DEPARTMENT OF MATHEMATICAL AND COMPUTATIONAL SCIENCES
UNIVERSITY OF TORONTO MISSISSAUGA

MAT344H5S LEC9101
Introduction to Combinatorics
Course Outline - Winter 2022

Class Location & Time	Mon, 10:00 AM - 11:00 AM MN 1270 Wed, 02:00 PM - 04:00 PM MN 1270
Instructor	Mike Pawliuk
Office Location	DH-3023
Office Hours	Mon 9am-10am, Mon 3pm-4pm
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Course Web Site	https://q.utoronto.ca
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Course Description

Basic counting principles, generating functions, permutations with restrictions. Fundamentals of graph theory with algorithms; applications (including network flows). [36L,12T]

Prerequisite: MAT102H5 and (MAT223H5 or MAT240H5)
Exclusion: MAT344H1 or MATC44H3 (SCI)
Distribution Requirement: SCI

Students who lack a pre/co-requisite can be removed at any time unless they have received an explicit waiver from the department. The waiver form can be downloaded from here.

Learning Outcomes

Upon successful completion of this course, students should be able to:

1. Demonstrate expertise in the following topics:
    - The pigeonhole principle
    - Combinatorial proofs and binomial identities
    - Compositions, Set Partitions, and Integer Partitions
    - Permutation cycles
    - The Inclusion-Exclusion method
    - Generating functions
        - Modelling using them
        - Using them to find a closed form for recurrence relations
    - Graphs
    - Trees
2. Analyze novel combinatorial objects by:
    1. Exploring/listing the objects in small cases
    2. Making novel conjectures about the objects, testing those conjectures, and refining those conjectures
    3. Relating the objects to previously known objects
    4. Proving conjectures (by you and other mathematicians)
    5. Generalizing results
    6. Explaining your insights
3. Create solutions to problems, and proofs of theorems, independently and without the help of outside resources, that are coherent, organized, and well-supported.
4. Go beyond previously solved problems, and ask novel and interesting questions about those problems, that require new insights to solve.
5. Create and implement a personalized self-improvement plan by identifying strengths and weaknesses you have as a

mathematician, and interventions to improve them.

Textbooks and Other Materials

Miklos Bona, *A Walk Through Combinatorics*, 4th Ed., World Scientific, 2017.

There should be new copies available at the UTM bookstore.

There are some important differences between the 3rd and 4th editions, most important of which is the absence in the 3rd edition of the "Quick Check" exercises in each section.

Assessment and Deadlines

Type	Description	Due Date	Weight
Other	Midterm personal reflection (Portfolio)	2022-02-11	25%
Other	Final personal reflection (Portfolio)	2022-04-08	75%
		Total	100%

More Details for Assessment and Deadlines

There are no required assignments, tests, or exams in this course. Instead students will each create a portfolio of their journey through the course, detailing how they have achieved the five course learning objectives in the syllabus.

This portfolio will be used to document your journey in the course, and will be used to support your final grade in the course.

Contents of the Portfolio

Your portfolio can contain any material you want that documents your journey in the course. Different students will include different materials depending on how they engage with the course material.

Some example contents could include:

- Solutions to textbook problems.
- Multiple iterated drafts of solutions to textbook problems with personal reflections, and how you incorporated feedback on the drafts.
- Summaries/reorganizing of course concepts in your own words.
- Personal journal reflections. (The instructor will post optional weekly journal prompts.)
- Summaries of scholarly journal articles referenced in the textbook.
- Reflection on your goals in the course, how you planned to achieve them, and what you did to achieve them.
- Evidence of going beyond the textbook and course notes. (e.g. combinatorics problems/theorems/generalizations you created.)

This is not an exhaustive list! If you have an idea for something else you may want to include, please discuss it with the instructor. The instructor will do his best to support novel, interesting, and meaningful ideas that show off your progess in the course.

Weekly written feedback

You are strongly encouraged to solve at least 5 textbook problems a week and submit **one (1) piece of work** for written feedback every Friday by 6pm Toronto time. Submissions will be made on Crowdmark.

A TA will provide written feedback, but will not assign a letter grade.

By incorporating this feedback into new solutions, you will create better solutions. These are good things to include in your portfolio.

In your submission please include instructions for the type/kind of feedback you want. For example, you might ask for feedback on:

- The correctness of your solution.
- The style/coherence/organization of your solution.
- Specific parts of longer solutions.
- Whether the main idea(s) of the solution seem plausible.

Final grade in the course

Students will suggest their final grade in the course to the instructor when they submit their final personal reflection (portfolio). This suggested grade should be supported by the contents of the portfolio.

The instructor reserves the right to reject/modify the final grades in two cases:

1. The portfolio does not support the student's suggested grade. (e.g. there is little to no substantive work in the portfolio and the student is suggesting an A+).
2. Students assign themselves too low a grade.

Grades of A or higher should only be assigned in the case that the portfolio documents excellent work and effort in achieving the stated course learning objectives. It should be complete,

Final meeting to discuss your portfolio

The portfolio and final grade will be presented to the instructor in a 1-on-1 meeting that will last approximately 30 minutes. In this meeting students should tell the instructor their personal journey/story in the course as supported by their portfolio. You should explicitly refer to the five course learning objectives and detail how your portfolio shows you accomplished them, and to what extent.

This can include:

- What were your goals in the course? How did you achieve them?
- What problems/topics were most interesting/engaging to you? How did this affect your work?
- What did you find challenging/easy/frustrating/exciting/fun?
- Which topics did you ignore, and why?
- Did you overcome any difficulties?
- How did you contribute to group work (if any)?

This meeting is not an oral exam.

You may invite an additional person to attend (as moral support), if you want.

This meeting should be scheduled so that it happens in the final two weeks of the course. In the event that no suitable meeting time is available, extensions will be granted for up to two weeks (until April 22, 2022).

Midterm Meeting

To prepare for the final meeting, students will meet with the instructor by February 11, 2022 to present their portfolio (so far) and propose a grade in the course so far. This meeting will be used to make sure that student and instructor expectations are calibrated.

This meeting will take around 10 minutes. Students can meet with the instructor in small groups if they wish (and then the meetings will be proportionally longer).

In the event that no suitable meeting time is available, extensions will be granted for up to two weeks (until February 25, 2022).

Scheduling Meetings

More information will be posted on Quercus about how to schedule these meetings with the instructor.

Penalties for Lateness

In the event that either meeting cannot be completed by the deadline, extensions will be granted for two weeks. After that time, late submissions will not be accepted.

Procedures and Rules

Missed Term Work

In order to receive special consideration, you must email the course coordinator and declare your absence on ACORN. For more information, visit the Office of the Registrar website (https://www.utm.utoronto.ca/registrar/utm-absence).

If you have a legitimate reason (e.g. illness, other impairment, etc.) for being unable to attend class or complete some other aspect of the course work then you need to contact the instructor as soon as possible, and no later than two weeks after the course work was due. If this is a recurring situation for whatever reason, you should speak to the instructor about it as soon as possible.

Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto Mississauga is a strong signal of each student's individual academic achievement. As a result, UTM treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters outlines behaviours that constitute academic dishonesty and the process for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course, or more than once in the same course, without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required, including (but not limited to) doctor's notes.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources.

Groupwork and Plagiarism

Students are encouraged to work on coursework in groups.

When working on a (weekly) submission or work that you include in your protfolio, students are required to follow these **three simple rules:**

1. **If you work in a group, then on each copy of the assignment you hand in, record the other students you worked with and which questions you worked on together** (yes that is sometimes complicated to recall, but do your best).
2. **Whether you work in a group, have help from a tutor or other source etc, you *must* write-up your own answer to each question in your own words.** (Copying or submitting someone else's work, letting someone copy or submit your work, writing a solution for another student, or having another student write a solution for you are **all** cases of Academic Dishonesty.)
3. **Students should cite any and all sources they use in their work.**(This includes using Wikipedia, other websites, textbooks or articles from outside the course, etc.)

Additional Information

Course Schedule

We will aim to cover many (but not all) of the topics from Parts I, II and III in the textbook (with additional topics, possibly using additional sources, as time permits).

There will be a week-by-week schedule on the course website with a more detailed summary of the topics we will cover each week.

Email policy:

Please use your @utoronto.ca email address for all communication with the instructor or the TAs, and should include [MAT344] in the subject line.

Lectures:

When the class is not in-person, the class will take place on Zoom. Information will be posted on Quercus. Each lecture section will

have 3 hours of synchronous class time each week. You are expected to attend class at this time and participate actively. Attendance will not be taken, and you will not be required to have your personal audio or video on throughout the class (although you may be encouraged to). When class is not in-person, lectures will be recorded by the instructor and made available for personal use of students.

Please register for a UTM Zoom account using your UTORid and password.https://utoronto.zoom.us

Tutorials:

Tutorials start the first week of the term (January 12, 2022), and the final tutorial is on Wednesday April 6, 2022. When the course is not meeting in-person, tutorials will be held on Zoom. Information will be posted on Quercus.

All students must enroll in a tutorial section. You should attend only the tutorial that you are enrolled in. It is important to attend your tutorial every week, starting the week of January 12. Tutorials give you a chance to study with the help of the TA and together with other students. A list of which TA is responsible for which tutorial can be found on Quercus under 'Information and documents; TA and instructor contact info'.

Office Hours:

Please do not hesitate to ask for help. The instructor of MAT344 is available for extra help outside of class time, during his scheduled office hours.

You do not need an appointment to visit office hours. Just show up, but come prepared with questions you have. For example, you can ask questions about a particular concept or something from lectures or the textbook that you want to clarify. Or you can bring a problem you have tried to work on but have questions about (in that case please bring the work that you have done, even if it is not complete). See the course website for any updates on office hour times.

Piazza:

MAT344 has its own Piazza page. You can use it to ask and answer any questions related to MAT344. You can also use it to connect with other students. See Quercus for links.

Course feedback:

A few weeks after the start of term, students will be given the opportunity to provide feedback to the instructor regarding the course and their teaching. Details will be posted on Quercus. You are strongly encouraged to participate and provide your feedback to your instructor.

Technology requirements:

- See the UofT Recommended Technology Requirements for Remote/Online Learning. https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/
- In addition to the minimum UofT requirements, in this course we require:
    - A camera or scanner. You will need to take a picture of your hand-written work and submit it.
    - Speakers or headphones. To use during LEC and TUT, or while watching a video.
    - Microphone and video camera are recommended. This is so that you can take part in small group discussions and participate during class. (You will also be able to participate using the chat.)
- Also see UTMs Learn Anywhere page. https://utm.library.utoronto.ca/content/learn-anywhere

Inclusion and Equity

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

The University provides academic accommodations for students with disabilities in accordance withthe terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's coursesand programs. At UTM, the Accessibility Services can provide more information about accessibility accommodations for students. https://www.utm.utoronto.ca/accessibility/welcome-accessibility-services

Copyright policy:

Please be advised that the intellectual property rights in the material referred to on this syllabus and posted on the course Quercus site, may belong to the course instructors or other persons. You are not authorized to reproduce or distribute such material, in any form or medium, without the prior consent of the intellectual property owner. Violation of intellectual property rights may be a violation of the law and University of Toronto policies and may entail significant repercussions for the person found to have engaged in such act.

If you have any questions regarding your right to use the material in a manner other than as set forth inthe syllabus, please speak to your instructor.

- Course materials are made available to you for personal use.
- You can not share (or 'publish') material anywhere.
- You can not record lectures or tutorials (both in-person and online) without permission from the instructor or the TA.
- You can not post any course material to any website, study group or online forum.
- If you post assignment or test questions to any website, study group or online forum (except the course Piazza discussion board) it may be a copyright violation and it may be an academic offence.

Notice of video recording and sharing (Download permissible; re-use prohibited)

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session. Course videos and materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation, and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. For questions about recording and use of videos in which you appear please contact your instructor.

Last Date to drop course from Academic Record and GPA is March 13, 2022.