MATHEMATICS

Classes VI – VIII

The development of the upper primary syllabus has attempted to emphasise the development of mathematical understanding and thinking in the child. It emphasises the need to look at the upper primary stage as the stage of transition towards greater abstraction, where the child will move from using concrete materials and experiences to deal with abstract notions. It has been recognized as the stage wherein the child will learn to use and understand mathematical language including symbols. The syllabus aims to help the learner realise that mathematics as a discipline relates to our experiences and is used in daily life, and also has an abstract basis. All concrete devices that are used in the classroom are scaffolds and props which are an intermediate stage of learning. There is an emphasis in taking the child through the process of learning to generalize, and also checking the generalization. Helping the child to develop a better understanding of logic and appreciating the notion of proof is also stressed.

The syllabus emphasises the need to go from concrete to abstract, consolidating and expanding the experiences of the child, helping her generalise and learn to identify patterns. It would also make an effort to give the child many problems to solve, puzzles and small challenges that would help her engage with underlying concepts and ideas. The emphasis in the syllabus is not on teaching how to use known appropriate algorithms, but on helping the child develop an understanding of mathematics and appreciate the need for and develop different strategies for solving and posing problems. This is in addition to giving the child ample exposure to the standard procedures which are efficient. Children would also be expected to formulate problems and solve them with their own group and would try to make an effort to make mathematics a part of the outside classroom activity of the children. The effort is to take mathematics home as a hobby as well.

The syllabus believes that language is a very important part of developing mathematical understanding. It is expected that there would be an opportunity for the child to understand the language of mathematics and the structure of logic underlying a problem or a description. It is not sufficient for the ideas to be explained to the child, but the effort should be to help her evolve her own understanding through engagement with the concepts. Children are expected to evolve their own definitions and measure them against newer data and information. This does not mean that no definitions or clear ideas will be presented to them, but it is to suggest that sufficient scope for their own thinking would be provided.

Thus, the course would de-emphasise algorithms and remembering of facts, and would emphasise the ability to follow logical steps, develop and understand arguments as well. Also, an overload of concepts and ideas is being avoided. We want to emphasise at this stage fractions, negative numbers, spatial understanding, data handling and variables as important corner stones that would formulate the ability of the child to understand abstract mathematics. There is also an emphasis on developing an understanding of spatial concepts. This portion would include symmetry as well as representations of 3-D in 2-D. The syllabus brings in data handling also, as an important component of mathematical learning. It also includes representations of data and its simple analysis along with the idea of chance and probability.

The underlying philosophy of the course is to develop the child as being confident and competent in doing mathematics, having the foundations to learn more and developing an interest in doing mathematics. The focus is not on giving complicated arithmetic and numerical calculations, but to develop a sense of estimation and an understanding of mathematical ideas.

General Points in Designing Textbook for Upper Primary Stage Mathematics

1. The emphasis in the designing of the material should be on using a language that the child can and would be expected to understand herself and would be required to work upon in a group. The teacher to only provide support and facilitation.
2. The entire material would have to be immersed in and emerge from contexts of children. There would be expectation that the children would verbalise their understanding, their generalizations, and their formulations of concepts and propose and improve their definitions.
3. There needs to be space for children to reason and provide logical arguments for different ideas. They are also expected to follow logical arguments and identify incorrect and unacceptable generalisations and logical formulations.
4. Children would be expected to observe patterns and make generalisations. Identify exceptions to generalisations and extend the patterns to new situations and check their validity.
5. Need to be aware of the fact that there are not only many ways to solve a problem and there may be many alternative algorithms but there may be many alternative strategies that maybe used. Some problems need to be included that have the scope for many different correct solutions.
6. There should be a consciousness about the difference between verification and proof. Should be exposed to some simple proofs so that they can become aware of what proof means.
7. The book should not appear to be dry and should in various ways be attractive to children. The points that may influence this include; the language, the nature of descriptions and examples, inclusion or lack of illustrations, inclusion of comic strips or cartoons to illustrate a point, inclusion of stories and other interesting texts for children.
8. Mathematics should emerge as a subject of exploration and creation rather than finding known old answers to old, complicated and often convoluted problems requiring blind application of un-understood algorithms.
9. The purpose is not that the children would learn known definitions and therefore never should we begin by definitions and explanations. Concepts and ideas generally should be arrived at from observing patterns, exploring them and then trying to define them in their own words. Definitions should evolve at the end of the discussion, as students develop the clear understanding of the concept.
10. Children should be expected to formulate and create problems for their friends and colleagues as well as for themselves.
11. The textbook also must expect that the teachers would formulate many contextual and contextually needed problems matching the experience and needs of the children of her class.
12. There should be continuity of the presentation within a chapter and across the chapters. Opportunities should be taken to give students the feel for need of a topic, which may follow later.

Course Structure for Class-VII

Number System (50 hrs)

(i) *Knowing our Numbers:Integers*

- Multiplication and division of integers (through patterns). Division by zero is meaningless
- Properties of integers (including identities for addition & multiplication, *commutative, associative, distributive*) (through patterns). These would include examples from whole numbers as well. Involve expressing commutative and associative properties in a general *form*. Construction of counterexamples, including some by children. Counter examples like
- subtraction is not commutative.
- Word problems including integers (all operations)

(ii) *Fractions and rational numbers:*

• Multiplication of fractions
• Fraction as an operator
• Reciprocal of a fraction
• Division of fractions
• Word problems involving mixed fractions
• Introduction to rational numbers (with representation on number line)
• Operations on rational numbers (all operations)
• Representation of rational number as a decimal.
• Word problems on rational numbers (all operations)
• Multiplication and division of decimal fractions
• Conversion of units (length & mass)
• Word problems (including all operations)

(iii) *Powers:*

• Exponents only natural numbers.
• Laws of exponents (through observing patterns to arrive at generalisation.)

(i) $a^m \cdot a^n = a^{m+n}$

(ii) $(a^m)^n = a^{mn}$

(iii) $\frac{a^m}{a^n} = a^{m-n}$, where $m-n \in \mathrm{N}$

(iv) $a^m \cdot b^m = (ab)^m$

Algebra (20 hrs)

ALGEBRAICEXPRESSIONS

- Generate algebraic expressions (simple) involving one or two variables
- Identifying constants, coefficient, powers
- Like and unlike terms, degree of expressions e.g., x^2y etc. (exponent≤3, number of variables)
- Addition, subtraction of algebraic expressions (coefficients should be integers).
- Simple linear equations in one variable (in contextual problems) with two operations (avoid complicated coefficients)

Ratio and Proportion (20 hrs)

- Ratio and proportion (revision)
- Unitary method continued, consolidation, general expression.
- Percentage- an introduction.
- Understanding percentage as a fraction with denominator 100
- Converting fractions and decimals into percentage and vice-versa.
- Application to profit and loss (single transaction only)
- Application to simple interest (time period in complete years).

Geometry (60 hrs)

(i)Understanding shapes:

- Pairs of angles (linear, supplementary, complementary, adjacent, vertically opposite) (verification and simple proof of vertically opposite angles)
- Properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles)

(ii)Properties of triangles:

- Angle sum property (with notions of proof & verification through paper folding, proofs using property of parallel lines, difference between proof and verification.)
- Exterior angle property
- Sum of two sides of a it's third side
- Pythagoras Theorem (Verification only)

(iii)Symmetry

- Recalling reflection symmetry
- Idea of rotational symmetry, observations of rotational symmetry of 2-D objects. (90^0,120^0, 180^0)
- Operation of rotation through 90^0 and 180^0 of simple figures.

- Examples of figures with both rotation and reflection symmetry (both operations)
- Examples of figures that have reflection and rotation symmetry and vice-versa

(iv)Representing 3-D in 2-D:

- Drawing 3-D figures in 2-D showing hidden faces.
- Identification and counting of vertices, edges, faces, nets (for cubes cuboids, and cylinders, cones).
- Matching pictures with objects (Identifying names)
- Mapping the space around approximately through visual estimation.

(v)Congruence

- Congruence through superposition (examples-blades, stamps, etc.)
- Extend congruence to simple geometrical shapes e.g. triangles, circles.
- Criteria of congruence (by verification) SSS, SAS, ASA, RHS

(vi)Construction (Using scale, protractor, compass)

- Construction of a line parallel to a given line from a point outside it. (Simple proof as remark with the reasoning of alternate angles)
- Construction of simple triangles. Like given three sides, given a side and two angles on it, given two sides and the angle between them.

Mensuration (15 hrs)

- Revision of perimeter, Circumference of Circle

Area

Concept of measurement using a basic unit area of a square, rectangle, triangle, parallelogram and circle, area between two rectangles and two concentric circles.

Data handling (15 hrs)

i. Collection and organisation of data – choosing the data to collect for a hypothesis testing.
ii. Mean, median and mode of ungrouped data – understanding what they represent.
iii. Constructing bargraphs
iv. Feel of probability using data through experiments. Notion of chance in events like tossing coins, dice etc. Tabulating and counting occurrences of 1 through 6 in a number of
v. throws. Comparing the observation with that for a coin. Observing strings of throws, notion of randomness.