, teacher may use different types of activities such as models, paper cutting, paper folding, measurement etc. The students should also be encouraged to perform these activities themselves). In view of this:

- (i) The truth of the unstarred propositions should be brought home to the pupils by either recalling them from earlier classes or by verifying them experimentally in the present class.
- (ii) **The proofs of only '*' marked propositions may be asked in the examination.**
- (iii) **The riders on '*' propositions only may be asked in the examination. However, they may involve the use of other results (unstarred ones).**
- (iv) **The unstarred propositions should not be asked as riders/exercises in the examination.**

Similar Triangles

- *1. If a line is drawn parallel to one side of a triangle, the other two sides are divided in the same ratio.
2. If a line divides any two sides of a triangle in the same ratio, the line is parallel to the third side.
3. If in two triangles, the corresponding angles are equal, their corresponding sides are proportional and the triangles are similar.
4. If the corresponding sides of two triangles are proportional, their corresponding angles are equal and the triangles are similar.
5. If one angle of a triangle is equal to one angle of the other and the sides including these angles are proportional, the triangles are similar.
6. If a perpendicular is drawn from the vertex of the right angle of a right triangle to the hypotenuse, the triangles on each side of the perpendicular are similar to the whole triangle and to each other.
- *7. The ratio of the areas of similar triangles is equal to the ratio of the squares of their corresponding sides.
- *8. In a right triangle, the square on the hypotenuse is equal to the sum of the squares on the other two sides.

- *9. In a triangle, if the square on one side is equal to the sum of the squares on the remaining two, the angle opposite to the first side is a right angle.
- 10. The internal bisector of an angle of a triangle divides the opposite side in the ratio of the sides containing the angle and its converse.

Circles

- 1. Two circles are congruent if and only if they have equal radii.
- 2. Equal chords of a circle subtend equal angles at the centre and conversely, if the angles subtended by the chords at the centre (of a circle) are equal, then the chords are equal.
- 3. Two arcs of a circle are congruent if the angles subtended by them at the centre are equal and its converse.
- 4. If two arcs of a circle are congruent, their corresponding chords are equal and its converse.
- 5. The perpendicular from the centre of a circle to a chord bisects the chord and conversely, the line drawn through the centre of a circle to bisect a chord is perpendicular to the chord.
- *6. There is one and only one circle passing through three given non-collinear points.
- 7. Equal chords of a circle (or congruent circles) are equidistant from the centre (s) and conversely, chords of a circle (or of congruent circles) that are equidistant from the centre(s) are equal.
- *8. 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.
- 9. The angle in a semi-circle is a right angle and its converse.
- *10. Angles in the same segment of a circle are equal.
- 11. If a line segment joining two points subtends equal angles at two other points lying on the same side of the line containing the segment, the four points lie on a circle.
- *12. The sum of the either pair of the opposite angles of a cyclic quadrilateral is 180° .
- 13. If a pair of opposite angles of a quadrilateral is supplementary, then the quadrilateral is cyclic.
- 14. The tangent at any point of a circle is perpendicular to the radius through the point of contact.
- 15. The lengths of tangents drawn from an external point to a circle are equal.
- *16. If two chords of a circle intersect inside or outside the circle, then the rectangle formed by the two parts of one chord is equal in area to the rectangle formed by the two parts of the other.
- 17. Converse of proposition 16.
- *18. If PAB is a secant to a circle intersecting it at A and B and PT is a tangent, then $PA \times PB = PT^2$.
- *19. If a line touches a circle and from the point of contact a chord is drawn, the angles which this chord makes with the given line are equal respectively to the angles formed in the corresponding alternate segments and the converse.

- *20. If two circles touch each other internally or externally, the point of contact lies on the line joining their centres. (Concept of common tangents to two circles should be given)

Constructions

1. Construction of tangents to a circle (i) At a point on it without using the centre. (ii) At a point on it using the centre. (iii) From a point outside it. [(i) Proofs of constructions not required. (ii) Constructions using ruler and compasses only].
2. Construction of incircle and circumcircle of a triangle with given sides.
3. Construction of a triangle, given base, vertical angle and either altitude or median through the vertex.
4. Construction of figures (triangles, quadrilaterals) similar to the given figure as per the given scale factor.

UNIT IV TRIGONOMETRY

(20 Periods)

Trigonometric Identities

1. $\sin^2 A + \cos^2 A = 1$
 2. $\sec^2 A = 1 + \tan^2 A$
 3. $\operatorname{cosec}^2 A = 1 + \cot^2 A$
4. Proving simple identities based on the above.

Trigonometric ratios of complementary angles

$$\sin (90^\circ - A) = \cos A$$

$$\cos (90^\circ - A) = \sin A$$

$$\tan (90^\circ - A) = \cot A$$

$$\operatorname{cosec} (9^\circ - A) = \sec A$$

$$\sec(90^\circ - A) = \operatorname{cosec} A$$

$$\cot (90^\circ - A) = \tan A$$

Problems based on above.

Heights and Distances

Simple Problems on heights and distances.

- (i) Problems should not involve more than two right triangles.
- (ii) Angles of elevation/depression should be only 30° , 45° , 60° .

UNIT V MENSURATION

(15 Periods)

Volumes and Surface Areas

- (i) Problems on finding volumes and surface areas of combinations of right circular cone, right circular cylinder, hemisphere and sphere. Frustum of a cone.
- (ii) Problems involving converting one type of metallic solid into another and other mixed problems. (Problems with combination of not more than two different solids be taken).

UNIT VI STATISTICS

(15 Periods)

Mean

Mean of grouped data. (Calculation by assuming assumed mean should also be discussed).

Probability

Elementary idea of probability as a measure of uncertainty (for single event only).

Pictorial Representation of Data

Reading and construction of pie chart. [(i) Sub parts of a pie chart should not exceed five). (ii) Central angles should be in multiples of 5 degrees.]

UNIT VII COORDINATE GEOMETRY

(15 Periods)

Co-ordinate Geometry

Distance between two points. Section formula. (internal division only.)

Prescribed Book

Mathematics for class IX, NCERT Publication.

Mathematics for class X, NCERT Publication.

गणित—कक्षा IX के लिए एन.सी.ई.आर.टी. प्रकाशन

गणित—कक्षा X के लिए एन.सी.ई.आर.टी. प्रकाशन