PEDAGOGY OF MATHEMTICS

Maximum Marks   : 100
External   : 70
Internal   : 30

Design of the Course

⇨ Each unit of study focuses on the specific aspect of Mathematics education relevant at that stage.

⇨ Several hands-on activities are part of each unit study.

Rationale and Aim

At the primary level children learn how to use mathematical knowledge in a systematic way when they deal with the world around them. At the same time children come across symbolic aspects of mathematical knowledge and learn how to relate to concepts and procedures in mathematics. For further development of mathematical knowledge, it is necessary that children become aware of key aspects of mathematics such as abstraction and generalization, mathematical ways of arguing, necessity for use of symbols. They need to learn mathematical ways of problem solving, relating to space, making sense of the information.

This course attempts to provide deeper insight, develop skills, and enhance sensitivity towards mathematical rigor by looking at fundamental domains of mathematics: Algebra, Geometry, and Data Handling.

Specific Objectives

· To develop insight into ways of reasoning mathematically.

· To create awareness and appreciation about algebraic thinking.

· To develop understanding of geometrical concepts.

· To develop facility in estimation of quantities (weights and sizes of small and large objects encountered in daily life; quantities encountered in mathematical computation)

· To develop facility in data handling, reading of graph and schematic diagrams (including road maps and railways maps); designing one's own schematic diagrams.

· To familiarise student-teachers with statistical ways of dealing with information and some mathematical concepts that help in the process

· To enhance the capabilities of the prospective teachers to reflect on processes relating to communicating formal mathematics to children

· To develop an interest in keeping in touch with what is being discusses and transacted in the area of mathematics education elsewhere in the world or country through exposure to good journals in the subject and to good websites and blog.

· To develop an interest in reading expository books in mathematics, particularly authors who gives sense of the historical side and the aesthetic side and the "play" side of mathematics.

Units of Study

Unit 1 : Mathematical Reasoning (14 marks)

- Processes of generalisation; pattern recognition and inductive reasoning process that enable formation of hypothesis. Study of counting problems and number pattern that show concretely how hypotheses are formulated and tested.
- Structure of Mathematics: Axioms, Definitions, Theorems
- Validation process of mathematical statements: Proof; Counter-Example; Conjecture; Recognizing the invalidity of wrong arguments; Simple fallacies.
- Problem solving in mathematics – a process (experiencing this process in a live manner, by engaging in actual problem solving; solving cryptarithms, coin puzzles. Logic puzzles; analyzing games like Naughts and Crosses; exploring magic squares)
- Creative thinking in Mathematics

Unit 2 : Algebra Thinking (12 marks)

- Number Patterns that help in appreciating the use of unknowns in expressing the generalisation resulting from the pattern.
- Algebraic formulation of number pattern helps in understanding those patterns – in accounting for them, and in anticipating new patterns.
- Playing with commonly encountered sequences like : square numbers, triangular numbers, power of 2, Fibonacci numbers; occurrences of some of these in counting problems and various other context.
- When and why we use variables
- Forming and solving simple linear equations
- Mathematical investigations/puzzles that rely on algebraic thinking

Unit 3 : Practical Arithmetic and Handling Data (12 marks)

- Collection, classification and interpretation of data
- Presentation of collected data
- Elementary statistical techniques, understanding concepts like : mean, median and mode, index number as used in the newspapers and mass media; also the use of simple graph.
- Time-tabling including railway time tables
- Percentage
- Ratio and proportion
- Interest and Discount as application of percentages and ratio and proportion

Unit 4 : Geometric ways of looking at Space and Shapes (12 marks)

- Geometric thinking Levels - Van Hieles
- Simple two and three dimensional shapes – geometric Vocabulary
- Congruency and similarity
- Transformations and geometric Shapes
- Measurement and geometric shapes
- Construction of the geometrical shapes using geometric equipment.

Unit 5: Communicating Mathematics (8 marks)

- Curriculum and Classroom Practices
- The role of text books in the teaching-learning process of mathematics
- Familiarizing oneself with resources available on the web-websites and blogs(Optional)
- Mathematics Laboratory/Resource Room
- Feed back to students about errors committed in their work
- Mathematics phobia and coping with failure

Unit 6: Issues about Assessment in Mathematics (12 marks)

- Open-ended questions and problems
- Assessment for conceptual understanding
- Assessment for evaluation of skills such as communication and reasoning
- Awareness of criticality of methods of assessment, of the strength and weaknesses of the various instruments commonly used for assessment.

Mode of Transaction
- Use of examples and non-examples while explaining mathematical ideas
- Critical analysis of text-books from the view point of thinking
- Emphasis on understanding mathematical vocabulary and its role in development of
- mathematical understanding

Essential Readings

1. Eves Howard (1983), *Great Moments in Mathematics (Volume 1)*, The Mathematics Association of America Chapter 2, 3, 4, 8, 9, 11, 12; pp2 to 42, 70 to 95, 110 to 134.
2. Gardener Martin (1969), *Mathematical Puzzles and Diversions Penguin*, New York, Chapter 4 and 14; pp42 to 49 and 126 to 132.
3. Harold, Jacobs (1994), *Mathematics : A Human Endeavor*, Chapter 1 to 5; pp1 to 238
4. Haylock, D. (2006), *Mathematics explained for Primary Teachers*, New Delhi: Sage publication, Chapter 27: Mathematics reasoning, 305-321.
5. IGNOU (2007). *Learning Mathematics* (LMT)1-6, School of Sciences, New Delhi
6. NCTM (2000), *Principles and Standards for School Mathematics*, National Council of Teachers Mathematics: USA
7. Pedoe, Dan. (1973), *The Gentle Art of Mathematics*, Dover Publications: New York, Chapter 1:pp11-37
8. Polva, George, (1973), *How to Solve It*, Princeton University Press: Princeton, New Jersey.
9. Sawyer, W.W., (1991), *Mathematicians' Delight*, Peguin: USA.
10. Sawyer, W.W., (2003), *Vision in Elementary Mathematics*, Dover Publications: USA. Chapter 1, 2, 9, 10; pp 8-39 and 186-269
11. Shirali, S.A., *A Primer in Number Sequences*, University's Press. Chapter 1 to 4: pp 1-53
12. Shirali, S.A., (1984) *First Steps in Number Theory*, MIR Publishers, Moscow. Chapter 3, 4 and 5: pp 9-42
13. Shirali, S.A., *Adventures in Iteration (Volume 1)*, Chapter 1-8: pp 1-45

C

14. Post, Thomas R., (1992). *Teaching Mathematics in Grades K-8: Research-Based Methods*. Washington D.C.: Allyn and Bacon. Chapters 8 and Chapter 15

15. Stewart, I. (1970). *Making Mathematics Live: A hand book for primary teachers.* Australlia: Angus and Robertson. Chapters 2.

16. Zevenbergen, R., Dole, R., Wright R. J. (2004). *Teaching Mathematics in Primary Schools*. Allen & Unwin; (First South Asian Edition). Chapter 12 and Chapter 14.

Advanced Readings for Faculty

1. Moses, B. (Ed.) (1999). *Algebraic Thinking*, Grades K-12.USA: National Council of Teachers of Mathematics.