

**PGDE(Sec) PROGRAMME CS MATHEMATICS
COURSE INFORMATION (July 2002)**

Rationale and Objectives:

Teaching mathematics involves a set of complex knowledge and skills. Recent developments in mathematics education have emphasised the match between the nature of mathematics, the pedagogical principles applied to classroom instruction and the way pupils learn mathematics. The main objective of this course is to equip student teachers with knowledge of teaching principles and with knowledge of how mathematics is learnt such that these, together with their knowledge of mathematics, may enable them to teach mathematics effectively.

Structure of the course and assessment:

The course consists of two compulsory core modules.

Semester 1: Core Module

PCM513 Teaching and Learning of Mathematics I (6 AUs)

Lecture (10 × 1 hr): Aims & objectives of mathematics education, mathematics curriculum in Singapore, learning theories in mathematics, problem solving and technology in mathematics education.

Workshop (31 × 2 hr): Teaching and learning of mathematics topics - Arithmetic, Algebra, Functions and Graphs, Mensuration, Geometry, Trigonometry, Statistics, Probability, Counting, Calculus, Sets, Matrices, Vectors, and Mechanics. Understanding of concepts in the topics, curriculum structure, learning difficulties, teaching approaches, motivation techniques for each of the topics will be dealt with. Lesson planning and hands-on computer laboratory sessions will also be incorporated.

Assessment: Continual assessment – participation in class including punctuality and attitude, follow-up on lectures, class work on IT and problem solving (50%), group presentation (20%), written assignment (30%)

Semester 2: Core Module

PCM514 Teaching and Learning of Mathematics II (2 AUs)

Hands-on session on assessment in mathematics, test construction and marking in the secondary mathematics curriculum. This module will also provide opportunity for student teachers to teach mathematics topics and practise their teaching skills. Feedback will be given by the tutor and fellow student teachers. They will be expected to put into practice the strategies and methods learnt during the course. Special attention will be given to the ability to explain concepts.

Assessment: Micro-teaching (50%) and assignment on test construction (50%)

References

Books (redspot)

- (1) Posamentier, A.S. & Stepelman, J. (1999) *Teaching Secondary School Mathematics: Techniques and Enrichment Units*. (5th edition) N.J.: Merrill. QA11 Pos
- (2) Sobel M.A. & Maletsky E.M. (1999) *Teaching Mathematics, A Sourcebook of Aids, Activities and Strategies*. (3rd edition) Prentice Hall. QA11 Sob
- (3) Orton A. (1992) *Learning Mathematics: Issues, Theory and Classroom Practice*. (2nd edition) Cassell Academic.

Textbooks (redspot)

- (1) Exploring Mathematics – Sec 1, 3 Special/Express, N(A), N(T) Textbook & Workbook. QA39.2 (This is based on the new syllabus.)
- (2) New Syllabus D Mathematics (4th edition) – Sec 2, 4. QA39.2 Teh, QA43 Teh (There is a 5th edition New Syllabus Mathematics Sec 1 & 3 based on the new syllabus)
- (3) New Elementary Mathematics: Syllabus D - 2, 4. Textbook, Teachers' Guide & Workbook. QA39.3 Sin
- (4) Secondary Mathematics (2nd edition) - 2A, 2B, 4A, 4B, 5A, 5B. Textbook, Teachers' Guide & Workbook. QA39.2 Sec
- (5) Secondary Mathematics: Normal (Technical) Course - 2A, 2B, 4A, 4B. Textbook, Teachers' Guide & Workbook. QA39.2 Sec

Journals

- (1) Australian Mathematics Teacher (QA11 AMT) - Teaching ideas at secondary level.
- (2) Mathematics in School (QA11 MS) - Articles & activities for primary and secondary mathematics.
- (3) Mathematical Medley (QA1 MM) - A publication of the Singapore Mathematical Society (SMS).
- (4) Mathematics Newsletter (QA11 MN) - A publication of MOE for primary & secondary mathematics teachers.
- (5) Mathematics Teacher (QA11 MTR) - Very useful for secondary to JC level, American style.
- (6) Mathematics Teaching (QA11 MTL) - Primary to A-level, British style.
- (7) Mathematics Teaching in the Middle Schools (QA11 MTMS) - Articles and teaching ideas at the upper primary and lower secondary level.
- (8) The Mathematics Educator (QA11 ME) - A publication of the Association of Mathematics Educators, Singapore.
- (9) Teaching Mathematics and its applications (QA11 TMA) - JC and college level
- (10) Teaching Statistics (HA1 TS) - Teaching ideas for statistics at various levels.

**PCM 513 PGDE(Sec) Mathematics
Assessment Guidelines July 2002**

Objectives:

- (a) To enable students to investigate possible ways to teach mathematical concepts and procedures at the secondary level.
- (b) To enable students to develop the ability to use and evaluate instructional materials and resources.

Modes of assessment:

I. **Continual assessment (50%)** – participation in class including punctuality and attitude, follow-up on lectures, class work on IT, and problem solving

II. **Group Presentation (20%)**

1. Students will work in groups (of about 4) for this presentation.
2. Each group will be assigned a task on the teaching of geometry or trigonometry.
3. Consult school textbooks, teachers' guides and workbooks (NIE library red-spot and instructional materials, 3rd floor), reference books, journals, and/or internet resources.
4. Prepare an oral presentation of about 25 minutes based on ideas from your reading and your group discussions. Novel and creative ideas are encouraged. Every member of the group *must present*.
5. The presentations will be carried out during tutorials/workshops in week 4 or 5. The schedule will be arranged by the respective tutors.
6. Assessment criteria:
 - (a) Delivery & communication
 - (b) Relevance & suitability
 - (c) How interesting
 - (d) Group co-operation

III. **Individual report (30% - deadline for submission: Friday, 18th October 2002, 5 pm)**

This report involves the conceptualisation and design of a double period (70 minutes) teaching lesson. You can select any secondary mathematics topics except those which have been included in the group presentation above.

Your report should consist of the following components:

1. Table of contents

2. Introduction (6%)

Give a brief outline of your lesson; its rationale and the concepts and skills to be acquired by the pupils. To support your conceptualisation of the lesson, give a brief review of relevant literature that have some bearing on the lesson relating to its significance in the curriculum, teaching/learning activities or common learning difficulties and misconceptions. You should also specify the type of pupils for whom the lesson is intended.

3. Development of the lesson (15%)

Describe how the lesson is developed to teach the concepts or skills; what methods are used; what learning activities and organisation (whole-class, group, pair or individual); what teaching aids are used (do not submit the actual teaching aids but you have to produce pictures, illustrations or plans how these aids can be teacher-made).

The teaching sequence and the selection and construction of teaching materials (examples, worksheets and other resources) should be clearly described. Provide a detailed lesson plan for the lesson.

4. Evaluation (6%)

Describe how pupil learning is assessed, what methods (test, worksheet, oral tests, interviews, homework, etc.) will be used.

Presentation of report (3%)

- Your report should be submitted on A4 size papers, page-numbered, and double-spaced. It should be proof-read and corrected for spelling, punctuation and syntactical errors.
- Your report should be about 6 to 8 pages in length. The following information should be indicated on the title page:
 - * Title of assignment
 - * Name of student
 - * Title of course
 - * Name of lecturer
 - * Name and address of the National Institute of Education
 - * Date of submission
- All ideas, information and quotations taken from books and journals must be appropriately acknowledged in the text itself and the source included in the references.

PCM513 Teaching and Learning of Mathematics I

List of tasks for group presentation and some suggested references:

1. Discuss ideas, activities and teaching aids for teaching Polygons.

[Kenny, Bezuszka & Martin (1992, p.70), Geddes (1992, p.40-61), Musser & Trimpe (1994, p.234-254), O ; fDaffer & Clemens (1976, ch.2), Serra (1993, ch.2 & 4)]

2. Discuss ideas, activities and teaching aids for teaching Geometric Construction.

[Serra (1993, ch.3), Farrell (1971, p.27-28), Pegg(1987), Posamentier & Sheridan (1982, p.9-22), Walter (1985), Bennett(1996)]

3. Discuss ideas, activities and teaching aids for teaching the topic Motion Geometry.

[Serra (1993, ch.7), O ; fDaffer & Clemens (1976, p.156-195, 224-230), Geddes (1992, p.62-69), Bennett (1996)]

4. Discuss ideas, activities and teaching aids for teaching the topic Congruent Triangles.

[Serra (1993, ch.5), Coxford (1991, p.51-54), Lang & Murrow (1988, ch.7), Kenny, Bezuszka & Martin (1992, p.34-37), Musser & Trimpe (1994, p.175-196, 230-231)]

5. Discuss ideas, activities and teaching aids for teaching the topic Nets (sec 1, Normal Technical) or Plan & Elevation (sec 3, Normal Technical).

[For Nets: Kenny, Bezuszka & Martin (1992, p.46-47), Sobel & Malesky (1988, p.206-208, 224), Olson (1975, p.48-58). For Plan & Elevation, refer to books on technical education, call no. T65.]

6. Discuss ideas, activities and teaching aids for teaching Pythagoras ; ftheorem.

[Video by Apostol (1989), Frank (1977), Serra (1993, ch.9), Interactive Mathematics Miscellany & Puzzles-A Bogomlny (<http://www.cut-the-knot.com>)]

7. Trigonometry has many practical applications and in its teaching, models and tools are also available. Discuss some real-life applications of trigonometry as well as activities and teaching aids for teaching Trigonometry.

[Serra (1993, ch.12), N.Z. EQUALS Network (1990), Sobel & Malesky (1988, p.227-228), Posamentier & Sheridan (1982, p.59-62)]

Please consult your tutor if your group wishes to work on other topics in Geometry or Trigonometry.

References: (in red-spot or reference section)

1. Apostol, T.M. (1989). *The Story of Pi*. Project Mathematics, California Institute of Technology. (QA460.P8 Dis)
2. Bennett, D. (1996). *Exploring Geometry with the Geometer's Sketchpad : Dynamic Geometry for the 21st Century*. Key Curriculum Press. (QA461 Ben – available from Springer – Verlag)
3. Coxford, A.F. (1991). *Geometry from Multiple Perspectives*. Reston, Va.: National Council of Teachers of Mathematics. (QA461 Cox)
4. Farrell M.A. (1971). *Geoboard Geometry*. Creative Publications. (QA461 Far)
5. Frank, S. (1977). *Was Pythagoras Chinese?* University Park: Pennsylvania University Press. (QA27.C5 Swe)
6. Geddes, D. (1992). *Geometry in the Middle Grades*. Reston, Va.: National Council of Teachers of Mathematics. (QA461 Ged)
7. Kenney M.J., Bezuska S.J. & Martin J.D. (1992). *Informal Geometry Explorations: an activity-based approach*. Dale Seymour Publications. (QA461 Ken)
8. Lang, S. & Murrow, G. (1988). *Geometry: A High School Course* (2nd edition). Springer-Verlag. (QA445 Lan)
9. Musser, G.L. & Trimpe, L.E. (1994). *College Geometry - A Problem-Solving Approach with Applications*. Macmillan College Publishing Company. (QA455 Mus)
10. N.Z. EQUALS Network. (1990). *Towards Better Trigonometry Teaching*. Latitude Publications. (QA 531 Tow)
11. O'Daffer P.G. & Clemens S.R. (1976). *Geometry: An Investigative Approach*. Addison-Wesley. (QA445 Oda)
12. Olson A.T. (1975). *Mathematics Through Paper Folding*. NCTM. (QA19.P34 Ols)
13. Pegg J. (1987). Developing Basic Geometric Constructions with Understanding, *The Australian Mathematics Teacher*, Vol 43(2). (Journal)
14. Posamentier, A.S. & Sheridan, G. (1982). *Math Motivators! Investigations in Geometry*. Addison-Wesley. (QA461 Pos)
15. Serra, M. (1993). *Discovering Geometry: An Inductive Approach*. Key Curriculum Press. (QA461 Ser)
16. Sobel M.A. & Maletsky E.M. (1988). *Teaching Mathematics, A Sourcebook of Aids, Activities and Strategies*. Prentice-Hall. (QA11 Sob)
17. Walter M. (ed) (1985). *Readings in Mathematical Education: Geometry*, Association of Teachers of Mathematics. (QA445 Geo)

**Various internet resources are also available. A good starting point is:
Math Forum <http://forum.swarthmore.edu/>**

PCM514 Teaching and Learning of Mathematics II

Description of Assignment Tasks and Assessment Criteria

Task I

Micro-teaching (50%)

Each student has to present a 15-minute teaching segment of a secondary mathematics lesson (one or two periods). The criteria for assessment are as follows:

- (a) Lesson preparation - delineating learning objectives, selection and sequencing of content, relevance and accuracy (please submit lesson plan for the entire lesson)
- (b) Delivery - organization, questioning technique, clarity of explanation, pace of lesson, use of teaching aids, innovative learning activities

Task II

Test Construction Assignment (50%)

Prepare a portfolio based on a selection of work that you have done during workshops on test construction. The portfolio must have four items.

Item 1 [5 marks] - Pairwork

Prepare, with a colleague, a table of specifications for a mid-year examination based on a given scheme of work.

Item 2 [15 marks] - Individual

(A) Identify the relevant specific instructional objectives (learning outcomes) and cognitive levels of a given set of test items. For identification of cognitive level, justify your classification. Also, state if the use of calculator should be permitted for the items.

(B) For given specific instructional objectives, write the relevant test item objectives and find suitable items. You must include items with different formats.

Item 3 [10 marks] - Pairwork

For given stems, work with a colleague to:

- (a) generate questions that assess different cognitive levels for low ability pupils,
- (b) generate questions that assess different cognitive levels for high ability pupils,
- (c) generate questions that assess different specific instructional (test objectives).

Item 4 [10 marks] - Individual

(A) For three given test items, prepare their mark schemes.

(B) Using a given mark scheme, grade students ; f1solutions.

Individual tutors are free to peg the remaining **10 marks to any aspect of class work they deem important or attitude/ attendance/ punctuality of the students.