

# Secondary School Certificate Examination Syllabus

## **MATHEMATICS**

### CLASS IX

Class IX examination in 2010 and onwards

#### Topics and Student Learning Outcomes of the Examination Syllabus SSC Part I (Class IX)

#### **1. Real and Complex Numbers:**

1.1.1 Define, write and identify terminating, non terminating, recurring, non recurring decimal fractions as rational and irrational numbers

1.1.2 Identify the set of real numbers as a union of sets of rational and irrational numbers

#### **1.1 Real Numbers:**

1.1.3 Identify and locate real numbers on the number line

#### **1.2 Properties of Real Numbers:**

1.2.1 Describe and identify the properties of real numbers (closure, commutative, associative, identities, inverse, distributive properties)

#### **1.3 Radicals and Radicands:**

1.3.1 Identify radicals, radicands and convert radical form to exponential form and vice versa

#### **1.4 Laws of Exponents/Indices:**

1.4.1 Identify base, exponent and simplify expressions containing exponents

1.4.2 Verify and apply the laws of exponents to simplify expressions with real base and exponents

$$(a). X^m \cdot X^n = X^{m+n} \quad (b). (XY)^m = X^m \cdot Y^m \quad (c). (X^m)^n = X^{mn} \quad (d). y^0 = 1$$

$$(e). \left(\frac{x}{y}\right)^m = \frac{x^m}{y^m} \quad (f). \frac{x^m}{x^n} = x^{m-n}$$

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#### **1.5 Complex Numbers:**

1.5.1 Define and describe complex number  $z$  represented by an expression of the form  $z = a + ib$  where  $a$  and  $b$  are real numbers and  $i = \sqrt{-1}$

1.5.2 Recognize  $a$  as real part and  $b$  as imaginary part of  $z = a + ib$

1.5.3 Calculate conjugate of a complex number

1.5.4 Describe and apply the condition for equality of complex numbers

## **1.6 Basic Operations on Complex Numbers:**

1.6.1 Perform basic operations (i.e. addition, subtraction, multiplication, and division) on Complex numbers

## **2. Sets and Functions:**

2.1.1 Recognize the sets denoted by N, Z, W, O, P and Q

2.1.2 Recognize operation on set ( $\cup$ ,  $\cap$ ,  $-$  or  $\setminus$ ,  $\Delta$ )

### **2.1 Operations on Sets (Revision):**

2.1.3 Perform operation on sets

- Union • Intersection • Difference • Symmetric difference ( $A\Delta B = (A\cup B) - (A\cap B)$ )
- Complement

### **2.1 Properties of Union and Intersection:**

2.1.1 Describe the following fundamental properties of union and intersection of two or three sets

- Commutative property of union • Commutative property of intersection
- Associate property of union • Associate property of intersection
- Distributive property of union over intersection • Distributive property of intersection over union • De Morgan's laws

2.1.2 Verifies the above mentioned fundamental properties for given sets

### **2.2 Venn Diagram:**

2.2.1 Draw Venn diagram to represent

- Union and intersection of sets • complement of a set • Symmetric difference of sets

2.2.2 Draw Venn diagram to verify

- Commutative laws for union and intersection of sets • Associative laws for union and intersection of sets • Distributive laws for union and intersection of sets
- De Morgan's laws

### **2.3 Ordered pairs and Cartesian product:**

2.3.1 Describe and write ordered pairs and cartesian product and related problems

### **2.4 Binary relation:**

2.4.1 Describe and write binary relation and identify its domain and range

### **2.5 Function:**

2.5.1 Define function and identify its domain, co-domain and range

2.5.2 Write and illustrate

- Into function • One-one function, • Into and one-one function (injective function)
- Onto function (surjective function) • One-one and onto function (bijective function)

2.5.3 Examine whether a given relation is a function or not

2.5.4 Differentiate between one-one correspondence and one-one function.

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## **3. Logarithms:**

### **3.1 Scientific Notation:**

3.1.1 Convert a number in standard form to scientific notation and vice versa;

3.2.1 Explain meaning of logarithm and exponential form and their relationship with each other and solve related problems  $a^x = y$   $\log_a y = x$  when  $a > 0$ ,  $y > 0$

### **3.2 Logarithm:**

3.2.2 Find characteristics and mantissa (by using log table) of common log (logarithm with base 10) of a number

3.2.3 Describe concept of antilog and use tables to find the antilog of a number

### **3.3 Laws of Logarithm:**

3.3.1 Prove the following laws of logarithm.

$$(1) \log_a mn = \log_a m + \log_a n \quad (2) \log_a \frac{m}{n} = \log_a m - \log_a n$$

$$(3) \log_a m^n = n \log_a m \quad (4) \log_a m \log_m n = \log_a n$$

### **3.4 Application of Logarithm:**

3.4.1 Apply laws of logarithm to convert lengthy processes of multiplication, division, and exponentiation into easier processes of addition and subtraction etc

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## **4. Algebraic Expressions and Algebraic Formulas:**

4.1.1 Define a rational expression as  $\frac{p(x)}{q(x)}$  of two polynomials  $p(x)$  and  $q(x)$ , where  $q(x)$

is not the zero polynomial

4.1.2 Decide whether a given algebraic expression is a

- Polynomial or not
- Rational expression or not

4.1.3 Define  $\frac{p(x)}{q(x)}$  as a rational expression in its lowest terms if  $p(x)$  and  $q(x)$  are

polynomials with integral coefficients and having no common factor

4.1.4 Reduce a given rational expression to its lowest terms

### **4.1 Algebraic expressions:**

4.1.5 Find the sum, difference and product of rational expression

4.1.6 Divide a rational expression with another rational expression and express the result in its lowest terms

4.1.7 Find the value of an algebraic expression at some particular real number

4.2.1 Write the formulae

$$\bullet (a + b)^2 + (a - b)^2 = 2(a^2 + b^2) \quad \bullet (a + b)^2 + (a - b)^2 = 4ab$$

4.2.2 Find the value of  $a^2 + b^2$ ,  $a + b$ ,  $a - b$ ,  $ab$  using above formulae

4.2.3 Write the formula  $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

### **4.2 Algebraic Formulae:**

4.2.4 Find the values of  $(a + b + c)$ ,  $a^2 + b^2 + c^2$ , and  $(ab + bc + ca)$ , when any two of these are given

4.2.5 write the formulae

$$\bullet (a + b)^3 = a^3 + 3ab(a + b) + b^3 \quad (a - b)^3 = a^3 - 3ab(a - b) - b^3$$

4.2.6 Find the value of  $a^3 \pm b^3$  when the values of  $a \pm b$  and  $ab$  are given

4.2.7 Find the value of  $(x^3 \pm \frac{1}{x^3})$  when the value of  $(x + \frac{1}{x})$  is given

4.2.8 Write the formulae

$$\bullet a^3 + b^3 = (a + b)(a^2 - ab + b^2) \quad a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

4.2.9 Find the continued product by using above formulae e.g.  $(x + y)(x - y)(x^2 + xy + y^2)(x^2 - xy + y^2)$

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**4.3 Surds and their Application:**

4.3.1 Recognize the surds and explain the surds of second order, use basic operations on surds of second order to rationalize the denominators and evaluate it

**4.4 Rationalization**

4.4.1 Rationalize the denominator of real number  $(a+b)\frac{1}{\sqrt{x}}$ ,  $\frac{1}{\sqrt{x}} + \frac{1}{\sqrt{y}}$  and their combinations where  $x$  and  $y$  are natural numbers and  $a$  and  $b$  are integers

**5. Factorization:****5.1 Factorization (Revision):**

5.1.1 Factorize the expression of the following types

$$\bullet ka + kb + kc \quad \bullet ac + ad + bc + bd \quad \bullet a^2 \pm 2ab + b^2 \quad \bullet a^2 - b^2 \quad \bullet a^2 \pm 2ab + b^2 - c^2$$

**5.2 Factorization:**

5.2.1 Factorize the expression of the following types

**Type I:**  $a^4 + a^2b^2 + b^4$  or  $a^4 + b^4$

**Type II:**  $ax^2 + bx + c$

**Type III:** (1).  $(ax^2 + bx + c)(ax^2 + bx + d) + k$   
 (2).  $(x + a)(x + b)(x + c)(x + d) + k$   
 (3).  $(x + a)(x + b)(x + c)(x + d) + kx^2$

**Type IV:** (1).  $a^3 + 3a^2b + 3ab^2 + b^3$  (2).  $a^3 - 3a^2b + 3ab^2 - b^3$

**Type V:**  $a^3 \pm b^3$

5.3.1 State and apply Remainder theorem to find remainder when a polynomial is divided by a linear polynomial;

**5.3 Remainder Theorem and Factor Theorem:**

5.3.2 Define zeros of a polynomial (the value of the variable for which the value of polynomial become zero  $P(x) = 0$ )

**5.4 Factorization of a Cubic Polynomial:**

5.4.1 Apply factor theorem to factorize a cubic polynomial.

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**6. Variations:****6.1 Ratio, Proportions:**

6.1.1 Define ratio, proportions and variations (direct and inverse) and Variations

6.1.2 Calculate 3<sup>rd</sup>, 4<sup>th</sup> proportional and mean proportional for continued proportion

**6.2 Theorems on Proportions:**

6.2.1 Apply theorems of invertendo, alternendo, componendo, dividendo and componendo-dividendo to find proportions

**6.3 Joint Variation:**

6.3.1 Define joint (direct and inverse) variations

6.3.2 Solve problems related to joint variations

**6.4 K-Method:**

6.4.1 Apply K-Method to prove conditional equalities involving proportions

6.4.2 Solve real life problems based on variations.

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**7. Matrices and Determinants:**

7.1.1 Define a matrix with real entries and relate its rectangular layout (formation) with real life

**7.1 Introduction to Matrices:**

7.1.2 Define:

- Rows and columns of a matrix and write order of a matrix
- Equality of matrices and identify equal matrices

**7.2 Type of Matrices (up to order 3×3):**

7.2.1 Define and identify types of matrices, such as row matrix, column matrix, rectangular matrix, square matrix, zero/null matrix, diagonal matrix, scalar matrix, unit matrix

7.2.2 Define and find transpose of a matrix, identify symmetric matrix and skew-symmetric matrix

7.3.1 Decide whether the given matrices are conformable for addition/subtraction

7.3.2 Add and subtract matrices

7.3.3 Multiply a matrix by a real number

7.3.4 Verify commutative and associate laws under addition

7.3.5 Define additive identity of a matrix

**7.3 Addition and Subtraction of Matrices (up to order 3×3):**

7.3.6 Find additive inverse of a matrix

7.4.1 Decide whether the given matrices are conformable for multiplication

7.4.2 Multiply two (or three) matrices

7.4.3 Verify associate law under multiplication

7.4.4 Verify distributive laws

7.4.5 Verify with the help of examples that commutative law under multiplication does not hold in general ( $AB \neq BA$ )

**7.4 Multiplication of Matrices (up to order 2×2):**

7.4.6 Verify with the help of examples that  $(AB)^t = B^t A^t$

7.5.1 Describe the determinant of a square matrix

7.5.2 Calculate determinant of a matrix

7.5.3 Define singular and non-singular matrices and solve related problems

7.5.4 Find adjoint of a matrix and related problems

7.5.5 Define multiplicative identity of a matrix

7.5.6 Find multiplicative inverse of a non-singular matrix A and verify that  $AA^{-1} = I = A^{-1}A$  where I is the multiplicative identity matrix

**7.5 Multiplicative Inverse of a Matrix (up to order 2×2):**

7.5.7 Verify the result  $(AB)^{-1} = B^{-1} \cdot A^{-1}$  with the help of examples

7.6.1 Solve matrix equations Find A, if  $A + \begin{pmatrix} 2 & 1 \\ 0 & 3 \end{pmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix} = 5 \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

## **7.6 Solution of Matrix Equations and Simultaneous Linear Equations:**

7.6.2 Solve a system of two linear equations in two unknowns using

- Matrix inverse method
- Cramer's rule

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## **8. Basic Statistics:**

8.1.1 Construct grouped frequency table

8.1.2 Construct histograms with equal and unequal class intervals

### **8.1 Frequency Distribution:**

8.1.3 Construct a frequency polygon

### **8.2 Cumulative Frequency Distribution:**

8.2.1 Construct a cumulative frequency table

8.2.2 Draw a cumulative frequency polygon;

8.3.1 Calculate and interpret (for ungrouped and grouped data):

- Arithmetic mean by definition and using deviations from assumed mean,
- Median, mode, geometric mean, harmonic mean

8.3.2 Describe and calculate weighted mean

### **8.3 Measures of Central Tendency:**

8.3.3 Estimate median, quartiles and mode graphically

### **8.4 Measures of Dispersion:**

8.4.1 Calculate and interpret range, variance and standard deviation

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## **9. Congruent Triangles:**

### **9.1 Congruent triangles:**

#### **9.1.1 Apply the following theorems along with corollaries to solve related problems:**

- In any correspondence of two triangles, if one side and any two angles of one triangles are congruent to the corresponding side and angles of the other, the two triangles are congruent.
- If two angles of a triangle are congruent then the sides opposite to them are also congruent
- In a correspondence of two triangles, if three sides of one triangle are congruent to the corresponding three sides of the other, the two triangles are congruent.
- If in the correspondence of two right-angled triangles, the hypotenuse and one side of one are congruent to the hypotenuse and the corresponding side of the other, then the triangles are congruent

## **10. Parallelograms and Triangles:**

### **10.1 Parallelogram and Triangles:**

#### **10.1.1 Apply the following theorems along with corollaries to solve related problems:**

- In a parallelogram:
  - i) The opposite sides are congruent
  - ii) The opposite angles are congruent

iii) The diagonals bisect each other

- If two opposite sides of a quadrilateral are congruent and parallel, it is a parallelogram.
- The line segment, joining the midpoints of two sides of a triangle, is parallel to the third side and is equal to one half of its length
- The medians of a triangle are concurrent and their point of concurrency is the point of trisection of each median
- If three or more parallel lines make congruent intercepts on a transversal they also intercept congruent segments on any other transversal

## **11. Line Bisectors and Angle Bisectors:**

### **11.1 Line Bisectors and Angle Bisectors:**

#### **11.1.1 Apply the following theorems along with corollaries to solve related problems:**

- Any point on the right bisector of a line segment is equidistant from its end points.
- Any point equidistant from the points of a line segment are on the right bisector of it
- The right bisectors of the sides of a triangle are concurrent.
- Any point on the bisector of an angle is equidistant from its arms
- Any point inside an angle, equidistant from its arms, is on the bisector of it
- The bisectors of the angles of a triangle are concurrent.

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## **12. Sides and Angles of a Triangle:**

### **12.1 Sides and Angles of a Triangle:**

12.1.1 Apply the following theorems along with corollaries to solve related problems.

- If two sides of a triangle are unequal in length, the longer side has an angle of greater measure opposite to it
- If two angles of a triangle are unequal in measure, the side opposite to the greater angle is longer than the side opposite to the smaller angle
- The sum of the lengths of any two sides of a triangle is greater than the length of the third side
- From a point, out-side a line the perpendicular is the shortest distance from the point to the line

## **13. Application of Ratio and Proportion in Geometrical Theorems:**

### **13.1 Ratio and Proportion:**

#### **13.1.1 Apply the following theorems along with corollaries to solve related problems:**

- A line parallel to one side of a triangle, intersecting the other two sides, divides them proportionally
- If a line segment intersects the two sides of a triangle in the same ratio then it is parallel to the third side
- The internal bisector of an angle of a triangle divides the side opposite to it's in the ratio of the length of the sides containing the angle
- If two triangles are similar, the measures of their corresponding sides are proportional

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## **14. Practical Geometry –Triangles:**

14.1.1 Construct a triangle when:

- Two sides and the included angle are given
- One side and two of the angles are given
- Two of its sides and the angle opposite to one of them (with all the three possibilities) are given

### **14.1 Construction of triangle:**

14.1.2 Draw: • Angle bisectors • Altitudes • Perpendicular bisectors • Medians of a given triangle and verify their concurrency.