DEPARTMENT OF MATHEMATICAL AND COMPUTATIONAL SCIENCES
UNIVERSITY OF TORONTO MISSISSAUGA

MAT344H5S LEC0101
Introduction to Combinatorics
Course Outline - Winter 2019

Class Location & Time	Mon, 05:00 PM - 06:00 PM DH 2060 Tue, 03:00 PM - 05:00 PM DH 2060
Instructor	Alex Rennet
Office Location	DH 3094
Office Hours	
E-mail Address	alex.rennet@utoronto.ca
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, MAT223H5/MAT240H5
Exclusion: MAT344H1,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.

Textbooks and Other Materials

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

There should be 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
Term Test	In-Class Test	2019-02-05	15%
Term Test	In-Class Test	2019-03-12	15%
Assignment	9 Hand-In Assignments (best 8 count)	On-going	12%
Quiz	3 In-Tutorial Quizzes	On-going	6%
Other	Pre-Class Reading Quizzes (marked for completion)	On-going	2%
Final Exam		TBA	50%
		Total	100%

More Details for Assessment and Deadlines

Missed Work

If a student misses a test or a tutorial quiz, or is unable to complete an assignment for a *valid, documented reason,* the corresponding portion of their mark will be incorporated into their final exam mark (not distributed across other term work).

Example: if a student is excused from one Midterm and one In-Tutorial Quiz, their final mark would be calculated with Quizzes worth 4%, and the Final Exam worth 50+2+15 = 67%.

Final Mark Calculation

Every students' final mark will be calculated by taking the *higher* of their mark on the standard marking scheme (as above), and their mark on an alternate scheme where 5% from their lowest Midterm is shifted to the Final Exam. This only applies if both midterms were written.

Quiz Info

There will be **three quizzes** held **during <u>your registered tutorial</u>** on the **following dates:**

- **January 30th**
- **February 27th**
- **March 27th**

Each quiz has **two parts:** an **individual component** and a **group component.**

- The quiz mark is mainly based on your individual work; but the overall quiz will be marked in a way so that your mark can only possibly *increase or remain the same* after the group component is taken into account.
- Groups will be required to contain at least 3 members (unless impossible in the given circumstances).
- Students will form their own groups, with help from the TA.

Students must write quizzes in their <u>Registered Tutorial.</u>

There will not be any make-up quizzes.

Midterm Info

There will be **two 90-minute midterms**. These will be written **during class time on Tuesdays in the usual lecture room.**

If you have a conflict with the timing of the midterms (for instance, if you have another course with a midterm scheduled during this time), **then you need to bring this to the attention of Prof. Alex Rennet (please email or bring a copy of your timetable and the syllabus of the course with the conflicting midterm).**

There will not be any make-up midterms.

Midterm Corrections

During a student's registered tutorial immediately following each midterm, they will be able to submit ONE "correction" of a (single) question on that midterm.

A "correction" consists of a **revised answer** to a single long-answer question (these will be highlighted on the midterms).

If a student submits one of these, then that student's mark for that question on the midterm will be the **average** of their original answer and the mark for the "correction", *except* if it would make their mark go down. (There's no way to lose; just don't forget to do it!)

If a student submits more than one correction for a given midterm, all of the corrections will be disregarded.

Examples: suppose a student submits a midterm that would be given 14/20 points, having received 2/5 points on "Question 2"...
*a) If that student were to submit a complete, correct answer to Question 2 in tutorial the next day, their mark would increase to **15.5/20** points. (Why? Because the **average** of 2 and 5 is 3.5, so the student gets 3.5/5 for that question, not 2/5; i.e. they get 1.5 extra points!)*

*b) If instead, they submitted an incorrect "correction" for Question 2 which would have only received 1/5 or 0/5 points (i.e. it was worse than their original answer), then they will still get **14/20** points.*

Assignment Info

There will be **nine short assignments**, due **on Quercus** by submission of a **pdf file.**

These assignments are due by **11:59pm (i.e. ~midnight) on Saturday** each week of the semester, except for test weeks.

- Jan 12, 19, and 26,
- Feb 2, and 16, and
- March 2, 9, 23, and 30.

Late assignments will not be accepted under any circumstances. Nor will assignments handed in by email.

Note also that the pdf file requirement is rigid - Quercus will not allow you to upload a picture or document file.

Assignments will typically be posted *approximately* one week before they are due.

Students' assignments should either be **very neatly handwritten**, or **typed**. More specific instructions will be given to students on Quercus regarding these expectations.

Only the best eight assignment marks a student receives will counted.

Accessibility Accomodations

If you require accomodation for a disability, I *strongly encourage you* to make an appointment with the AccessAbility centre on campus as soon as possible (see http://www.utm.utoronto.ca/accessability/accessability-services-2037-davis-building).

Note: if you write your tutorial quizzes outside of the tutorial room through Accessibility, you will unfortunately not be able to participate in the group component of these quizzes. (But note that this cannot cause your quiz mark to decrease.)

Penalties for Lateness

Late assignments will not be accepted.

There are no make-up tests, tutorial quizzes, reading quizzes or assignments.

Procedures and Rules

Missed Term Work

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 submit documentation to 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.

- In all cases of illness etc, you must use the **official UTM medical certificate**. The certificate must specify the exact period during which you were unable to carry out your academic work.

Missed Final Exam

Students who cannot write a final examination due to illness or other serious causes must file an online petition **within 72 hours of the missed examination**. Original supporting documentation must also be submitted to the Office of the Registrar **within 72 hours of the missed exam**. Late petitions will **NOT** be considered. If illness is cited as the reason for a deferred exam request, a U of T Verification of Student Illness or Injury Form must show that you were **examined and diagnosed at the time of illness and on the date of the exam, or by the day after at the latest**. Students must also record their absence on ACORN on the day of the missed exam or by the day after at the latest. Upon approval of a deferred exam request, a non-refundable fee of $70 is required for each examination approved.

Academic Integrity

Honesty and fairness are fundamental to the University of Toronto's mission. Plagiarism is a form of academic fraud and is treated very seriously. The work that you submit must be your own and cannot contain anyone elses work or ideas without proper attribution. You are expected to read the handout How not to plagiarize (http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize) and to be familiar with the Code of behaviour on academic matters, which is linked from the UTM calendar under the link Codes and policies.

Groupwork and Plagiarism

Students are encouraged to work on assignments in groups.

When working on an assignment, students are nevertheless 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.)

Final Exam Information

Duration: 3 hours
Aids Permitted: None

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.

Learning Outcomes

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

- Apply a variety of strategies to solve combinatorial problems.
- Formulate rigorous proofs of results that arise in the context of Graph Theory and Combinatorics, including results related to:
    - Connectedness, colouring, and planarity of graphs
    - Existence and non-existence of various types of paths in graphs
    - Trees
    - Generating functions and recurrence relations
    - Binomial identities
    - Permutations, Combinations and Partitions
- Analyze novel definitions and concepts about graphs and combinatorial objects, for instance by:
    - Creating examples and counterexamples.
    - Relating them to familiar definitions and concepts.
    - Formulating and verifying hypotheses about them.
- Write solutions to problems and proofs of theorems that are coherent, organized and well-supported.

Last Date to drop course from Academic Record and GPA is March 17, 2019.