Learning Outcomes for Mathematics

Class- IX

Suggested Pedagogical Processes	Learning Outcomes
The learners may be provided with opportunities individually or in groups and encouraged to — • work with real numbers and consolidate the concepts of numbers learnt in earlier classes. Some such opportunities could be: ▪ to observe and discuss real numbers. ▪ to recall and observe the processes involved in different mathematical concepts studied earlier and find situations in which they come across irrational numbers. For example, finding the length of the diagonal of a square with side, say, 2 units or area of a circle with a given radius, etc. • to observe the properties of different types of numbers, such as, the denseness of the numbers, by devising different methods based on the knowledge of numbers gained in earlier classes. One of them could be by representing them on the number line. • to facilitate in making mental estimations in different situations, such as, arranging numbers like 2, 21/2, 23/2, 25/2, etc., in ascending (or descending) order in a given time frame or telling between which two integers the numbers like, √17, √23, √59, – √2, etc., lie. • y apply relevant results to factorise the polynomials. • draw and compare the graphs of linear equations in one or two	**The learner —** • **Applies** logical reasoning in classifying real numbers, proving their properties and using them in different situations. • **identifies/ classifies** polynomials among algebraic expressions and factorises them by applying appropriate algebraic identities. • **relates** the algebraic and graphical representations of a linear equation in one or two variables and applies the concept to daily life situations. • **identifies** similarities and differences among different geometrical shapes. • **derives** proofs of mathematical statements particularly related to geometrical concepts, like parallel lines, triangles, quadrilaterals, circles, etc., by

variables. • discuss the proofs of mathematical statements using axioms and postulates. • play the following games related to geometry. ▪ For Euclid's axioms, if one group says, If equals are added to equals, then the results are equal. The other group may be encouraged to provide example such as, If $a = b$, then $a + 3 = b + 3$, another group may extend it further as $a + 3 + 5 = b + 3 + 5$, and so on. ▪ By observing different objects in the surroundings one group may find the similarities and the other group may find the differences with reference to different geometrical shapes— lines, rays, angles, parallel lines, perpendicular lines, congruent shapes, non-congruent shapes, etc., and justify their findings logically. • work with algebraic identities using models and explore the use of algebraic identities in familiar contexts. • discuss in groups about the properties of triangles and construction of geometrical shapes such as, triangles, line segment and its bisector, angle and its bisector under different conditions. • find and discuss ways to fix position of a point in a plane and different properties related to it. • engage in a survey and discuss about different ways to represent data pictorially such as, bar graphs, histograms (with varying base	applying axiomatic approach and solves problems using them. • **finds** areas of all types of triangles by using appropriate formulae and apply them in real life situations. **constructs** different geometrical shapes like bisectors of line segments, angles and triangles under given conditions and provides reasons for the processes of such constructions. • **develops** strategies to locate points in a Cartesian plane. • **identifies and classifies** the daily life situations in which mean, median and mode can be used. • **analyses** data by representing it in different forms like, tabular form (grouped or ungrouped), bar graph, histogram (with equal and varying width and length), and frequency polygon. • **calculates** empirical probability through experiments and describes its use in words.

lengths) and frequency polygons. • collect data from their surroundings and calculate central tendencies such as, mean, mode or median. • explore the features of solid objects from daily life situations to identify them as cubes, cuboids, cylinders, etc. • play games involving throwing a dice, tossing a coin, etc., and find their chance of happening. • do a project of collecting situations corresponding to different numbers representing probabilities. • visualise the concepts using Geogebra and other ICT tools.	• **derives** formulae for surface areas and volumes of different solid objects like, cubes, cuboids, right circular cylinders/ cones, spheres and hemispheres and applies them to objects found in the surroundings. • **solves** problems that are not in the familiar context of the child using above learning. These problems should include the situations to which the child is not exposed earlier.

Learning Outcomes for Mathematics

Class- X

Suggested Pedagogical Processes	Learning Outcomes
The learners may be provided with opportunities individually or in groups and encouraged to — • extend the methods of finding LCM and HCF of large numbers learnt earlier to general form. • discuss different aspects of polynomials, such as — their degree, type (linear, quadratic, cubic), zeroes, etc., relationship between their visual representation and their zeroes. • play a game which may involve a series of acts of factorising a polynomial and using one of its factors to form a new one. For example, one group factorizing say, ($x3 – 2x2 – x – 2$) and using one of its factors $x–1$ to construct another polynomial, which is further factorized by another group to continue the	**The learner —** • **generalises** properties of numbers and relations among them studied earlier to evolve results, such as, Euclid's division algorithm, Fundamental Theorem of Arithmetic and applies them to solve problems related to real life contexts . • **develops** a relationship between algebraic and graphical methods of finding the zeroes of a polynomial.

process. • use quadratic equations to solve real life problems through different strategies, such as, making a perfect square, quadratic formula, etc. • discuss different aspects of linear equations by engaging students in the activities of the following nature: ▪ one group may ask another to form linear equation in two variables with coefficients from a particular number system, i.e., natural numbers or numbers that are not integers, etc. ▪ graphically representing a linear equation in 1D or 2D and try to explain the difference in their nature. ▪ encouraging students to observe identities and equations and segregate them. • use graphical ways to visualise different aspects of linear equations, such as, visualising linear equations in two variables or to find their solution. • observe and analyse patterns in their daily life situations to check if they form an Arithmetic Progression and, if so, find rule for getting their nth term and sum of n terms. The situations could be — our savings or pocket money, games such as, playing cards and snakes and ladders, etc. • analyse and compare different geometrical shapes, charts, and models made using paper folding and tell about their similarity and congruence. • discuss in groups different situations,	• **finds** solutions of pairs of linear equations in two variables using graphical and different algebraic methods. • **demonstrates** strategies of finding roots and determining the nature of roots of a quadratic equation. • **develops** strategies to apply the concept of A.P. to daily life situations. • **works** out ways to differentiate between congruent and similar figures. • **establishes** properties for similarity of two triangles logically using different geometric criteria established earlier such as, Basic Proportionality Theorem, etc.

such as, constructing maps, etc., in which the concepts of trigonometry are used. • work in projects related to heights and distances, that may include situations in which methods have to be devised for measuring the angle of inclination of the top of a building and their own distance from the building. • devise ways to find the values of different trigonometric ratios for a given value of a trigonometric ratio. • observe shapes in the surroundings that are a combination of shapes studied so far, such as, cone, cylinder, cube, cuboid, sphere, hemisphere, etc. They may work in groups and may provide formulas for different aspects of these combined shapes. • determine areas of various materials, objects, and designs around them for example design on a handkerchief, design of tiles on the floor, geometry box, etc. • discuss and analyse situations related to surface areas and volumes of different objects, such as, (a) given two boxes of a certain shape with different dimensions, if one box is to be changed exactly like another box, which attribute will change, its surface area or volume? (b) By what percent will each of the dimensions of one box have to be changed to make it exactly of same size as the other box? • discuss and analyse the chance of happening of different events through simple activities like tossing a coin, throwing two dices simultaneously, picking up a card from a deck of 52	• **derives** formulae to establish relations for geometrical shapes in the context of a coordinate plane, such as, finding the distance between two given points, to determine the coordinates of a point between any two given points, to find the area of a triangle, etc. • **determines** all trigonometric ratios with respect to a given acute angle (of a right triangle) and uses them in solving problems in daily life contexts like finding heights of different structures or distance from them. • **derives** proofs of theorems related to the tangents of circles • **constructs —** ▪ a triangle similar to a given triangle as per a given scale factor. ▪ a pair of tangents from an external point to a circle and justify the procedures. • **examines** the steps of geometrical constructions and reason out each step • **finds** surface areas and volumes of objects in the surroundings by visualising them as a combination of different solids like cylinder and a cone, cylinder and a hemisphere, combination of different cubes, etc.

playing cards, etc. • generalise the formulas of mean, median and mode read in the earlier classes by providing situations for these central tendencies. • collect data from their surroundings and calculate the central tendencies. • to draw tangents to a circle from a point which lies outside and a point which lies inside the circle. They may be motivated to evolve different ways to verify the properties of such tangents.	• **calculates** mean, median and mode for different sets of data related with real life contexts. • **determines** the probability of an event and applies the concept in solving daily life problems.

Suggested Pedagogical Processes in an Inclusive Setup

Children with special needs to be taken along the class and keeping in view the learning objectives, similar to those of the others, appropriate activities may be designed. The teacher should take into account the specific problem of the child and plan alternate strategies for teaching-learning process. A healthy inclusive classroom environment provides equal opportunity to all the students; to those with and without learning difficulties. The measures to be adopted may include:

- developing process skills through group activities and using ICT for simulation, repeated practice and evaluation.
- assessing learning progress through different modes taking cognizance of the learner's response.
- observing the child's engagement in multiple activities, through varied ways and levels of involvement.
- using of embossed diagram in the pedagogical process and learning progress.
- using of adapted equipment (large print materials, adapted text materials with simple language, more pictures and examples, etc.) in observation and exploration (for example: visual output devices should have aural output and vice versa) during the teaching-learning process.
- using multiple choice questions to get responses from children who find it difficult to write or explain verbally.