

# MATHEMATICS

## Course Structure

I Term Units	Topics	Marks
I	Number System	17
II	Algebra	25
III	Geometry	37
IV	Co-ordinate Geometry	6
V	Mensuration	5
<b>Total</b>		<b>90</b>
II Term Units	Topics	Marks
II	Algebra	16
III	Geometry	38
V	Mensuration	18
VI	Statistics	10
VII	Probability	8
<b>Total</b>		<b>90</b>

## First Term Course Syllabus

### Unit I: Number Systems

#### 1. Real Numbers

- Review of representation of natural numbers
- Integers
- Rational numbers on the number line
- Representation of terminating / non-terminating recurring decimals, on the number line through successive magnification
- Rational numbers as recurring/terminating decimals
- Examples of non-recurring / non-terminating decimals
- Existence of non-rational numbers (irrational numbers) such as  $\sqrt{2}$ ,  $\sqrt{3}$  and their representation on the number line

- Explaining that every real number is represented by a unique point on the number line and conversely, every point on the number line represents a unique real number
- Existence of  $\sqrt{x}$  for a given positive real number  $x$  (visual proof to be emphasized)
- Definition of  $n$ th root of a real number
- Recall of laws of exponents with integral powers
- Rational exponents with positive real bases (to be done by particular cases, allowing learner to arrive at the general laws)
- Rationalization (with precise meaning) of real numbers of the type  $1/(a+b\sqrt{x})$  and  $1/(\sqrt{x}+\sqrt{y})$  (and their combinations) where  $x$  and  $y$  are natural number and  $a$  and  $b$  are integers

## Unit II: Algebra

### 1. Polynomials

- Definition of a polynomial in one variable, with examples and counter examples
- Coefficients of a polynomial, terms of a polynomial and zero polynomial
- Degree of a polynomial
- Constant, linear, quadratic and cubic polynomials
- Monomials, binomials, trinomials
- Factors and multiples
- Zeros of a polynomial
- Motivate and State the Remainder Theorem with examples
- Statement and proof of the Factor Theorem
- Factorization of  $ax^2 + bx + c$ ,  $a \neq 0$  where  $a$ ,  $b$  and  $c$  are real numbers, and of cubic polynomials using the Factor Theorem
- Recall of algebraic expressions and identities
- Further verification of identities of the type  $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$ ,  $(x \pm y)^3 = x^3 \pm y^3 \pm 3xy(x \pm y)$ ,  $x^3 \pm y^3 = (x \pm y)(x^2 \pm xy + y^2)$ ,  $x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$  and their use in factorization of polynomials
- Simple expressions reducible to these polynomials

## Unit III: Geometry

### 1. Introduction to Euclid's Geometry

- History - Geometry in India and Euclid's geometry

- Euclid's method of formalizing observed phenomenon into rigorous mathematics with definitions, common/obvious notions, axioms/postulates and theorems
- The five postulates of Euclid
- Equivalent versions of the fifth postulate
- Showing the relationship between axiom and theorem, for example:
  - (Axiom) 1. Given two distinct points, there exists one and only one line through them
  - (Theorem) 2. (Prove) Two distinct lines cannot have more than one point in common

## 2. Lines and Angles

- (Motivate) If a ray stands on a line, then the sum of the two adjacent angles so formed is  $180^\circ$  and the converse
- (Prove) If two lines intersect, vertically opposite angles are equal
- (Motivate) Results on corresponding angles, alternate angles, interior angles when a transversal intersects two parallel lines
- (Motivate) Lines which are parallel to a given line are parallel
- (Prove) The sum of the angles of a triangle is  $180^\circ$
- (Motivate) If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles

## 3. Triangles

- (Motivate) Two triangles are congruent if any two sides and the included angle of one triangle is equal to any two sides and the included angle of the other triangle (SAS Congruence)
- (Prove) Two triangles are congruent if any two angles and the included side of one triangle is equal to any two angles and the included side of the other triangle (ASA Congruence)
- (Motivate) Two triangles are congruent if the three sides of one triangle are equal to three sides of the other triangle (SSS Congruence)
- (Motivate) Two right triangles are congruent if the hypotenuse and a side of one triangle are equal (respectively) to the hypotenuse and a side of the other triangle
- (Prove) The angles opposite to equal sides of a triangle are equal
- (Motivate) The sides opposite to equal angles of a triangle are equal
- (Motivate) Triangle inequalities and relation between 'angle and facing side' inequalities in triangles

## **Unit IV: Coordinate Geometry**

### **1. Coordinate Geometry**

- The Cartesian plane, coordinates of a point, names and terms associated with the coordinate plane, notations, plotting points in the plane.

## **Unit V: Mensuration**

### **1. Areas**

- Area of a triangle using Heron's formula (without proof) and its application in finding the area of a quadrilateral.

## **Second Term Course Syllabus**

### **Unit II: Algebra**

#### **2. Linear Equations in Two Variables**

- Recall of linear equations in one variable
- Introduction to the equation in two variables
- Focus on linear equations of the type  $ax+by+c=0$
- Prove that a linear equation in two variables has infinitely many solutions and justify their being written as ordered pairs of real numbers, plotting them and showing that they seem to lie on a line
- Examples, problems from real life, including problems on Ratio and Proportion and with algebraic and graphical solutions being done simultaneously

### **Unit III: Geometry**

#### **4. Quadrilaterals**

- (Prove) The diagonal divides a parallelogram into two congruent triangles
- (Motivate) In a parallelogram opposite sides are equal, and conversely
- (Motivate) In a parallelogram opposite angles are equal, and conversely
- (Motivate) A quadrilateral is a parallelogram if a pair of its opposite sides is parallel and equal
- (Motivate) In a parallelogram, the diagonals bisect each other and conversely
- (Motivate) In a triangle, the line segment joining the mid points of any two sides is parallel to the third side and (motivate) its converse

## 5. Area

Review concept of area, recall area of a rectangle

- (Prove) Parallelograms on the same base and between the same parallels have the same area
- (Motivate) Triangles on the same (or equal base) base and between the same parallels are equal in area

## 6. Circles

Through examples, arrive at definitions of circle related concepts, radius, circumference, diameter, chord, arc, secant, sector, segment subtended angle

- (Prove) Equal chords of a circle subtend equal angles at the center and (motivate) its converse
- (Motivate) The perpendicular from the center of a circle to a chord bisects the chord and conversely, the line drawn through the center of a circle to bisect a chord is perpendicular to the chord
- (Motivate) There is one and only one circle passing through three given non-collinear points
- (Motivate) Equal chords of a circle (or of congruent circles) are equidistant from the center (or their respective centers) and conversely
- (Prove) The angle subtended by an arc at the center is double the angle subtended by it at any point on the remaining part of the circle
- (Motivate) Angles in the same segment of a circle are equal
- (Motivate) If a line segment joining two points subtends equal angle at two other points lying on the same side of the line containing the segment, the four points lie on a circle.
- (Motivate) The sum of either of the pair of the opposite angles of a cyclic quadrilateral is  $180^\circ$  and its converse.

## 7. Constructions

- Construction of bisectors of line segments and angles of measure  $60^\circ$ ,  $90^\circ$ ,  $45^\circ$  etc., equilateral triangles
- Construction of a triangle given its base, sum/difference of the other two sides and one base angle
- Construction of a triangle of given perimeter and base angles

## **Unit V: Mensuration**

### **2. Surface Areas and Volumes**

Surface areas and volumes of:

- Cubes
- Cuboids
- Spheres (including hemispheres)
- Right circular cylinders/cones

## **Unit VI: Statistics**

- Introduction to Statistics
- Collection of data
- Presentation of data:
  - Tabular form
  - Ungrouped / grouped
  - Bar graphs
  - Histograms (with varying base lengths)
  - Frequency polygons
  - Qualitative analysis of data to choose the correct form of presentation for the collected data
- Mean, median, mode of ungrouped data.

## **Unit VII: Probability**

- History, Repeated experiments and observed frequency approach to probability
- Focus is on empirical probability. (A large amount of time to be devoted to group and to individual activities to motivate the concept; the experiments to be drawn from real - life situations, and from examples used in the chapter on statistics)