M Ed Two Year Programme

S.Ma 1 (a) : Introduction to Mathematics Education

Maximum Marks: 100

Course Vision

This course has been designed for students who wish to understand the nuances of development of mathematics as a disciple. The course delineates main assumptions behind a range of theoretical perspectives on the nature of mathematics. The course engages in conceptualising and analysing the processes that promote learning of mathematics from a disciplinary perspective. Issues and related to nature of language of mathematics and how linguistics affect learning of mathematics will dealt with through seminal scholarly texts and researches. Scholars will also study contemporary researches in Mathematics education and teacher development.

Unit 1: Essence of Doing Mathematics

The focus of this section will be on understanding how mathematics is a humanly created subject. The premises of promoting analytical thinking and how it leads to creating mathematical structures will be studied.

What is mathematics? Mathematics as a study of patterns; of shapes, chance, numbers, motion, variation. What does it mean to think mathematically? Building logical thinking, analytical thinking and quantitative reasoning.

What are axioms, origin and significance of axioms; Understanding how axiomatic systems form the basis of creating mathematical structures. Importance of being creating axioms, being absurd, paradoxes and intuitions.

Proof and proving: nature of proof, Methods of proofs: proving conditionals, by contradiction, proofs by induction. Methods of proving: creating conditions, using examples and non-examples, logical argumentations, conjecturing and postulates, proofs without words; how these build mathematical structures.

Unit 2: Learning Mathematics

In this section the focus will be on building a disciplinary perspective of mathematics. Significant aspects and perspectives of cultivating reasoning and communication; problem solving and problem posing, mathematical talks and evolution of concepts will be identified and critically analysed.

Perspectives on learning mathematics- Piaget, Skemp, Bruner and Vygotsky; Fischbein on intuitive thinking

Dealing with abstraction, particulrisation and generalisation, Processes of proof and proving, conjecturing, arguing; use of phrases associates with proving: special case, extreme case, counter example, existence proof, abstracting, generalisng Problem-solving and Problem posing, patterning, reasoning

Discourse and dialogue, Communication in mathematics classrooms, use of discourse as the basis for encouraging students' mathematical thinking in classrooms

History of Mathematics, historical development of major ideas in mathematics, evolution of concepts, contributions of noteworthy mathematicians, analysis of classics in mathematics
Mathematical modelling

Unit 3: Mathematics, Language and linguistics

Issues and related to nature of language of mathematics and how linguistics affect learning of mathematics will dealt in this section.

Mathematical notations, Nature of Mathematical language: precision; graphical and symbolic logic and expressions; underpinnings of language of mathematics: as qualifiers, implication, equivalence, quantifiers.
Nature of mathematical discourse: including specialist syntax; use of mathematical symbols; specialised ways of talking including written and spoken forms of mathematical explanation; word problems
Social dimensions: particular ways in which students and teachers talk in mathematics classes that are not specifically mathematical, but that are associated with mathematics.
Issues with bilingual and multilingual mathematics learners.

Unit 4: Research in Mathematics Education

This section will introduce key areas that are being researched in Mathematics education.

Purpose and scope of research in mathematics education in India. Contemporary and emergent issues in mathematics education.

History, issues and current trends pertaining to design and methodologies that have contributed in this area.
Research in policy making, teaching, student-learning in mathematics.

Unit 5: Teachers' Preparation in Mathematics

Teacher's knowledge and beliefs have a significant role in developing mathematical thinking in students. This section of the course is devoted to studying teachers' understanding of the subject, association of teacher's beliefs and knowledge and children's leaning and reforms and challenges in teacher's professional development

Teachers' knowledge and belief about the disciple of mathematics and its influence
Teacher's subject knowledge and its effect on her pedagogical decisions, with respect to promoting mathematical thinking in classroom, reflective teaching practices in mathematics

Nature of professional development of a mathematics teacher. Challenges and scope for continuing professional development of teachers.

List of Recommended Readings

AMT-01. Teaching Mathematics. IGNOU Series

Atweh, H. Forgasz, & B. Nebres (Eds.), Sociocultural research on mathematics education: An international perspective (pp. 295–311). Mahwah, NJ: Erlbaum.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of Teacher Education, 59(5), 389−407.

Barta, J., & Brenner, M. E. (2009). Seeing with many eyes: Connections between anthropology and mathematics. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.), Culturally responsive mathematics education (pp. 85–109). New York: Routledge.

Bauersfeld, H. (1988). Interaction, construction, and knowledge: alternative perspectives for mathematics education. In D.A. Grouws, T.J. Cooney & D. Jones (Eds.), Perspectives on research on effective mathematics teaching (pp. 27 - 46). Reston, VA: National Council of Teachers of Mathematics.

Bharath. S., **English**, L. (2010).Theories in Mathematics education. Seeking new frontiers. Springer.

Boaler, J. (1998). Open and Closed mathematics: Students' experiences and understandings. Journal for Research in Mathematics Education

Borba, M., & Skovsmose, O. (1997). The ideology of certainty in mathematics education. For the Learning of Mathematics, 17(3), 17−23.

Brown, T. (1994). Describing the mathematics you are part of: A post-structuralist account of mathematical learning. In P. Ernest (Ed.), Mathematics, education and philosophy: An international perspective (pp. 154−161). Bristol, PA: Falmer Press.

Burton, L. (2003). Which Way Social Justice in Mathematics education? Westport, CT: Praeger Publishers.

Cobb, P., & Hodge, L. L. (2007). Culture, identity and equity in the mathematics classroom. In N.S. Nasir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom (pp. 159-171). New York: Teachers College Press.

Crowe, M. (1975). Ten "laws" concerning patterns of change in the history of mathematics. Historia Mathematica, 2, 161-166.

Crowe, M. (1992). Afterword: A revolution in the historiography of mathematics? In Revolutions in mathematics. Oxford press

D'Ambrosio, U. (1990). The role of mathematics education in building a democratic and just society. For the Learning of Mathematics, 10, 20−23.

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

Dowling, P. (1998). The sociology of mathematics education: Pedagogic texts. Bristol, PA: Falmer Press.

Ellis, M., & Berry, R. Q. (2005). The paradigm shift in mathematics education: Explanations and implications of reforming conceptions of teaching and learning. The Mathematics Educator, 15(1)

Ernest P. (1991). The Philosophy of Mathematics Education.

Gay, G. (2009). Preparing culturally responsive mathematics teachers. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.), Culturally responsive mathematics education (pp. 189–205). New York: Routledge.

Greer, B., Mukhopadhyay, S., Nelson-Barber, S., & Powell, A. B. (2009). Introduction. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.), Culturally responsive mathematics education (pp. 1–7). New York: Routledge.

Gutierrez, R. (2007). (Re)Defining equity: The importance of a critical perspective. In N. S. Nasir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom (pp. 37-50). New York: Teachers College Press.

Gutstein, E. (2007). "So one question leads to another": Using mathematics to develop a pedagogy of questioning. In N. S. Nasir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom (pp. 51-68). New York: Teachers

Hanna, G. (1995). Challenges to the importance of proof. For the Learning of Mathematics, 15(3), 42-49.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching Chicana students. Qualitative Studies in Education, 14(5), 623−639.

Hill, H. C., Sleep, L., Lewis, J. M., & Ball, D. L. (2007). Assessing teachers' mathematical knowledge: international perspective. Mahwah, NJ: Erlbaum.

Kazemi, E., & Stipek, D. (2001). Promoting conceptual thinking in four mathematics classrooms. *The Elementary School Journal*, *102*(1), 59–80.

Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in U. S. schools. Educational Researcher, 35, 3–12.

Lakatos, I. (1976). Proof and Refutations: The Logic of Mathematical Discovery, ed. J. Worrall and E. Zahar. Cambridge: Cambridge

LMT-01. IGNOU Series

Lubienki, S. L. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. Journal for Mathematical Behavior, 15(4), 375-402.

Martin, D. B., & McGee, E. O. (2009). Mathematics literacy and liberation: Reframing mathematics for African-American children. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.), Culturally responsive mathematics education (pp. 207–238). New York: Routledge.

MESE -001(2003). Teaching and Learning Mathematics. IGNOU series

Moschkovich J.H. (2010). Language and Mathematics Education: Multiple Perspectives and Directions for Research. Learning of Mathematics, 17(3), 17−23.

Moschkovich, J. (2007). Bilingual mathematics learners: How views of language, bilingual learners, and mathematical communication affect instruction. In N. S. Nasir & P. Cobb (Eds.), Improving access to mathematics: Diversity and equity in the classroom

Mukhopadhyay, S., & Greer, B. (2001) Modeling with a purpose: Mathematics as a critical tool. In B. Atweh, H. Forgasz, & B. Nebres (Eds.), Sociocultural research on mathematics education: An international perspective (pp. 295–311). Mahwah, NJ: Erlbaum.

Newman, J. (2003). The World of Mathematics: A Four-Volume Series. Washington Tempus
Noss, R. & Hoyles, C. (1996). Windows on Mathematical Meanings. Dordrecht: Kluwer Academic Publishers.

Philipp, R. A., Ambrose, R., Lamb, L L. C., Sowder, J. T., Schnappelle, B. P., Sowder, L., Thanheiser, E., & Chauvot, J. (2007). Effects of early field experiences on the mathematical content knowledge and beliefs of prospective elementary school teachers: What knowledge matters and what evidence counts? In F. K. Lester (Ed.), Second handbook of research on mathematics teaching and learning (pp. 111–155). Charlotte, NC: Information Age.

Raman, M. (2004). Epistemological messages conveyed by three high-school and college mathematics textbooks. Journal of Mathematical Behavior, 23, 389-404.

Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. Review of Educational Research, 75, 211-246.

Rousseau, C. K., & Powell, A. (2005). Understanding the significance of context: A framework to examine equity and reform in secondary mathematics. The High School Journal, 88(4),19-31.

Schoenfeld, A. H. (2004). The Math Wars. Educational Policy, 18(1), 253.

Skemp, R. (1978). Relational understanding and instrumental understanding. *Arithmetic Teacher 26* (3), 1-16.

Skovsmose, O. (2005). Travelling through education: Uncertainty, mathematics, responsibility. Rotterdam, Sense Publishers.

Stanic, G. M. A. (1989). Social inequality, cultural discontinuity, and equity in school mathematics. Peabody Journal of Education, 66(2), 57-71.

Steen, L. A. (2001). Mathematics and Democracy: The Case for Quantitative Literacy. National Council on Education and the Disciplines.

Stein, M. K., & Lane, S., (1996). Instructional tasks and the development of student capacity to think and reason: An analysis of the relationship between teaching and learning in a reform mathematics project. Educational Research and Evaluation, 2, 50-80.

Stein, M. K., Grover, B. W., & Henningsen, M. (1996). Building student capacity for mathematical thinking and reasoning.

Thurston, W. P. (1994). On proof and progress in mathematics. Bulletin of the American Mathematical Society, 30(2), 161-177.

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

Wheeler D (1983). Mathematisation matters. *For the Learning of Mathematics*, *3*(1).
Wu, H. (1997). The mathematics education reform: Why you should be concerned and what you can do. The American Mathematical Monthly, 946-954.