Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year	AY2022-2023
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Fedor Duzhin
Course Author Email	fduzhin@ntu.edu.sg
Course Title	Mathematical Problem-Solving
Course Code	MH5000
Academic Units	2
Contact Hours	24
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	(MH1100, MH1101, MH1200, MH1201, MH1300) OR (CY1601, CY1602, MH1201, MH1300) OR Approval by the Division
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

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/)

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Solve non-standard problems from various areas of mathematics such as algebra, calculus, combinatorics, and geometry.
ILO 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

Reading and References (if applicable)

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

Planned Schedule

Week or Session	Topics or Themes	ILO	Delivery Mode	Activities	Readings
1	intro	1		Non-graded homework prepared by the instructor	
2	tutorial 1	1		Graded homework prepared by the instructor	
3	tutorial 2	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	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Tutorials	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.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Others(Peer grading)	2	1. d 3. a	20		Individual	Holistic	Relational
2	Continuous Assessment (CA): Others(Homework)	1	1. c, d 2. b, c 3. a	30		Individual	Analytic	Extended Abstract
3	Continuous Assessment (CA): Test/Quiz(Simon Marais Competition)	1	1. c 2. b, c	50		Individual	Holistic	Extended Abstract

Description of Assessment Components (if applicable)

Formative Feedback

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

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Communication	Basic
Creative Thinking	Advanced
Curiosity	Intermediate
Learning Agility	Basic
Problem Solving	Intermediate

Course Policy

Policy (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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

Policy (Absenteeism)

Policy (Others, if applicable)

Diversity and inclusion policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

It is our goal to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences, and that honours your identities; including ethnicity, gender, socioeconomic status, sexual orientation, religion or ability.

To help accomplish this:

- If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety disorder or social phobia;
- If you feel like your performance in the class is being impacted by your experiences outside of class;
- If something was said in class (by anyone, including the instructor) that made you feel uncomfortable;

Please speak to your teaching team, our school pastoral officer or a peer or senior (either in-person or via email) about how we can help facilitate your learning experience.

As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.

All members of the class are expected to adhere to the NTU anti-harassment policy. if you witness something that goes against this or have any other concerns, please speak to your instructors or a faculty member.

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 foryou.

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