Bachelor of Education (B.Ed.)

Title of the Course: Pedagogy IIA: P.2.10A: Mathematics
(Semester: 01)

Credits: 2
MM: 50 (External: 35 Internal:15)
Contact Week 15

Introduction of the Course

Through this course, the student-teachers shall engage with each of the content areas of school mathematics. The focus shall be on critically examining existing teaching practices, textbooks and curriculum in relation to different concepts. By drawing from an understanding of children's reasoning patterns and misconceptions, student-teachers shall be expected to develop teaching strategies and assessment practices for engaging classroom cultures that enhance conceptual understanding of diverse learners.

Learning Outcomes

After completion of the course, student will be able to:

1. Engage with each of the content areas of school mathematics.
2. Critically examine the existing teaching practices, textbooks and curriculum in relation to different concepts.
3. Understand children's reasoning and misconceptions in different areas of school mathematics.

Number of Units: 2 **Weeks 15 = 30 hours**

Unit 1: Content Specific Pedagogy -I **(8 weeks = 16 hours)**

- Number systems and Number Theory
  a) properties associated with numbers including their geometric representations, exploring fundamental theorems of arithmetic, sequences and series including arithmetic and geometric progressions.
  b) Different interpretations of rational numbers –fractions as a part-whole relationship, rational number as the result of division of two numbers, as a ratio; proportional relationship; and real-life context for teaching rational numbers
  c) Role of 'number talks' in promoting number sense

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d) Misconceptions and errors related to understanding of different types of Numbers.

- Patterns, Functions and Algebra
  a) Big ideas in algebraic reasoning such as finding, describing and using patterns, idea of functions, using functions to make predictions, understanding linearity and proportional reasoning, understanding non-linear functions and exploring algebraic structure, equations and inequalities
  b) Elementary calculus: graphs and functions; rate of change; limits, continuity and discontinuity.
  c) Misconceptions and errors related to Algebra.
- Study of School curriculum and Textbooks with respect to the Number system, numbers, patterns, and Algebra

Unit 2: Content Specific Pedagogy -II **(7 weeks = 14 hours)**

- Geometry
  a) Development of Euclidean geometry. Significance of axioms and postulates; types of proof, processes of proving. Development of new geometries and their historical importance.
  b) Exploring different dimensions of geometry: one dimension, two dimensional and three dimensional system, projective geometry, Coordinate system.
  c) Conceptual understanding of symmetry, congruency and similarity; attributes of different geometrical shapes - surface area and volume
  d) Fundamental ideas related to trigonometry, topology, motion
  e) Use of software applications to teach and learn geometry- Examining and visualising 3D shapes and their representation in 2D
  f) Misconceptions and errors related to different geometrical concepts.
- Statistics & Probability
  a) Understanding different statistical concepts of data collection and representation, use and meaning of central tendencies.
  b) Investigating basic concepts of probability such as nature of distributions, randomness, sample space, independent events, mutually exclusive and exhaustive events; law of large numbers, law of small numbers; relationship between statistics and probability
  c) Understanding subjective probability and discerning classical and experimental approaches of probability, Intuitive sources of probabilistic thinking in children.
  d) Misconceptions and errors related to different statistical and probability concepts.
- Study of School curriculum and Textbooks with respect to the Geometry, Statistics and Probability.

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Practicum/ Suggested Projects / Assignments (Any Two)

1. Pick a textbook of any Examination Board and do a critical analysis of a content area
2. Observe children while they are studying in the classroom. Make anote of how the teacher is developing the concept
3. Make a chart of the misconceptions that children have with respect to a content. Suggest ways by which the teacher can help students reduce their misconceptions
4. Construct a math assessment with 10 problems aligned to standards. Include multiple choice, short answer, and multi-step problems. Provide an answer key and grading rubric.
5. Analyze student work samples with common math errors. Diagnose the specific misconceptions. Design targeted reteaching strategies and interventions.
6. Research and demonstrate a math game that builds multidisclinary approach. Discuss links to curriculum and how you would implement it in instruction.
7. Design hands-on math manipulatives with household materials. Explain the manipulatives' mathematical function and how teachers can implement them

Note: On the basis of the above, the teacher may design his/her own relevant projects/ assignments.

Essential/ Recommended Readings

- AMT. IGNOU Series
- Gould, S. J. (1995). Lie and figures. Sandarbh, 5–14. (Hindi)
- Lamon, S. (2005).Teaching fractions and ratios for understanding: Essential content knowledge and instructional strategies for teachers, Mahwah, NJ: Erlbaum
- LMT -01. IGNOU Series
- Steen L.A. (1990) On the shoulders of the giant. New approaches to numeracy. National Academic Press.
- Mason J.,Graham A., Wilder S. J. (2005).Developing thinking in Algebra. Sage Publication Wilder S. J
- Mason J.(2005) Developing thinking in Geometry. Sage Publication
- Graham A. (2006). Developing Thinking in Statistics. Sage Publication
- MESE -001(2003).Teaching and Learning Mathematics. IGNOU series
- Maurya, R. P., Kanvaria, V. K. et al. (2014). *Training package in mathematics at higher secondary stage.* DESM, NCERT, New Delhi.

Additional Readings

- Dhar, A. (1999). Wonderful geometrical figures. Sandarbh, 23–36.
- Clements, D.H., & Battista, M.T. (1992). Geometry and spatial reasoning. In D.A. Grouws (Ed.), Handbook of research on mathematics teaching and learning (pp. 420-464). New York, Macmillan

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- Kieran, C. (1992). The learning and teaching of school algebra. In Grouws, D.A. (Ed.), Handbook of Research on Mathematics Teaching and Learning, New York: MacMillan Publishing Company, 390–419.
- Zazkis, R. &Liljedahl, P. (2002). Generalization of patterns: The tension between algebraic thinking and algebraic notation. Educational Studies in Mathematics, 49, 379-402.
- Knuth, E.,Choppin, J., &Bieda, K.(2009). Proof: Examples and beyond. Mathematics Teaching in Middle School, 15(4), 206-211
- Subramaniam, J. (2005). Teaching negative numbers to school children. Sandarbh, 4(52), 44– 55.(in Hindi)
- Maurya, R. P., Kanvaria, V. K. et al. (2012). *Ganit shikshashastra.* NCERT, New Delhi. ISBN 9789350072103.

Teaching Learning Resources (Digital and others): Across Units (If any)

- https://www.youtube.com/watch?v=rKoWCF8Gqyc. Carolyn Kieran: Developing structural thinking on early algebra with primary grade students
- https://www.youtube.com/watch?v=mzlCdv0ExAY . Lecture Series: Dr. Keith Devlin - The Birth of Algebra

Teaching Learning Process

The course will be taught through interactive pedagogic methods such as classroom discussion, debates, film discussions, critical media analysis, collaborative learning tasks which enhance reading comprehension of core writings in the area and innovative projects. Reflective expression and learning will be encouraged.

Assessment Method

The assessment will be formative in nature and will factor in student participation. Individual and group tasks and assignments will be given. Summative evaluation will be done through end- semester examination.

Key words: Number sense, Geometrical thinking, Algebraic Thinking, Probabilistic thinking

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