

Teachers Hand Book

Maths

10th Class



**State Council for Educational Research
and Training
Telangana State, Hyderabad**

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Preface

"Destiny of India is constructed in her classrooms" said Kothari Commission. It means the schools should play a great role of preparing rational citizens. (Moreover, RTE-2011 provided all the children the right of acquiring quality education. Quality in education means the child should be able to think, communicate, conduct with discrimination, acquiring expected class wise and subject wise competencies etc. Development of these skills in a child is the duty of the school. And this has to be done by teachers.

The school should realise its duties in these commercialized days of education and subsequently the teachers must change themselves in performing roles and responsibilities. Knowledge is believed in information and remembering and retrieving that knowledge has become ultimate objective in the classroom. Main aim of exams is to test the quality of that memory but not the competencies those to be developed in learning of the subject. The attitude of teachers should be transformed from these old practices to innovative initiations. Thus the system of school can be rejuvenated.

Key principles of APSCF-2011 directs us that the children should learn meaningfully. They should construct their knowledge and utilize it in daily life situations : It also stated that the learning should not confine to classroom and it should encourage the children to research, explore, reflect through activities or projects.

It is thus believed that the children are knowledge constructors and the teachers should transform their teaching strategies so that the children can construct knowledge by critical teaching learning process of social constructivism. The evaluation system should be changed correspondingly. As per the above mentioned key principles, the syllabi, text books, teaching learning process and evaluation procedures in our state have been revised upto 10th class. SCERT has reformed the system and teaching learning processes and 9, 10 examination reforms are about to be implemented from 2014-15.

The SCERT has designed teachers handbooks to provide comprehensive understanding on new textbooks, modern teaching learning strategies and examination reforms. Philosophical aspects of new textbooks, special features of new textbooks, expected competencies, learning strategies for competencies, preparation of the teacher, year plan, lesson plan, examination reforms propositions, summative papers, formative exams and strategies have been discussed in this handbooks. This handbook is useful in implementing meaningful teaching learning strategies in the classroom. Therefore, we hope that the teacher will ruminate his experience, creativity in thinking and implement successful teaching learning strategies.

The teacher is able to utilise this book in understanding textbook and can write year and lesson plans in implementing teaching learning process accordingly. He can understand 9, 10 examination reforms and examination implementation process. He should also elevating himself as the best teacher by carving future generations by understanding truth. We appreciate the members of C&T department of SCERT, textbook writers and state resource group members who participated in designing this book.



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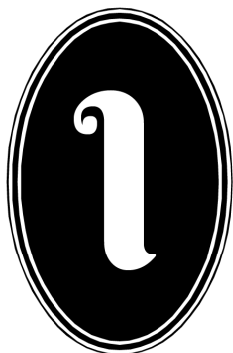


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UNDERSTANDING TEXT BOOKS

OVERVIEW :

Text books guides is like a compass in teaching learning process to be conducted in the classroom. The textbook is helpful in improving the skills of children in the class. A textbook is designed on the basis of syllabus and educatinoal objectives of a particular subject at a particular level. Based on that textbook, the teacher has to conduct teaching learning process. So, the teacher has to use the textbook to develop the expected skills but not to use as a tool for more transacting the information.

Nowadays, use of the textbook is confined only to solve problems which are given in the exercises. Generally, if the students are copying solutions from black board when every problem is solved onthe board, some teachers are giving the problems to the children to solve after solving 1 or 2 problems. The teachers are considering this solving of problems in all exercises as completing syllabus can treat this process as mathematics learning if the students copy or imitate?

- What is the role of the text book in learning Maths?
- How should be learning of maths?
- How to develop the skills among children in mathematics learning?

Learning Maths should enhance abilities in children like Problem Solving, Reasoning Proof, Communication, Connections; Visualisation & Representation. Subsequently the child would solve

problems which come across in daily life and motivated to discover new inventions. A textbook can be helpful in improving the Mathematical skills but not just to extract the content on information given in it. Present text books are designed in such a way that the students can search for different ways of solving problems by understanding connections between various concepts and logical reasoning behind them. The teachers and students may understand here that this textbook should encourage the children to understand the concept, prove the statements and solve problems themselves. consequently, the students develop Reasoning, communication, representation skills and trained accordingly. Let us look at the areas and concepts mentioned in textbooks and understand them.

CONTENTS OF TEXT BOOK :

- **Foreword** : It is discussed about nature and scope of textbooks. It mainly discussed universalisation of education, process of learning mathematics by children at secondary level, application of mathematical concepts in daily life, Role of a teacher (Execution of conducting T.L.P. by considering individual differences, positive approach towards mathematics, participation of all etc) at the end Expressing gratitude to all (SCERT all writers, DEOs, MEOs, HMs, C&DSC, AP and Vidybhavan Society) and a welcome for comments and suggestions for the improvement of the textbook.
- **AREAS OF MATHEMATICS - CHAPTERS** : This text book consists of 14 chapters. These chapters are related to various mathematical areas like Number System, Geometry, Co-ordinates, Trigonometry, Mensuration, Data handling etc., The mathematical modelling has been introduced as appendix for the exposure of students on real life incidents. This is also a mathematical skill to be learnt by the children at this stage. Though the chapter can not be considered for exams, children develop a capability to solve problems by mathematical modeling on their own.
- Every teacher has to read and understand instructions to teachers and visualise in various strategies that her / she would adopt in TLP. Mainly we can understand the development of syllabus from 6th to 10th, methods or strategies to solve exercises. Then, content flow has been discussed for each chapter when we teach this content every chapter, it doesn't mean completion of syllabus. The teachers instructions to given in the textbook guides the teacher to use the Textbook as an effective tool to achieve academic standards in the teaching learning

process. Understanding these instructions is an important step in the readiness of teacher or teacher preparation.

- What happens, if the 10th class mathematics book is filled with intermediate level content?

Highlights of the Text Book :

As per guidelines given by NCF-2005, RTE-2005 and APSCF-2011, Text Books should be child centred; and it should take into account interests, attitudes, learning style and background of the children. These are key concepts in developing this 10th class Mathematics Text Book.

When we observe the new Mathematics Text Book for 10th class it has the following characteristics / specialities.

The text book has been designed to make the children to learn mathematics based on one's natural abilities / innate abilities and make the children think in mathematical perspective. Let us learn example in page No : 215 of 10th Mathematics Text Book question has been asked in an exercise "Think-discuss" as For a right angled triangle with integer sides atleast one of its measurements must be an even number. Why? This question encourages the children to think about different ways of construction of a right angled triangle with different combinations of measurements. The child can understand logic behind the truth and he will be encouraged to give suitable reasons by the end of this activity.

In page no : 115 for solving "We have three methods to solve quadrature equation. Among these three, which method would you like to use? Why? This problem is intended to enable the children to think about various methods to solve a quadratic equation. And child is given opportunity to express reason why he has chosen a particular method with proper reasons.

The text book is designed to bid adian to rote learning methods and replacing them by the methods which encourage mutual interactions, activities, project work, inventions, experiments and analysis.

For example, let us observe page no : 272 of Mathematics Text Book of 10th class, the way how the trigonometric ratios are defined in a different way by an activity. Teachers most of the used to follow the the traditional method for defining trigonometric ratios simply by writing the formulae on the black board. By which children could not understand, how trigonometric ratio are defined and what they are. By participating in this activity children can able to give the relation between the sides of a triangle with respect to an angle in it. Finally he can induce the trigonometric ratios on his own.

Similarly in page no : 307 an activity of tossing a coin 50 times, 100 times, 150 times and count the occurrence of head and tails (events). The students can define the meaning of the probability and state seasons.

In page no : 193, there is an activity on similarity. By participating in the activity children can frame the rules for similarity of two polygon with the same number of sides. Two are similar if (i) all the corresponding angles are equal and (ii) All the corresponding sides are in the same ratio on their own. Like this, there are many similar activities which encourage children to think and generalise or frame rules in the form of mathematical statements. These activities provide the ample opportunity for the children to utilize their abilities and enjoy mathematics learning. Observe and identify those activities and discuss.

- Children can utilise the mathematical concepts they have learnt. They understand the concepts which are given in text books on basis of their previous experiences and real life contexts. These conceptual understandings enhance problem solving skills in students. Thus a student constructs knowledge and applies it in his daily life.

For example, solving linear equations given in pgs 83 and 84 and the concepts of solving problems in chapter "Application of trigonometry". Child can apply this knowledge in daily life.

- The content in text book does not restrict the children to limit their understanding and solving of the problems on the concepts in the Text book, but encourages the child to learn beyond the scope of the text book.

For example in page no : 252, 274 under 'Think-Discuss', the task makes the children to think beyond the concepts covered in the Text book. In these cases, the child interact within his peer group or with material and comes to conclusion by the reflections. Thus a child comprehends the concepts.

Structure of lesson / unit :

Each lesson / unit of the text book is designed in a systematic manner

- Strengthening the concepts learnt in the lower classes by revision. Thus extending the knowledge with various concepts in the present class.

- Understanding various mathematics concepts, which are given in textbook by daily life situations / incidents / activities / games / puzzle / series / examples etc.
- Different example problems with solutions are given after understanding a concept and to understand strategies of solving problem by using the concept.
- In exercise is given with the title "Do this" to ensure that the children understood a particular concept. Aim of this "Do this" exercise is to solve the problems by children individually. When a student is unable to solve this exercise, we can say that the child has not understood the concept. The alternative strategies or activities should be designed to understand the concept for these children.
- Another type of exercise is given with name "Try this" to promote critical thinking in the child and understand the concept with more comprehension. These problems can be solved by discussing in groups. Support of teacher is needed.
- "Think discuss & write" - exercise is given to make the children to think elaborately and learn beyond the textbook, to improve, thinking process and for extensive understanding of the concepts. (In this task interactions play a vital role; (interactions - within peer group or with teacher or with material)
- Suitable activities / projects are given by which children can construct knowledge and learn by direct experience.
- An 'Exercise' is given in which the problems are included after understanding 3 or 4 concepts. Each exercise contains 7-15 problems, solving these problems children can develop their academic standards.
- Optional exercise is given to broaden thinking level of the child to stimulate student's internal quest and enthusiasm for problem solving to give, exposure for competitive exams. This exercise is not meant for examinations.

Exercises with in the chapter :

In the 10th class Mathematics Textbook various situations, activities are given to introduce concept. Besides given exercises, "Do this", "Try this" and "Think, discuss & write" exercises are given with few problems or questions.

Let us discuss how teachers can use these exercises in effective learning process.

1. Do this :-

- Do this exercise is intended to know how far the children understand the particular concept. Immediately after understanding a concept.
- It is limited for a single concept. Problems can be solved by applying the concept directly.

Example :

Find the distance between following points (page : 162)

(i) (3, 8), (6, 8), (ii) (-4, -3), (-8, -3)

- Children has to solve these problems on their own. By solving these problems, 'self confidence' is developed among the students.
- While students solving the problems from 'Do this' exercise, Teacher has to observe, whether they are doing correctly or not or facing any problem. If they make any mistake, correction can be done through a healthy discussion.
- If children solve the problems effectively without mistakes, teacher can conclude that the children have understood the concept at minimum level.
- So the teacher has to encourage the children to solve the problems under 'Do this' exercise individually.

2. Try These :-

- The problems or questions in these exercises are given to learn the concept extensively, to understand the concept comprehensively and generalise new inventions on the concepts after understanding a concept.
- The problem in these exercises are (little bit complex).

Eg: page No : 49

(i) Write a quadratic polynomial and a cubic polynomial in variable x in the general form.

(ii) Write a general polynomial $q(z)$ of degree ' n ' with the coefficients b_0, b_1, \dots, b_n what are the conditions to write this.

- So all the children of the class may not solve on their own hence teacher has to support or encourage the group activities.
- While solving the exercises under "Try these" the teacher has to observe by going around the groups and watch what they are discussion about? Which strategy they have adopted? are there any misconceptions? and teacher may give proper suggestion to improve their understanding.
- These questions are thought provoking and accepting challenges.
- Reasoning and communication skills are developed in a child by solving problems in these exercises.

3. Think - Discuss :-

- These exercises are intended to enhance the children to think beyond learned concepts.
- Children can extend their conceptual understanding with solving of these problems / activities.
- There are group activities.

Eg : Page No : 252 (T.B.)

- These problems are helpful to extract the creativity of the children.
- These problems are helpful as additional material on the concept for learners. They are useful to discuss with classmates to understand concepts.

Exercises like

- Do this, Try these, Think - Discuss are helpful to children to strengthen their mathematics knowledge by mathematical understanding concepts. They are useful to construct the knowledge through thinking mathematically. These exercises have to be solved in presence of teacher only in the classroom.

4. Exercises :-

- There are 5 to 8 exercises in each Chapter depending the number of concepts and each exercise contains 10 to 15 problems.
- All problems are not similar in these exercises. These problems strengthen the learnt concepts by applying them in the daily life and skills like critical thinking, communication, and connection will be developed.

- All the problem has to be solved by the children on their own.
- According to the length of exercises teacher has to discuss problem - solving strategies, so that they can solve the problems at homes or in leisure periods.
- Teacher has to take care for not to copy from their classmates note books, or from guide or copy for Black board. Try to engage children to solve the problems on their own.

5. Optional Exercises :-

- Problem in Optional Exercises are intended for extensive learning and to achieve academic standards comprehensively.
- The problems in these exercises are helpful in developing higher order thinking and applying the problem solving strategies in their daily life situations, more over these problems reinforce the mathematics learning.
- These problems help children to ready for competitive exams and to learn beyond the Text Book.
- Though these problems may not be covered in the Public Examinations, the teacher should not neglect to practice these problems.
- So by identifying the importance and objective of optional exercises teacher has to encourage the children to solve the problems in these exercises, and they should explain why and how the strategies are adopted. Here the role of teacher is very important.



LESSON-WISE ACADEMIC STANDARDS - INDICATORS

Introductions :

- Why should we teach mathematics?
- Why should we achieve through mathematics teaching?
- How to make the children to think mathematically?

In the process of education, the child not only learns in the classroom but also every where even outside the classroom. He learns everywhere every child has natural abilities to learn, but the education sharpens his abilities and converts those abilities into skills. Whatever child experiences even outside the classroom, the classroom should utilize those experiences to enhance them and help the child to even create new thoughts. Speaking mathematically, Mathematics learning should develop skills like problem solving, thinking logically, Reasoning, Representing, connecting etc. Therefore, we need some specific statements which guide us to develop those skills in our mathematics classroom. These statements are named as “Academic Standards”.

“Academic standards are clear statements about what students must know and be able to do within a stipulated period to perform skills in a particular content or connecting contents.

To understand about how to write academic standards, we have to understand clearly what are academic standards.

- They are clear statements even normal public should understand them.
- They guide as for the teaching learning process about what skill to be performed by the children after learning.
- They guide us for the assessment of child's performance.
- Sometimes they may be defined for more than one content i.e. combination of contents.
- Sometimes they may be defined with connecting of multiple skills.
- Sometimes they may be defined with multi concepts.

Therefore, we can clearly say that academic standards are clear statements with contain single content or multiple contents, single skill or multiple skills and even with single concept or multiple concepts. Teachers should take the responsibility of performance of the child which is defined by the academic standards.

Now, let us book at the skills to be developed in our mathematics classrooms.

Problem solving :

Usually, students solve problems with a formula, substituting values in it and finding solution. Is this really problem solving skill, what we are expecting from the child? Whatever the mathematics concept is understood, it should be applied in various different situations. The student should think and establish relation with his different experience daily life. Then he seeks ways and means of mathematisation using symbols, processes like addition, subtraction, multiplication, division, squaring etc and gets solution in problem solving. Through problem solving, student gets the pleasure of finding solution when she verifies, gives reasons explains processes, concepts through easy communication, links or connects with different concepts. Mathematics learning should not force the child to find the alternative procedures / ways of finding solutions. When a student is habituated all the process of problem solving and be able to connect it with his daily life, she could create many more different problems with different situation and with different types of numbers.

Therefore to understand problem solving, we need to understand the following steps in problem solving.

Steps in problem solving

- Identify what is given?
- Identify what is to be found?
- Understanding what concepts are involved.
- Visualizing whole the above items.
- Get ideas about procedures, formulas for the solution.
- Selection of the best procedure or formula.
- Substitution.
- Manipulation/ calculation.
- Arriving solution.
- Verification.
- Conclusion.
- Generalisation.
- Trying out other strategies, formulas, procedure for the solution.
- Finding shortcut.
- Explaining procedures and reasoning.
- Creating similar problems in various situation and with various types of numbers.

Though the term ‘Problem solving’ may look simple and even the process may look simple some times. There will be problems with more complexity. The amplexity of the problems depends upon the following things.

- Making connections as defined in connections section.
- Number of steps.
- Number of operations.
- Context unraveling.
- Nature of procedures.

There are many types of problems like word problems (with single concept or multiple concepts, with single operation or multiple operations) pictorial problems, procedural problems, Mathematical abstract problems with equations or in equations, reading data, tables, graph etc.

Hence finally we can conclude that problem solving skill in mathematics learning should make the student to think logically, give reasons, connect concepts, visualise the things etc : Mathematisation of child's life would emerge the child into a mathematician.

Reasoning – proof

Every student has potential for higher order – thinking. The key is to unlock the world of mathematics through a student's natural inclination to strive for purpose and meaning. Reasoning is fundamental character to the knowing and doing of mathematics. Conjecturing and demonstrating logical validity of conjectures are the essence of the creative act of doing mathematics. Mathematics teacher has been felt so as learn everything from the teacher. This opinion is making the students to completely depend upon teachers have been felt so as learn everything from the teacher. This opinion is making the students to completely depend upon teachers and not allowing students to think on their own, generate and conclude. When a student is allowed to think, generate and conclude on his own, his ability of reasoning is developed. Then the student can give reasons mathematically. When a student understands, analysis the context, make intuitions, conjectures and finally generalizes, then we may say that he concluded logically. This may be reflected by his justification of the argument or procedures. Reasoning skills allow a student to examine logical arguments. Most of the mathematical statements are the result of inductive and deductive logics.

The student should perform Reasoning – Proof

- Understanding and making mathematical generalizations, intuitions and conjectures.
- Understanding and justifies procedures.
- Examining logical arguments.
- Uses inductive and deductive logic.

Communication

Is mathematics full of numbers or Is it manipulation of numbers? If you want say 3 objects are more than 2 objects, then what would you like to do?

Communication is an essential part of mathematics and mathematics learning. It is a way of sharing, clarifying, reasoning, generating our understanding. Through communication, ideas become objects of reflection, refinement, discussion and amendment. The communication process also helps build meaning and permanence for ideas and makes them public. When students are challenged to think and give reason about mathematical concepts and to communicate the results of their thinking to others orally or in writing.

The communication skill is reflected in :

- Writing and reading mathematical expressions like $3 + 4 = 7$, $3 \times 4 = 12$, $3 < 4$ etc.
- Creating mathematical expressions.
- Explaining mathematical ideas in her own words. Ex : A square is closed figure having four equal sides and all equal angles.
- Explaining mathematical procedures. Eg: Adding two digit numbers involves first adding the digits in units place and then adding the digits at the tens place / keeping in mind carry over.
- Explaining mathematical logic.

As mathematics learning is carried out in mechanical, way, negligence on mathematics communication prevailed in mathematics classrooms. Wherever it is possible, the students should be allowed to speak on mathematical equations an expressions. For eg: If a student has been allowed to think about $x + 2 = 6$, He should visualize it as the sum of x and 2 gives 6. Then it will be easy for him to solve the equation. Therefore, the student needs communication skills to give proper reasonings or proper conclusions or to solve problems in mathematics.

Connections :

As we discussed earlier, mathematics learning needs to develop logic in the child it helps the child to give reasons for him to conceptualise and solve problems wherever they come across. To develop in conceptualization process, the student has to link or connect things in logical manner one by one, finally generalizes and comes to conclusion. Moreover, If we look at problem solving the student decides a strategy to solve the problem after “making connection” in between the given things in the data of the problem. Therefore, in the process of development of logic or problem solving, “making connections” is an important skill in mathematics learning.

In the process of connecting things in mathematics learning, he needs to connect the abstractions in mathematics with the objects or contexts in his daily life or with concepts in other subjects. He even may need to connect the abstractions with the concepts within the mathematics. This performance of the child will help the child to link mathematics with his daily life. Hence mathematisation of child’s life is possible as expected by NCF-2005. Making “connections” is specified by the following performance in the children.

- Connecting concepts within a mathematical domain fore relating adding to multiplication, parts of a whole to a ratio, to division. Patterns and symmetry, measurements and space.
- Making connections with daily life.
- Connecting mathematics to different subjects.
- Connecting concepts of different mathematical domains like data – handling and arithmetic or arithmetic and space.
- Connecting concepts to multiple procedures.

Hence, performance of the child in mathematics can be adjudged by how best the logical connections he is making and arriving at conclusions. These connections may be in between concepts

of mathematics or the concept and area or the concept and other subjects or the concept and daily life contexts.

Visualization & representation

We conduct many programs or do several works in our daily life. We visualize a plan or imagine a sequence of actions to make the program successful. Mathematics is involved in almost every program we conduct. For example, we deal with costs of objects, measurements to construct a building as perform a marriage. Like this, mathematical visualization skill is a necessary skill in our daily life.

Visualization creates mental images in the mind when there mental images are related or liked with a logic, visualization about a context or situation or procedure is formed. Hence, the child in our classroom needs visualisation skill in the process of conceptualization or problem solving while mathematics learning. While conceptualization, he forms an idea or notion about a concept by visualizing the thing involved in it. Without visualizing, one cannot understand any concept. Not only in the process of conceptualization, But also in the process of solving problem, the child needs visualization skill. In the process of problem solving, a child needs to visualize all possible strategies to solve a problem and select the best way to solve it. This skill helps the child to develop his logic in mathematics.

When we want to convey our visualization, we represent to in the form of a flow chart or table or graph or any other pictorial form. Representation skill is another import skill to perform in mathematics learning.

Therefore, we need following specifications to perform in “Visualization & Representation”.

- Interprets and reads data in a table, number line, pictograph, bar graph, 2-D figures, 3-D figures, pictures etc.
- Making tables, representing number line, pictures etc.

Hence, Visualization & Representation skill provides easyness to convey our perceptions on ideas.

Till now, we have discussed about the skills on the basis of which we have to write academic standards. When we decide and write an academic standard, it guides our teaching learning process to achieve that standard in the child. Moreover, these academic standards ensure the “performance” of the child and they are displayed in the form of performance.

ACADEMIC STANDARDS CHAPTER WISE

Class : IX
Area : NUMBER SYSTEM
Key concepts : Real Numbers

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Pupils can find rational numbers between given two rational numbers.
- Can solve the problems on real numbers. (Rationalizing the denominators, by using its conjugate or rationalizing factor.)

2. Reason & Proof

- Can compare the given numbers (rational / irrational) and give reasons.
- Can differentiate rational and irrational numbers.

3. Communication

- Can express rational numbers in decimal forms.
- Can give examples for rational / irrational numbers / surds.

4. Connection

- -

5. Representation

- Pupils can represent terminating / non-terminating recurring decimals on the number line through successive magnification.
- Can represent rational & irrational numbers on number line.

Area : **ALGEBRA**

Key concepts : • Polynomials

• Linear equations in two variables

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems on polynomials (Finding the value of variable, finding zeros of polynomials, division and factorization of polynomial)
- Can solve the problems on polynomials by using remainder theorem & factor theorem.
- Can solve the linear equations in two variables.

2. Reason & Proof

- Can differentiate various polynomials (monomials, binomials) and give examples.
- Can verify the division & factorization of a polynomial by using remainder theorem and factor theorem.
- Can verify algebraic identifies.
- Can verify the solutions of given linear equations.

3. Communication

- Can express and explain monomial, binomial, trinomial etc., according to the no. of terms in it, and give examples for the above.
- Can explain about remainder theorem and factor theorem.
- Can identify and explain the linear equations in two variables.
- Can write daily life situations in the form of linear equations (Vice-versa).

4. Connection

- Can solve the problems of day to day life by using linear equations (Bu using arithmetic, algebraic concepts)

5. Representation

- Can represent linear equations in two variables on graphs (plane) and read the graph.
- Can draw the equation of lines parallel to X-axis and Y-axis.

Area : **CO-ORDINATE GEOMETRY**

- Key concepts** :
- Cartesian system
 - Plotting points in a co-ordinate plane

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- -

2. Reason & Proof

- Can justify the position of points in a co-ordinate plane.

3. Communication

- Can say abscissa and ordinate of a given point and also as X-co-ordinate, Y-co-ordinate.
- Can express the point using brackets (i.e. : (x, y))

4. Connection

- Can find the areas of given geometrical shapes joining the points in a plane (using graph).

5. Representation

- Can locate a point in the co-ordinate plane.

Area : **GEOMETRY**

- Key concepts** :
- Elements of geometry
 - Lines and angles
 - Triangles
 - Quadrilaterals
 - Area
 - Circles
 - Geometrical constructions

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems on linear pair of angles

- Can solve the problems on linear pair of angles
- Can solve the problems based on congruency of triangles.
- Can solve problems parallelogram
- Can solve problems on area of triangle and quadrilaterals.
- Can solve problems on angle subtended by chord at a point in a circle.
- Can solve the problem on angles made by major arc and minor arc of a circle.
- Can solve problems on angles of a cycle quadrilaterals.

2. Reason & Proof

- Can prove theorms (Ex : Two distinct lines cannot have more than one point in common")
- Can show and verify the axioms & postulates for given situations.
- Can differentiate between intersecting lines and concurrent lines.
- Can prove (The sum of angles of a triangle is 1800") theorems with lines and angles, lines of transversal etc.
- Can give reasons in constructions of geometrical figures.
- Can give reasons for congruency in triangles and inequalities in a triangle.
- Can prove theorems on based on congruency of triangle.
- Can verify rules of congruency of triangle (i.e, SAS, AAS, SSS, ASA, RHS etc.)
- Can verify and give reasons in finding angles in parallelogram.
- Can show and verify the given statements based on parallelogram and the mid point theorem of triangle.
- Can prove theorems ("Parallelograms on the same base and between the same parallels are equal in area" etc) and verify it.
- Can prove theorems based on angle sustended by a chord at a point in a circle.
- Can give reasons for determining angles made by a chord, major are minor arc and cycle quadrilaterals.

3. Communication

- Can give axioms from their day to day life.
- Can appreciate Euclidian geometry, axioms and postulates.

- Can identify and explain intersecting lines and non-intersecting lines.
- Can identify and say various types of angles.
- Can explain about linear pair of angles.
- Can explain the steps in construction geometrical figures.
- Can explain congruency of triangles and rules of congruency in triangle.
- Can explain properties of parallelogram.
- Can differentiate between congruency and similarity.
- Can give statements in mathematical language on conclusions he made.
- Can explain steps in construction of
 - a) Perpendicular bisector of a given line segment.
 - b) Bisector of a given angle.
 - c) and a triangle.

4. Connection

- Can solve problems on angles involving arithmetic and algebraic concepts.
- Can solve problems on lines of transversal using different concepts.
- Connect the rules of congruency to the other plane figures.
- Can connect the concepts of angle made by a chord on the circle and angle made by a arc.
- Can connect the generalization he made on angles made in different situations while problems solving.

5. Representation

- Can draw geometrical figures with given measurements.
- Can construct triangle with given measurements & circle segment also.
- Represent the plane figure formed when the mid points of the sides of the given figure are joined.
- Can construct circum circle with given measurements.
- Can construct
 - a) Perpendicular bisector of a given line segment.
 - b) Bisector of a given angle.

Area : **MENSURATION**

Key concepts : Surface areas and volumes

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve problems on surface areas & volume of cube, cuboid, prism, cylinder, cone, sphere, hemisphere and right circular cylinders / cones.

2. Reason & Proof

- Can compare and contrasts surface areas and volumes of cube, cuboid, prism, cylinder, cone, sphere, hemisphere etc.

3. Communication

- Can explain formulae for surface areas and volumes of cube, cuboid, prism, cylinder, cone, sphere, hemisphere etc.
- Can explain the relationship of surface areas of given figures and also for volumes of given figures.

4. Connection

- Can solve the problems on surface areas, volumes of cube, cuboid, prism, cylinder, cone, sphere, hemisphere etc. by using algebraic, arithmetic concepts and more operations.
- Can relate / connect area and volume of cube cuboid, prism, cylinder, cone sphere, hemisphere to each other infinding surface areas and volumes of 3D objects.

5. Representation

- Can represent 3D figures (cube, cuboid, cylinder, etc) in 2D figures (net shapes)

Area : **STATISTICS AND PROBABILITY**

Key concepts : Statistics

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can calculate mean, median, mode of ungrouped data.
- Can find the mean by deviation method.

2. Reason & Proof

- Can give reasons for their judgments on mean, median, mode.
- Can estimate mean, median for ungrouped data and verify them.

3. Communication

- Can explain the terms and formulae for mean, median, and mode and their advantages and disadvantages.
- Can explain scope and necessity of grouped data.

4. Connection

- Can relate mean, median, mode with each other while problem solving.
- Can we algebraic and arithmetic concepts in solving problems related to mean, median, mode.

5. Representation

- Can prepare frequency distribution / cumulative frequency distribution tables for given data.
- Can represent the data in frequency graphs (Histograms)

Key concepts : Probability

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems on single event of a sample space of a random experiment.

2. Reason & Proof

- Can estimate probability of an event of a random experiment and give reasons in finding probability.

3. Communication

- Can explain the terms random experiment event, probability etc.,
- Can explain the statements related to probability in mathematical language.

4. Connection

- Can connect the previous arithmetic concepts to understand and solving problems.

5. Representation

- Can represent the outcomes of the random experiment in the form of table.

Area : PROOF IN MATHE MATICS

Key concepts : -

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- -

2. Reason & Proof

- Can generalize the observations into mathematical statements on the basis of inductive and deductive reasonings.
- Can give reasons for different statements made by them.
- Can prove the mathematical statements and verify them.

3. Communication

- Can express their generalizations in mathematical statements.

4. Connection

- Can connect their generalize-tions to form new statements.

5. Representation

- -

Class : X

Area : NUMBER SYSYEM

Key concepts : Real Numbers

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Pupils can solve the problems on finding LCM, HCF by using prime factorization method.
- Can solve the problems on rational numbers, irrational numbers and logarithms.

2. Reason & Proof

- Pupils can understand and verify the fundamental theorem of arithmetic and give conclusions for the above theorem.

- Can prove the results of irrationality of $\sqrt{2}$, $\sqrt{3}$ etc., and decimal expansion of rational numbers in terms of terminating / non terminating recurring decimal (vice versa)
- Can understand and verify the properties of real numbers.
- Can prove and verify laws of logarithms through generalizations made by them by inductive reasoning & deductive reasoning.

3. Communication

- Can give examples and explain the fundamental theorem of arithmetic.
- Can state whether the given rational numbers will have terminating / non terminating, repeating decimal form by without performing division.
- Can convert the given number in exponential form to logarithm form (vice versa)
- Can explain the scope and necessity of logarithm and can explain laws of logarithms and terms in logarithms.

4. Connection

- Can connect some concepts of real numbers in solving problems.
- Can connect laws of exponents to laws of logarithms and also each law of logarithms to derive other laws of logarithm.
- Can connect logarithm in daily life situations.

5. Representation

- Can represent a real number on a number line.

Key concepts : Sets

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems related to sets and their basic operations.
(Union, intersection, difference)

2. Reason & Proof

- Can differentiate empty set, finite set, infinite sets and universal sets and give reasons.
- Can justify whether the given statements belong to set or not.
- Can identify equal sets and give reasons.
- Can justify that the intersection of two disjoint sets is a null set.

3. Communication

- Can give examples for sets.
- Can express the given set in roster form and set builder form.
- Can convert roster form of a set to set builder form (vice-versa).
- Can use the signs / symbols regarding sets at the appropriate time / situation.
- Can explain about subsets.

4. Connection

- Can connect the concept of set in daily life situations.
- Can interlink number, arithmetic algebraic concepts in sets.

5. Representation

- -

Area : ALGEBRA

Key concepts : Progression

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can find the required term of given Arithmetic progression and also find common difference of A.P.
- Can calculate the n th term and sum of first n terms of an A.P.
- Can calculate the n th term in G.P.

2. Reason & Proof

- Can give generalizations from Arithmetic progression, Geometric progression for common difference in AP and common ratio in GP and n th term in AP and GP.
- Can generate the formula for sum of n terms in AP.

3. Communication

- Can express and explain the general form of AP, GP.
- Can explain the formula and terms in AP and GP.
- Can give examples for AP and GP.

4. Connection

- Can connect arithmetic and algebraic concepts while solving the problems on AP and GP.

5. Representation

- -

Key concepts : Polynomials

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can find the zeros of polynomial (quadratic polynomial and cubic polynomial)
- Can solve the simple problems on division algorithm for polynomials with Integral co-efficients.

2. Reason & Proof

- Can verify / check and give for reasons zeros of a given polynomial.
- Can made some generalizations by observing zeroes of polynomials and justify them.

3. Communication

- Can express "degree" of a polynomial, zeroes of a polynomial terms of the polynomial (linear, quadratic & cubic polynomial)

4. Connection

- Can connect / interlink the zeroes and coefficients of a polynomial to each other whole solving problems.

5. Representation

- Can represent a linear polynomial on the graph and also quadratic polynomial, cubic polynomial.

Key concepts : Pair of linear equations

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can find solutions on pair of linear equations in two variables.
(Model methods algebraic method, elimination method) and substitution method.
- Can solves the simple problems on linear equations.

2. Reason & Proof

- Can verify and given reasons for solutions of pain of linear equations.

- Can check whether the given pair of linear equation is consistent or not and dependent and can give reasons.

3. Communication

- Can express their daily life situational issues in the form pair linear in two variables. (Vice-versa).

4. Connection

- Can relate between co-efficients and nature of system of equations.
- Can solve the problems of different situations (by using algebraic and arithmetic and geometrical concepts) from day to day life related to pair of linear equations.

5. Representation

- Can represent the pair of linear equations in two variables through graph. And find / identify the solutions for them in graphical method.

Key concepts : Quadratic equation

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the simple problems on quadratic equations by using factorization, and the method of completing the square.

2. Reason & Proof

- Can give reasons for the solutions (nature roots) for a quadratic equation.
- Can verify that whether the solutions of a given quadratic equation are correct or not (or)
Can verify that whether given solutions are roots of the quadratic equation and give reasons for that.
- Can estimate the roots of quadratic equations and give reasons through verifying them.

3. Communication

- Can express day to day life situations in the form of equations (Vice-versa).
- Can express the nature of the roots of quadratic equations.

4. Connection

- Can solve the problems on quadratic equations involving algebraic, geometric concepts.

5. Representation

- Can draw the graph for quadratic equations.

Area : **GEOMETRY**

Key concepts : Similar triangles

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problem based on theorems, (Thales theorem etc.) (properties of similar triangles)
- Can find the area of similar triangles.
- Can solve the problems on Pythagoras theorem.

2. Reason & Proof

- Can prove theorems based on similarity of triangles.
- Can make the conclusions that all the congruent figures are similar but the converse is not true.
- Can prove & give converse for the theorems by examining through some activities.
- Can prove theorems related to similarity properties of triangle.

3. Communication

- Can give statements by their generalizations in mathematical form.
- Can explain properties of triangles.
- Can give converse statement, negation of statement for given statements.

4. Connection

- Can connect Algebraic and various geometrical concepts in solving the problems in different daily life situations.

5. Representation

- Can draw the line segment and division of that with given measurements.
- Can draw triangles with given measurements.

Key concepts : Co-ordinate geometry

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can calculate distance between two points in a co-ordinate plane.
- Can find area, perimeter of given geometrical figures joining points in plane.

- Can solve the problems on section formula. (dividing line in two segments with a point in given ratio)
- Can find the tri-sectional points of a line segment.
- Can solve the problems on finding mid point, centroid and slope of a line.

2. Reason & Proof

- Can give the reasons for the location of a plotted points in a coordinate plane and for the distance between those points.
- Can generalize the mid point of a line segment through some activities related section formula.
- Can generalize the slope of a line and can give reasons for its. (Based on angle (inclined) of a line a plane.)

3. Communication

- Can explain the formulae for distance between two points in a plane and the area of a figure formed by joining pints in a plane etc..
- Can express their conclusions had made from co-ordinate geometry in mathematical statements (Vice-versa)

4. Connection

- Can connect various geometrical concepts in solving problems on coordinate geometry. (Ex: perimeter, area of circle, triangle, Quadrilaterals etc.)
- Can use Heron's formula to find the area of a given triangle joining three points in a plane.
- Can connect the concept of linear equations to co-ordinate geometry. (i.e. straight line)

5. Representation

- Can plot the given pints on a coordinate plane.
- Can draw the figures by joining given points in a plane.

Key concepts : Tangents and secants to a circle

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems in finding length of the tangent of a circle.
- Can solve the problems in finding the area of the segment.

2. Reason & Proof

- They can made conclusions on tangents / secants of a circle and can give reasons.

- Can distinguish and differentiate tangents and secants of a circle.
- Can prove theorems on tangents and secants of a circle and their converse also.
- Can make generalization and differentiate area of the minor / major segment of a circle.

3. Communication

- Can explain about tangents and secants of a circle.
- Can explain theorems / statements in his own and in mathematical statements.

4. Connection

- Can connect the idea of the chord in understanding tangent and secants of a circle.
- Can connect various geometrical concepts in solving tangents and secants of a circle, and area of the segment in the circle.

5. Representation

- Can draw / construct tangents at different points of a circle.
- Can draw / construct secants of the circle.
- Can draw a pair of tangents of circle.

Area : TRIGONOMETRY

Key concepts : Trigonometric ratios

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems on trigonometric ratios for the angles from 00 to 900.
- Can solve simple problems on trigonometric identities.

2. Reason & Proof

- Can give reasons in finding values of trigonometric ratios from 00 to 900 and lengths of a line etc. in given triangle.
- Can generalize trigonometric ratios and can verify them.

3. Communication

- Can explain the terms "Hypotenuse, opposite side, adjacent side of given triangle.
- Can explain the terms sin, cos, tan etc and using by them they can give their conclusions in mathematical statements.

- Can express the scope and need of trigonometry (in solving day to day life problems) in mathematics.

4. Connection

- Can use Algebraic concepts while solving problems on trigonometric ratios.

5. Representation

- Can prepared a table of for trigonometric ratios for the angles from 00 to 900.

Key concepts : Applications of trigonometry

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve simple problems on application of trigonometry. (hights, distance etc).

2. Reason & Proof

- Can differentiate the angle of elevation, angle of depression in a triangle (while solving problems)

3. Communication

- Can explain and give their conclusions of angle of elevation, angle of depression in mathematical statements.

4. Connection

- Can solve the daily life problems by using trigonometry. (by connecting Algebraic and geometrical concepts)

5. Representation

- Can draw figures related to problems on trigonometry.

Area : **PROBABILITY**

Key concepts : Probability of single event

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems on simple space of a random experiment in different methods.

2. Reason & Proof

- Can give conclusions and generalizations by experimentally and theoretical on probability on single event and sure event, impossible event.
- Can assume and gives reasons of equally likely outcomes.

- Can explain terms in probability.
- Can express the use of probability.

4. Connection

- Can connect the pervious arithmetic concepts to understand and solving problems on probability.

5. Representation

- Can give the outcomes or represent out comes of the random experiment in the form of table.

Area : MATHE MATICAL MODELLING

Key concepts : Mathematical models

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- -

2. Reason & Proof

- Can give reasons for steps in solving problems and in modeling

3. Communication

- Can give some mathematical models for previous class that they already learnt.
- Can express the advantages / limitations of mathematical modeling.

4. Connection

- Can inter link various concepts for modeling.

5. Representation

- -

Area : MENSURA TION

Key concepts : Surface areas and volumes

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve the problems on finding surface area, volumes of combinations of any two of the given solid shapes.

2. Reason & Proof

- Can give generalizations and can concludes through area, volume of simple solid shapes to each other and to combination of two solid shapes and give reasons for them.

3. Communication

- Can explain terms and formulae in mensurations areas, volumes of various solid shapes.

4. Connection

- Can use various geometrical, algebraic, arithmetic concepts in solving problems on mensuration.

5. Representation

- Can draw simple solid shapes and combination of solid shapes with given shapes.

Area : DATA HANDLING

Key concepts : Statistics mean, median, mode

ACADEMIC STANDARDS AND LEARNING INDICATORS

1. Problem Solving

- Can solve simple problems on finding mean, median, mode for given ungrouped/ grouped data with different methods.

2. Reason & Proof

- Can estimate mean, median, mode for given ungrouped data and can give reasons.
- Can distinguish he ogives boundaries

3. Communication

- Can explain the terms mean, median, mode grouped data, ungrouped data.
- Can explain usage of different values of central tendencies through ogives.
- Can explain the terms in the formulae.

4. Connection

- -

5. Representation

- Can represent the data in the form of distributive / cumulative frequency tables.
- Can represent the data in graphical way.