**Content-specific Strategies for Teaching Mathematics**

**Programme(s) in which it is offered: B.Sc.B.Ed. Mathematics**

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| --- | --- |
| **Course Category**: Core  | **Schedule of Offering**: Odd |
| **Course Credit Structure:** 4 | **Course Code:** EDM3111 |
| **Total Number of Hours:** 5 | **Contact Hours Per Week:** 5 |
| **Lecture:** 3, 3 | **Tutorial:** 0, 0 |
| **Practical:** 1, 2 | **Medium of Instruction:** English |
| **Date of Revision:** | **Skill Focus:** Employability |
| **Short Name of the Course:** Content-specific Teaching Strategies (Math) | **Course Stream *(Only for Minor Courses)*:** |
| **Grading Method:** Regular | **Repeatable:** Credit |
| **Course Level:** Intermediate |  |

**Course Description**

This is a core course for students of B.Sc.B.Ed. Mathematics programme. This course discusses the nature of mathematical content such as concepts, generalisations, proofs and problems, and some teaching strategies specific to these content categories.

**Course Introduction**

Concepts, generalisations, proofs, problems and solutions form the major composition of the mathematical content at school level. A mathematics teacher should understand the difference in the nature of these content categories and be able to strategize the teaching-learning activities appropriate to these contents. This course discusses certain content-specific strategies for teaching mathematics at secondary school level.

**Course Objective**

The objectives of the course are:

1. To explore the meaning, understanding and teaching of mathematical concepts
2. To discuss and explore strategies for teaching mathematical generalisations
3. To discuss and explore strategies for teaching proofs in mathematics
4. To discuss and explore strategies for teaching problem solving in mathematics
5. To discuss various assessment strategies specific to the kind of mathematical content

**Course Outcome**

At the end of the course students will be able to:

1. Apply concept analysis as a tool to plan teaching of a mathematical concept.
2. Analyse the role of examples, non-examples and counter examples in teaching concepts.
3. Apply the moves of teaching a mathematical generalisation appropriately.
4. Apply appropriate strategy in discovering / establishing a generalisation.
5. Distinguish between the different types of proofs and apply them appropriately in proving a generalisation.
6. Apply the maxims of problem posing and problem solving effectively in teaching mathematical content.
7. Apply appropriate strategy in assessing the learning of a concept, generalisation and a proof.
8. Diagnose the difficulty in learning of a particular content of mathematics and apply appropriate remedial measure whenever necessary.

**PO-CO Mapping**

**PO-CO Mapping Matrix**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO/PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
| CO1 |  |  |  |  |  |  |  |  |
| CO2 |  |  |  |  |  |  |  |  |
| CO3 |  |  |  |  |  |  |  |  |
| CO4 |  |  |  |  |  |  |  |  |
| CO5 |  |  |  |  |  |  |  |  |
| CO6 |  |  |  |  |  |  |  |  |
| CO7 |  |  |  |  |  |  |  |  |
| CO8 |  |  |  |  |  |  |  |  |

**Prerequisites and other constraints**

This course does not require any prerequisite course. This course is offered to all students of B.Sc.B.Ed. Mathematics programme.

**Pedagogy**

The course intends to engage the students in interactive lectures, brainstorming sessions, and group discussions. Frequent group and individual assignments. demonstrations and presentations shall be employed for continuous assessment of the learners.

**Suggested Reading:**

1. J. Boaler (Ed.): 2001. *Multiple perspectives on the teaching and learning of mathematics* (pp. 83-104). Westport, CT: Ablex.
2. Cooney and Others (1975). Dynamics of Teaching Secondary School Mathematics, Boston: Houghton Mifflin.
3. Cooke, Roger. (2005).*The History of Mathematics: A Brief Course*, second edition. New York: John Wiley & Sons, xvii + 607pp.
4. Donlan, C (Ed.), *The development of mathematical skills* (pp. 75-110). Hove, UK: Psychology Press.
5. Driscoll, M., Egan, M., Nikula, J., & DiMatteo, R. W. (2007). Fostering geometric thinking: A guide for teachers, grades 6-10. Portsmouth, NH: Heinemann.
6. Grouws, D.A. (ed.) (1992). Handbook of Research on Mathematics Teaching and Learning, NY: Macmillan Publishing.
7. Lampert, M. (2001). *Teaching Problems and the Problems of Teaching*. New Haven: Yale University Press.
8. Lester, F., & Charles, R. I. (Eds.) (2003). *Teaching mathematics through problem solving*. Reston, VA: National Council for Teachers of Mathematics.
9. Lester, F.K (Ed) (2007). Second Handbook of Research on Mathematics Teaching and Learning, Charlotte, NC: NCTM & Information Age Publishing.
10. Malone, J. and Taylor, P. (eds.) (1993). Constructivist Interpretations of Teaching and Learning Mathematics, Perth: Curtin University of Technology.
11. Marshall, S. P. (1995) Schemes in Problem-solving. NY: Cambridge University Press.
12. Moon, B. & Mayes, A.S. (eds.) (1995). Teaching and Learning in Secondary School. London: Routledge.
13. NCERT, A Textbook of Content-cum-Methodology of Teaching Mathematics, New Delhi: NCERT.
14. NCERT and State textbooks in Mathematics for Class VI to X
15. Nickson, Marilyn (2000). Teaching and Learning Mathematics: A Guide to Recent Research and its Applications, NY: Continuum.
16. Nunes, T and Bryant, P (Eds.) (1997). Learning and Teaching Mathematics: An International Perspective, Psychology Press.
17. Polya, G. (1963). How to solve it, Princeton, NJ: Princeton University Press.
18. Polya, G. (1981). *Mathematical discovery: On understanding, learning and teaching problem solving*. New York: John Wiley and Sons.
19. Richardson, V (Ed.), (2001). *Handbook of research on teaching (4th edition)* (pp. 433- 456). New York: MacMillan.
20. Stylianides, A.J. (2007). Proof and proving in school mathematics. Journal for Research in Mathematics Education, 38, 289-321.

**Evaluation Pattern**

**Evaluation Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Continuous InternalAssessment (CIA) Components\* | Component Type | Weightage Percentage | TotalMarks | Tentative Dates | Course Outcome Mapping |
| Mid-Semester Examination | 50% of CIA | 15 | Around 8th week | 1, 2, 3, 4 |
| Individual/Group Presentation | 25% of CIA | 7.5 | Every two weeks | 1, 2, 3, 4, 5, 6, 7, 8 |
| Assignment | 25% of CIA | 7.5 | Every two weeks | 1, 2, 5, 7, 8 |
| CIA Marks | 100% (to be converted into 30%) | **30** |  |  |
| ESE  | 70% | **70** | At the end of the semester | 1, 2, 3, 4, 5, 6, 7, 8 |

 **Module Sessions**

**Module 1: Teaching Mathematical Concepts (18 Hours)**

Meaning of concept, concept image, concept learning, understanding of a concept and teaching of a concept; Concept analysis -a tool for teachers to develop deep understanding of concepts, conceptual hierarchy and concept- mapping.

Characteristics of mathematical definitions

Moves (Activities) in teaching a concept – defining, stating necessary and/or sufficient condition, giving example with/without a reason, Comparing and contrasting, giving counter example; non-example with/ without a reason; and generating concept formation and concept assimilation strategies, linkages between concept learning and mathematical processes-- connections/structure among mathematical concepts, communication, representation and reasoning.

Assessment of in-depth understanding of concepts; difficulties students encounter in learning and using concepts, causes and remedial instruction.

**Reading:**

1. Nunes and Bryant (1997)
2. Nickson (2000)
3. Cooney (1975)

**Activities:**

1. Individual Presentation
2. Group Presentation
3. Assignment

**Module 2: Teaching Mathematical Generalizations (20 Hours)**

Discovery ofmathematical generalizations**:** Nature and purpose of learning by discovery, Inductive- and deductive – guided discovery strategies, Maxims for planning and conducting discovery strategies; planning of strategies involving either induction or deduction or both for constructing knowledge.

Constructing understanding ofmathematical generalizations:Learning by Exposition/explicit/ direct instruction

Moves in teaching for understanding of generalizations: Introduction moves – focus, objective, motivation; Assertion, Interpretation moves- instantiation, paraphrasing, review of prerequisites, translation, analogy, analysis; Justification, Application – planning of strategies for teaching generalizations.

Objectives/outcomes of learning generalizations and their assessment.

Difficulties students encounter in learning and using generalizations, causes for such difficulties and strategies to make students overcome such difficulties.

**Reading:**

1. Moon and Mayes (1995)
2. Nunes and Bryant (1997)
3. Nickson (2000)

**Activities:**

1. Individual Presentation
2. Group Presentation
3. Assignment

**Module 3: Teaching Proofs in Mathematics (20 Hours)**

Developing an intuition about the nature of proof – to make the transition from concrete thinking to more formal reasoning and abstract thinking as they progress from class to class.

Kinds of proof – direct proof, mathematical induction, proof by contradiction, proof by cases, the contra positive, and disproof by counter example

Objectives/outcomes of teaching proofs in mathematics; assessment of product and developmental (thinking skills) outcomes,

Diagnosing basic causes for difficulties in learning proofs and proving theorems; planning remedial teaching strategies based on the perceived causes, implementing and evaluating the strategies.

**Reading:**

1. Stylianides (2007)
2. Malone and Taylor (1993)
3. Nickson (2000)

**Activities:**

1. Individual Presentation
2. Group Presentation
3. Assignment

**Module 4: Teaching Problem Solving in Mathematics (17 Hours)**

Meaning of a problem, problem-solving and teaching of and through problem-solving; importance of teaching problem solving, posing a problem, generating problems.

Modelling and model for problem-solving in algebra and geometry, Situation model for solving word problem, discovering or exploring various options for solving the problem i.e. developing heuristics, carrying out the plan and generating and extending a good problem.

Objectives of teaching problem solving and assessment of the outcomes.

Diagnosing basic causes for difficulties in learning proofs, planning remedial teaching strategies based on the perceived causes, implementing and evaluating the strategies.

**Reading:**

1. Polya (1963)
2. Polya (1981)
3. Marshall (1995)
4. Lampert (2001)

**Activities:**

1. Individual Presentation
2. Group Presentation
3. Assignment