COURSE OUTLINE: MH5000

Course Title	**Mathematical Problem-Solving**		
Course Code	**MH5000**		
Offered	Study Year X, Semester 1		
Course Coordinator	Fedor Duzhin (Dr)	fduzhin@ntu.edu.sg	6513 7469
Pre-requisites	(MH1100, MH1101, MH1200, MH1201, MH1300) OR (CY1601, CY1602, MH1201, MH1300) OR Approval by the Division		
AU	2		
Contact hours	Tutorials: 24		
Approved for delivery from	AY 2022/23 semester 1		
Last revised	3 Jun 2022, 10:47		

Course Aims

The aim of the course is to prepare students for competitions, such as Simon Marais Mathematics Competition (https://www.simonmarais.org/) or International Mathematics Competition for university students (http://imc-math.org/)

Intended Learning Outcomes

Upon successfully completing this course, you should be able to:

1. Solve non-standard problems from various areas of mathematics such as algebra, calculus, combinatorics, and geometry.
2. Evaluate solutions of non-standard math problems prepared by other people - for instance, identify gaps and logical flaws.

Course Content

Advanced material from linear algebra, calculus, discrete mathematics, combinatorics, probability etc revisited

Assessment

Component	Course ILOs tested	SPMS-MAS Graduate Attributes tested	Weighting	Team / Individual	Assessment Rubrics
Continuous Assessment					
Technology-enhanced Learning					
Peer grading	2	**1.** d **3.** a	20	individual	See Appendix for rubric
Tutorials					
Homework	1	**1.** c, d **2.** b, c **3.** a	30	individual	See Appendix for rubric
Mid-semester Quiz					
Simon Marais Competition	1	**1.** c **2.** b, c	50	individual	See Appendix for rubric
		Total	**100%**		

These are the relevant SPMS-MAS Graduate Attributes.

1. **Competence**

   c. Discover patterns by abstraction from examples

   d. Use computer technology to solve problems, and to communicate mathematical ideas

2. **Creativity**

   b. Build on the connection between subfields of mathematics to tackle new problems

   c. Develop new applications of existing techniques

3. **Communication**

   a. Present mathematics ideas logically and coherently at the appropriate level for the intended audience

Formative Feedback

Formative feedback is informal. It is a result of extensive communication between the course instructor and students.

Learning and Teaching Approach

Tutorials (24 hours)	The learning process is organized as follows: every week one student prepares a problem set consisting of non-standard problems from different areas of mathematics and submits it to the course instructor for approval (to make sure that it is really diverse and challenging). The problem set is then uploaded to NTULearn and other students submit their solutions typed in online LaTeX (overleaf) a week later. Their solutions are independently graded by the instructor and the author of the problem set. The author of the problem set is graded based on consistency of her scores with the instructor's score and the rest of the students are graded based on how well they present their solutions. Besides, students are required to participate in Simon Marais Competition and their participation is graded by the course instructor.

Reading and References

Larson, Loren C. Problem-solving through problems. Springer Science & Business Media, 2012. ISBN 978-1-4612-5498-0;

Gelca, Răzvan, and Titu Andreescu. Putnam and beyond. Vol. 63. New York: Springer, 2007. ISBN-10: 0387257659;

Course Policies and Student Responsibilities

You are required to work individually in this course and adhere to the NTU Honour Code. For instance, plagiarism is a huge offense.

If you miss the Simon Marais Competition, the course instructor will organize a make-up test for you.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the Academic Integrity website for more information. Consult

your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Fedor Duzhin (Dr)	SPMS-MAS-05-23	6513 7469	fduzhin@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course ILO	Readings/ Activities
1	Intro	1	Non-graded homework prepared by the instructor
2	Tutorial 1	1	Graded homework prepared by the instructor
3	Tutorial 2	1, 2	Homework, peer grading
4	Tutorial 3	1, 2	Homework, peer grading
5	Tutorial 4	1, 2	Homework, peer grading
6	Tutorial 5	1, 2	Homework, peer grading
7	Tutorial 6	1, 2	Homework, peer grading
8	Tutorial 7	1, 2	Homework, peer grading
9	Tutorial 8	1, 2	Homework, peer grading
10	Tutorial 9	1, 2	Homework, peer grading, Simon Marais Competition
11	Tutorial 10	1, 2	Homework, peer grading
12	Tutorial 11	1, 2	Homework, peer grading
13	Tutorial 12	1, 2	Homework, peer grading

Appendix 1: Assessment Rubrics

Rubric for Technology-enhanced Learning: Peer grading (20%)

A score for consistency between peer grading and instructor grading is given to every student on the week when she authors the problem set. On that week, the author of the problem set does not receive a score for tutorials and gets a score for peer grading instead.

Let A be the author of the problem set, let X≠A be any student but A, and let Q be a question. Then let A(X, Q) be the score out of 10 given by A to X for solving Q and let I(X, Q) be the score ouf ot 10 given by the instructor to X for solving Q. The mean squared error (MSE) is then the mean of

$[A(X,Q) - I(X, Q)]^2$

for all X, Q. We then use the following rubric

Excellent: MSE < 1

Good: 1 ≤ MSE ≤ 2

Acceptable: 2 ≤ MSE ≤ 3

Not acceptable: MSE > 3

Problem set authors will be required to make an oral presentation about typical mistakes in peers' work.

Rubric for Tutorials: Homework (30%)

Five questions, each question is 10 points.

10 - fully correct

8 - minor gap

5 - half-solved question

2 - not solved, but some relevant ideas are found

0 - completely incorrect

Besides, 20% of the homework score is given for oral presentation of the answer.

Rubric for Mid-semester Quiz: Simon Marais Competition (50%)

Students will be required to attend the actual Simon Marais Competition. It is held on one of the Saturdays during the semester. Please check their website for the date (time will be arranged by NTU invigilators):

https://www.simonmarais.org/

Invigilators will then photocopy the work of students who are registered for MH9000 before sending it out to Australia. The instructor will grade it independently from the official graders according to the following rubric:

Outstanding: more than 2 questions are solved correctly

Excellent: 2 questions are solved correctly

Good: 1 question is solved correctly

Acceptable: an honest attempt to solve something in the competition