

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	Ng Keng Meng
Course Author Email	kmng@ntu.edu.sg
Course Title	Foundations of Mathematics
Course Code	MH1300
Academic Units	4
Contact Hours	51
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	None (A-level Mathematics or equivalent)
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to develop and equip you with the necessary skills for a mathematically related job. You should demonstrate a basic understanding of fundamental mathematical concepts and processes such as such as formal mathematical proofs. You should also learn the rigorous way to approach mathematical problems and to be familiar with the process of abstracting from examples, as these skills are essential for all future mathematics courses. You should develop critical analytical skills for a career in a mathematical related job. You will acquire the communication skills necessary to communicate technical ideas, both written and verbal, to a broad audience.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Distinguish between the different kinds of mathematical statements
ILO 2	Apply the rules of elementary logic to correctly formulate mathematical arguments.
ILO 3	Apply truth tables to decide logical equivalence and the validity of arguments
ILO 4	Differentiate between the different kinds of quantified statements.
ILO 5	Decide the truth of statements.
ILO 6	Derive the different ways to prove a quantified statement.
ILO 7	Apply different proof techniques in various situations, including direct proofs, indirect proofs, proof by cases, proof by contraposition and proof by contradiction.
ILO 8	Distinguish between the different proof techniques above, and judge when each method is more suitable than another.
ILO 9	Explain how to disprove a given mathematical statement.
ILO 10	Recall proof by mathematical induction.
ILO 11	Give examples of when strong mathematical induction is preferred
ILO 12	Employ the use of the Well-ordering principle in problems.
ILO 13	Describe the concept of a sequence and distinguish it from a series.
ILO 14	Describe the notion of a set and apply the different set operations to reason about them.
ILO 15	Apply the algebraic method and the element method to prove statements about sets.
ILO 16	Solve problems using the concept of relations and equivalence relations.
ILO 17	Describe the equivalence classes of a given equivalence relation.

ILO 18	Rediscover functions as relations.
ILO 19	Judge when a given function is injective, surjective or bijective.
ILO 20	Explain the concept of function composition and inverse.
ILO 21	Differentiate natural numbers and other systems of numbers.
ILO 22	Perform basic arithmetical operations on complex numbers.
ILO 23	Produce the complex roots of a given complex value.
ILO 24	Administer the Division and Euclidean algorithms to solve for various quantities such as the greatest common divisor and apply them to linear combinations.
ILO 25	Solve simple equations involving of modulo arithmetic.
ILO 26	Independently describe underlying mathematical concepts and solve related, but not previously encountered problems.

Course Content

Elementary logic, mathematical statements, quantified statements
 Sets, operations on sets, Cartesian products, properties of sets
 Natural numbers, integers, rational numbers, real numbers, complex numbers
 Relations, equivalence relations, equivalence classes
 Functions, injective and surjective functions, inverse functions, composition of functions
 Division algorithm, greatest common divisor, Euclidean algorithm, fundamental theorem of arithmetic, modulo arithmetic

Reading and References (if applicable)

- Main Textbook – Discrete Mathematics with Applications, Susanna S. Epp, Thomson Brooks, 4th Edition. ISBN 9780495391326
- Reference – Discrete Mathematics, Richard Johnsonbaugh, Pearson New International Holding, 7th Edition. ISBN 9781292022611
- Reference – Discrete Mathematics with its Applications, Kenneth Rosen, McGraw Hill. ISBN 9781260091991

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Elementary Logic	1-6, 26			
2	Elementary Logic	1-6, 26			
3	Elementary Logic	1-6, 26			
4	Mathematical Proof	7-12, 26			
5	Mathematical Proof	7-12, 26			
6	Mathematical Proof	7-12, 26			
7	Mathematical Proof	7-12, 26			
8	Mathematical Proof	7-12, 26			
9	Mathematical Proof	7-12, 26			
10	Sets, relations and functions	13- 20, 26			
11	Sets, relations and functions	13- 20, 26			
12	Systems of numbers	21- 25, 26			
13	Systems of numbers	21- 25, 26			

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Lectures will be designed to be interactive and students are expected to engage in the in-class activities.
Tutorials	Tutorials are designed for students to clear up doubts about the problems posed. Students are expected to work through the problems on their own before each tutorial session

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): Assignment(Assignment)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26	1. a, b 2. a, c 3. a, b 5. a	10		Individual	Analytic	Relational
2	Continuous Assessment (CA): Class Participation(In-class activities)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1. a, b, c 2. a, b	15		Individual	Analytic	Multistructural

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
3	Continuous Assessment (CA): Test/Quiz(Mid-semester Quiz)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	1. a, b, c 2. a	25		Individual	Analytic	Extended Abstract
4	Summative Assessment (EXAM): Final exam(Examination (2 hours))	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26	1. a, b, c 2. a, b, c	50		Individual	Analytic	Extended Abstract

Description of Assessment Components (if applicable)

These are the relevant SPMS-MAS Graduate Attributes.

1. Competence

- a. Independently process and interpret mathematical theories and methodologies, and apply them to solve problems
- b. Formulate mathematical statements precisely using rigorous mathematical language
- c. Discover patterns by abstraction from examples

2. Creativity

- a. Critically assess the applicability of mathematical tools in the workplace
- 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
- b. Work in teams on complicated projects that require applications of mathematics, and communicate the results verbally and in written form

5. Character

- a. Act in socially responsible and ethical ways in line with the societal expectations of a mathematics professional, particularly in relation to analysis of data, computer security, numerical computations and algorithms

Formative Feedback

For the midterm and final exams, feedback on the common mistakes are given on NTULearn after the grades are announced.

For the HW, tutors will discuss and answer any questions about mistakes.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Creative Thinking	Intermediate
Problem Solving	Advanced
Sense Making	Advanced

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)

Students are expected to complete all assigned pre-class readings and activities, attend all tutorial classes punctually and take all scheduled assignments and tests by due dates.
Students are expected to participate in all tutorial discussions and activities.

Policy (Absenteeism)

Absence from the midterm without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for CA components.
All homework assignments must be submitted to your tutor by the end of the tutorial session.
Failure to do so will affect your score.

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.

Collaboration is encouraged for your homework because peer-to-peer learning helps you understand the subject better and working in a team trains you to better communicate with others. As part of academic integrity, crediting others for their contribution to your work promotes ethical practice.

You must write up your solutions by yourself and understand anything that you hand in.

If you do collaborate, you must write on your solution sheet the names of the students you worked with. If you did not collaborate with anyone, please explicitly write, "No collaborators."

Failure to do so constitutes plagiarism.

Use of materials outside the course is strongly discouraged. If you use outside source, you must reference it in your solution.