B.Ed. Two Year Programme

P.2.10 : Mathematics

Maximum Marks: 100

UNIT 1: Content Specific Pedagogy

Student-teachers shall engage with each of the content areas stated below by examining important concepts. 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. Student-teachers' understanding of the concepts shall be facilitated through questions and activities that can also be suitably used with children to help them build complex mathematical understanding. Student-teachers shall be challenged to refine, review and explain their thinking without falling back on standard rules and procedures. The unit shall make use of personal reasoning and reflection as well as offer time to discuss among themselves the material and resources for teaching.

I. What is geometry? Development of Euclidean geometry, what makes it popular, origin and significance of axioms and postulates; types of proof, processes of proving: making generalisations and justifications. Development of new geometries and their historical importance.

II. Exploring different dimensions of geometry: one dimension, two dimensional and three dimensional systems and objects, representing objects in different dimensions, projective geometry, Coordinate system, change of axes: translation ,rotation; idea of locus, spatial aspect of the physical world and representing nonvisual mathematical concepts and relationships. Conceptual understanding of symmetry, congruency and similarity; attributes of different geometrical shapes - surface area and volume,

III. Fundamental ideas related to trigonometry, topology, motion

IV. Use of software applications to teach and learn geometry- Examining and visualising 3D shapes and their representation in 2D

Statistics & Probability

I. Understanding different statistical concepts of data collection and representation, use and meaning of central tendencies, analyzing variations; statistical analyses of

practical examples embedded in social contexts such as studying inequities, government budgets, population growth, environmental issues etc.

II. 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

III. Understanding subjective probability and discerning classical and experimental approaches of probability, Intuitive sources of probabilistic thinking in children; children's informal notions about chance and randomness; conducting probability experiments using standard and non-standard randomisers; making subjective judgments in probabilistic situations and revising one's estimates in the light of subsequent data/information

Number systems and Number Theory

I. Use of numbers and integers, and quantitative methods as a means of communicating, processing and interpreting information.

II. Exploring properties associated with numbers including their geometric representations, exploring fundamental theorems of arithmetic, sequences and series including arithmetic and geometric progressions

III. Different interpretations of rational numbers –fractions as a part-whole relationship, rational number as the result of division of two numbers, as a ratio etc.; proportional relationship; and real life context for teaching rational numbers

IV. Children's reasoning in relation to integers and rational numbers, role of 'number talks' in promoting number sense

Patterns, Functions and Algebra

I. Relationship between arithmetic and algebra

II. 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

III. Development of algebraic reasoning leading to more sophisticated ideas related to growth and decay, optimization, making different types of graphs (linear and non-linear) and drawing interpretations from the nature of graphs

IV. Elementary calculus: graphs and functions; rate of change; limits, continuity and discontinuity.

Readings

AMT-01 Block 3 Unit-9: Negative Numbers (These are part of the IGNOU materials)

AMT-01 Block 3, Unit-10: Generalizing Arithmetic to Algebra

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

Devlin K. (2011). Introduction to Mathematical thinking.

Dhar, A. (1999). Wonderful geometrical figures.Sandarbh, 23–36.

Gould, S. J. (1995). Lie and figures. Sandarbh, 5–14. (Hindi)

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.

Lamon, S. (2005).Teaching fractions and ratios for understanding: Essential content knowledge and instructional strategies for teachers, Mahwah, NJ: Erlbaum

LMT -01. IGNOU Series

Subramaniam, J. (2005). Teaching negative numbers to school children.Sandarbh, 4(52), 44–55.(in Hindi)

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 MiddleSchool, 15(4), 206-211Steen 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

Newman, J. (2003). The World of Mathematics: A Four-Volume Series. Washington Tempus

Sautoy, M. du. (2008). The Story of Maths. UK: BBC Four Documentary. (Also available as a book)

Timothy Gowers (2002). Mathematics: A Very Short Introduction. Oxford University Press

Wheeler D (1983). Mathematisation matters. For the Learning of Mathematics, 3(1).

UNIT 2: Designing and Planning a Unit and Lessons

I. Engagement with the National curriculum, syllabus and textbooks. Critical study of all three in light of the conceptual understanding of concepts dealt in Unit 1

II. Studying the curriculum: relating to what is worth knowing and experiencing in mathematics, understanding the nuances between intended curriculum and implemented curriculum.

III. Developing unit plans and concept maps: understanding children‟s cultural knowledge and misconceptions; designing constructive lesson plans, understanding the role of communication, mathematical community and group dynamics in classrooms

IV. Critical engagement with ICT, mathematics laboratory, simulations and mathematical modelling in promoting mathematical thinking

Readings

NCERT.(2006). Syllabus for classes at the elementary level (Vol. 1). New Delhi: NCERT.

NCERT.(2006). Syllabus for secondary and higher secondary classes. New Delhi: NCERT.

LMT-01 Block 2, Unit-05: Building a Constructive Classroom (classroom organization, material and assessment)

Boaler, J. (2013). Ability and Mathematics: The mindset revolution that is reshaping education. FORUM, 55, 1, 143-152.

UNIT 3: Assessment and Evaluation

I. Critical role of assessment in enhancing learning-Explore diverse methods and tools of assessing an array of learning/performance outcomes of diverse learners, relationship of assessment with self-esteem, motivation, and identity as learners, assessment for learning and role of feedback

II. Traditional assessment vs. assessment within a constructivist paradigm. Engaging critically with the existing system of assessment, analysing its shortcomings. Understanding and suggesting ways for creating a continuum between assessment and learning.

III. Assessing reasoning, argumentation and logical thinking in mathematics - Performance based assessment

Readings

Boesen, J., Lithner, J., & Palm, T. (2010).The relation between types of assessment tasks and the mathematical reasoning students use.Educational Studies in Mathematics, 75, 89–105.

Cooper, B., & Dunne, M. (1998).Any one for tennis?Social class differences in children's responses in national curriculum mathematics testing.The Sociological Review, 46(1), 115-148.

Grant, D. A. (2000). What's on the test? An analytical framework and findings from an examination of teachers' math tests.Educational Assessment, 6(4), 221-256.

Hamilton, T. M. (2010). Mathematics learners and mathematics textbooks: A question of identity? Whose curriculum? Whose mathematics? Curriculum Journal, 21(1), 3-23.

Morgan, C., & Watson, A. (2002). The interpretative nature of teacher's assessment of students' mathematics: Issue for equity. Journal for Research in Mathematics Education, 33(2), 78-110.

NCERT.(2006). Position paper-National focus group on assessment(NCF 2005). New Delhi: NCERT.

Swaffield, S. (2011).Getting to the heart of authentic assessment for learning, Assessment in Education: Principles, Policy & Practice, 18(4), 433-449.

Assignments/Projects/Practicum

- Textbook analysis
- Activity analysis
- Analysing student’s oral and written responses
- Undertaking performance based assessment in a classroom
- Small action research on children’s conceptions related to a mathematical concept
- Designing field based projects for middle or secondary school children
- Designing mathematical games and puzzles
- Mathematical modelling
- Investigation of proofs without words
- Using historical anecdotes as means for promoting mathematical communities in classrooms
- ICT-based projects for linking higher mathematics
- Analyzing ‘math-talks’
- Creating documentaries of students’ mathematical work