MATH 239: Introduction to Combinatorics

Spring 2015 Course Outline

Overview. The first portion of the course is Combinatorial Analysis. We introduce generating series and apply them to enumerate compositions of an integer and $\{0,1\}$-strings. We then consider the solution to recurrence equations.

The second portion of the course is Graph Theory. We introduce graphs, isomorphisms, paths, cycles, trees, and connectivity, and continue with planarity, colouring, bipartite matching, and applications.

Classes, tutorials and instructors. To send an email, add @uwaterloo.ca.

Sec	Lectures	Tutorials	Instructor	Office	Phone	Email
1	MWF 9:30 MC 4059	T 2:30 MC 4059	P. Nelson	MC 5134	x37300	apnelson
2	MWF 8:30 MC 4059	T 1:30 MC 4059	M. Pei	MC 6492	x35587	mpei
3	MWF 2:30 MC 4061	M 12:30 MC 1085	J. Geelen	MC 5124	x35594	jim.geelen
4	MWF 1:30 PHY 145	M 3:30 MC 2066	P. Nelson	MC 5134	x37300	apnelson

Schedule. This is a tentative schedule with topics that we plan to cover.

Week	Dates	Topics	Assessments
1	May 4, 6, 8	1.1-1.3 Counting, bijections, combinatorial proofs	
2	May 11, 13, 15	1.4, 1.5 Generating series, formal power series	A1 due May 13
3	May 20, 22	1.5, 1.6 Recurrences, sum and product lemmas	A2 due May 20
4	May 25, 27, 29	2.1, 2.3-2.5 Integer compositions, binary strings, unambiguous expressions	A3 due May 27
5	June 1, 3, 5	2.6-2.8, 3.1, 3.2 Recursion of strings, solving homogeneous recurrences	A4 due June 3
6	June 8, 10, 12	3.6, 4.1-4.3 Counting binary trees, graph theory, isomorphism, degrees	A5 due June 10
7	June 15, 17, 19	4.4, 4.6, 4.8 Bipartite graphs, paths, cycles, connectedness	A6 due June 17
8	June 22, 24, 26	4.8, 4.9 Components, cuts, Eulerian circuits, bridges	A7 due June 24
9	June 29, July 3	5.1, 5.2 Trees, spanning trees	Midterm July 2
10	July 6, 8, 10	5.3, 7.1, 7.2 Bipartite characterization, planarity, Euler's formula	A8 due July 8
11	July 13, 15, 17	7.4-7.7 Euler's formula, platonic solids, nonplanar graphs, colouring	A9 due July 15
12	July 20, 22, 24	7.8, 8.1-8.3 Dual graphs, matchings, vertex covers, König's theorem	A10 due July 22
13	July 27, 28	8.4, 8.6, 8.7 Hall's theorem, perfect matchings, edge colouring	A11 due July 28

Online. No printed material will be distributed in class. Go to the University of Waterloo's LEARN website learn.uwaterloo.ca to find news, assignments, solutions and information about this course.

Textbook. *Introduction to Combinatorics: Course Notes for Math 239*, which is available online. Printed copies are also available from Campus Copy at MC 2018.

Additional materials not covered in the course notes will also be published online.

Grades. Assignments 10%, midterm 30%, final exam 60%

Note: A necessary condition for passing the course is that the weighted average of your midterm and final exam must be at least 50%. More specifically, if M is your midterm percentage and F is your final exam percentage, then you need $\frac{1}{3}M + \frac{2}{3}F \geq 50\%$.

Assignments. There will be 11 graded homework assignments in all. The assignments will be posted online and most are due on Wednesdays at 11am in the dropboxes outside MC 4066 (see schedule on the previous page). **No late assignments will be accepted. Assignments handed into the wrong dropboxes will receive no credit.** The lowest assignment mark will not be counted in your overall grade. We generally do not grant extensions or shift assignment weights for any reason including illness, absence, late enrolment, and assignments lost in the grading process.

Guidelines on completing the assignments. You may ask your instructors or TAs for help during their office hours or tutorial centre hours. You may also discuss the assignments in small groups. However, **you must write up the solutions on your own**. This means that you may not write up your solutions while you are with a group, and you should not consult any notes you have taken during your group discussions while writing up your solutions.

In addition, you may not use electronic resources for help with assignment questions directly. For example, you may read internet materials to learn about Kuratowski's Theorem, however, you may not directly search for an assignment question on Kuratowski's Theorem. Also, you are not allowed to use solutions obtained from previous offerings of this course. Any submitted assignments that are suspected of cheating will be sent to the integrity officer of the Faculty of Mathematics.

Exams. A midterm will be held on Thursday July 2, 4:30-6:20PM. A final exam will be scheduled later. No calculators are allowed during exams. Missed exams will count as 0 unless suitable medical documentation is provided. There will not be any make-up exams.

Unclaimed materials. Assignments and midterms that are not claimed will be destroyed after the final exam.

Tutorials. Graduate student TAs will be responsible for the tutorials. They will present examples, answer student questions, and return marked assignments. They will *not* present solutions to assignment problems before the due date. However, they can do related examples, and can also answer some specific questions related to an assignment problem (without giving away the solution) provided the problem has been seriously attempted. Tutorial problems will be posted online ahead of time. The tutorials will begin on the second week.

Teaching assistants.

Section 1: Aaron Chan (acschan@uwaterloo.ca)
Section 2: Michael Szestopalow (mszestopalow@uwaterloo.ca)
Section 3: Alan Arroyo-Guevara (amarroyoguevara@uwateloo.ca)
Section 4: Cameron Marcott (c2marcot@uwaterloo.ca)

Tutorial centre. Graduate student TAs will be in the Tutorial Centre, MC 4067. Schedule for this will be posted online.

Instructor office hours. Schedule for instructor office hours will be posted online.

INC policy. In case of serious illness during the final exam, you need to have passing grades for both the assignments and the midterm exam before an instructor can grant a grade of INC.

Academic Integrity. In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. For more information, check www.uwaterloo.ca/academicintegrity.

Grievance. A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm.
When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline. A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline,
http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm.
For typical penalties check Guidelines for the Assessment of Penalties,
http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals. A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals,
http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Students with disabilities. The AccessAbility Services, located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with them at the beginning of each academic term.