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

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY2024-2025
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Chan Song Heng
Course Author Email	chansh@ntu.edu.sg
Course Title	Discrete Mathematics
Course Code	MH1301
Academic Units	3
Contact Hours	38
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	A or H2 level Mathematics or equivalent
Co-requisites	
Pre-requisite to	
Mutually exclusive to	MH1812
Replacement course to	
Remarks (if any)	

Course Aims

This core course aims to develop your understanding of fundamental mathematical concepts such as basic counting principles, recurrence relations and basic graph theory concepts. We will cover various combinatorial aspects of graph theory and introduces some of the tools used to tackle graph theoretical questions. These concepts are essential for future mathematics courses. You will learn to understand and apply basic counting principles, and to model practical problems using graph models and apply graph algorithms to solve them.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Describe basic counting rules and identify the scenarios where they are applicable
ILO 2	Compare and differentiate permutations, combinations and their generalizations
ILO 3	Apply appropriate counting rules to solve simple counting problems arising in other subfields of mathematics and practice
ILO 4	Formulate recurrence relations from real-life counting problems
ILO 5	Solve homogeneous and nonhomogeneous linear recurrence relations
ILO 6	Define and relate basic notions in graph theory
ILO 7	Represent real-life situations with graphs
ILO 8	Apply algorithms and theorems from graph theory to analyze and solve realistic problems arising in science, engineering, business, and other disciplines

Course Content

Basic of Counting, Inclusion-Exclusion Principle
Pigeonhole Principle, Permutations and Combinations
Binomial Theorem, Generalized Permutations and Combinations
Generalized Permutations
Recurrence Relations, Linear Recurrence Relations
Linear Recurrence Relations
Review of Counting and Recurrence Relations
Graphs: Examples, Definitions, Representation
Traversing Graphs: Shortest-, Euler-, Hamilton-Paths and Cycles
Graph Properties: Coloring, Planarity
Weighted Graphs
Directed Graphs
Review of Graphs

Reading and References (if applicable)

Kenneth H. Rosen, Discrete Mathematics and Its Applications, (8th edition), McGraw Hill, ISBN 978-126-0091-99-1
Kenneth H. Rosen, Discrete Mathematics and Its Applications, (7th edition), McGraw Hill, ISBN 978-981-4670-13-5

Susanna S. Epp, Discrete Mathematics with Applications, (5th edition), Cengage Learning, ISBN 978-035-7114-08-7.

NOTE: The above readings comprise the foundational readings for the course and more up-to-date relevant readings will be provided when they are available."

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Basic of Counting, Inclusion-Exclusion Principle	1, 3	Textbook 6.1, 8.5	In-person	
2	Pigeonhole Principle, Permutations and Combinations	2, 3	Textbook 6.2, 6.3	In-person	Quiz during lecture
3	Binomial Theorem, Generalized Permutations and Combinations	2, 3	Textbook 6.4, 6.5	In-person	
4	Generalized Permutations	2, 3	Textbook 6.5	In-person	Quiz during lecture
5	Recurrence Relations, Linear Recurrence Relations	4, 5	Textbook 8.1	In-person	
6	Linear Recurrence Relations	4, 5	Textbook 8.2	In-person	Quiz during lecture
7	Graphs: Examples, Definitions, Representation	6, 7	Textbook 10.1, 10.2,10.3	In-person	
8	Traversing Graphs: Shortest-, Euler-, Hamilton-Paths and Cycles	7, 8	Textbook 10.4, 10.5,10.6	In-person	Quiz during lecture

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
9	Graph Properties: Coloring, Planarity	7, 8	Textbook 10.7, 10.8	In-person	
10	Review of Counting and Recurrence Relations, Graphs.	1-5		In-person	Mid-Semester Quiz
11	Weighted Graphs	7, 8	Textbook 10.1, 10.2	In-person	Quiz during lecture
12	Directed Graphs	6, 7, 8	Textbook 10.1, 10.2	In-person	
13	Review of Graphs	6, 7, 8		In-person	Quiz during lecture

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures (26 hours)	Derivation and demonstration: Helps you understand the motivation behind mathematical notions and ideas. Presents systematic ways to solve problems. Problem solving: Develops competence in solving a variety of problems related to counting, recurrence relations and graph theory.
Tutorials (12 hours)	Derivation and demonstration: Helps you understand the motivation behind mathematical notions and ideas. Presents systematic ways to solve problems. Problem solving: Develops competence in solving a variety of problems related to counting, recurrence relations and graph theory. Peer Instruction: Develops communication and presentation skills and strengthens mathematical skill.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(MCQ and Short Answer Questions)	1, 2, 3, 4, 5, 6, 7, 8		16	Individual	Analytic	Multistructural
2	Continuous Assessment (CA): Class Participation(Presentation and Participation)	1, 2, 3, 4, 5, 6, 7, 8		4	Individual	Holistic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(Mid-semester Quiz)	1, 2, 3, 4, 5, 6		20	Individual	Analytic	Relational
4	Summative Assessment (EXAM): Final exam(Examination (2 hours)	1, 2, 3, 4, 5, 6, 7, 8		60	Individual	Analytic	Relational

Description of Assessment Components (if applicable)

1. Test/Quiz (MCQ and Short Answer Questions). These consist of quizzes administered every 2 to 3 weeks at the beginning of lectures. There will be a total of 5 to 6 quizzes throughout the semester, depending on the schedule. Each quiz is worth approximately 4%, with the total contribution capped at 16% of the final grade

2. Class Participation (Presentation and Participation). Students are required to present during tutorial sessions twice in the semester. Each presentation is worth 2%.

3. Test/Quiz (Mid-semester Quiz). This will be conducted around week 10 of the semester.

Formative Feedback

1. For the Test/Quiz (MCQ and Short Answer Questions), feedback on common mistakes and the level of difficulty of the problems will be discussed during the lecture. This will be done during the lecture after the quiz was given.

2. Tutorial Presentation and Participation: Any errors in the solution presented and feedback on the presentation will be given by tutor.

3. Mid-Semester Quiz: comments on answers and common errors are given to you after the mid-semester quiz is marked.

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	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)

Students are expected to attend lectures and tutorials.

Policy (Absenteeism)

Absence due to medical or other reasons
If you are sick and not able to attend the Mid-Semester Quiz, you must:

1. Send an email to the instructor regarding the absence.
2. Submit the original Medical Certificate* to an administrator.

*The Medical Certificate mentioned above should be issued in Singapore by a medical practitioner registered with the Singapore Medical Association.

One Makeup Mid-Semester Quiz will be arranged if you have valid reasons for missing the Mid- Semester Quiz. If you are sick or are unable to attend the Makeup Mid-Semester Quiz, you must likewise perform the above two actions (1. send an email to instructor regarding absence and 2. submit original MC to an administrator). There will not be any further makeup quiz for those who missed the Makeup Mid-Semester Quiz.

For the Lectures Quizzes, there are no makeups if you did not attend lecture and missed the quiz. If you are sick or are unable to attend the Lecture Quizzes, you must perform the above two actions (1. send an email to instructor regarding absence and 2. submit original MC to an administrator). There are no makeup quiz for those who missed the Lecture Quizzes.

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.

Appendix 1: Assessment Rubrics

Rubric for Lectures: MCQ and Short Answer Questions (16%)

Point-based marking.

Note: You are allowed to discuss among yourselves if you wish to. So the quizzes can be completed based on individual or team effort. Marks are awarded based on your individual submission.

Rubric for Tutorials: Presentation and Participation (4%)

For Presentation of tutorial solution: students will be assessed on the quality of presentation and solution and be awarded between 1.4%-2.0% per presentation. Students make two presentations during the semester.

1.4% - For Presentation.

	+ 0.2%	+ 0.1%	+ 0.0%
Correctness of solution	Solutions are accurate, complete, and demonstrate a clear understanding of the problem	Solutions are partially incorrect, incomplete, or show misunderstanding of the problem.	Solutions are completely wrong or irrelevant to the problem.
Clarity of explanation	Explanation is clear, logical, and helps the audience understand the solution effectively.	Explanation is unclear, disorganized, or fails to make the solution understandable.	No explanation offered.
Engagement with Audience	Maintains eye contact, speaks confidently, and uses visual aids effectively to support points.	Limited eye contact, low confidence, or over-reliance on reading notes/slides.	No effort made to engage with the audience.

Rubric for Mid-semester Quiz: Short Answer Questions (20%)

Point-based marking

(not rubric based)

Rubric for Examination: Short Answer Questions (60%)

Point-based marking

(not rubric based)