MATH 268, Fall 2025: Combinatorics and Graph Theory

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Class Meetings Tuesdays, Thursdays: 10:10 AM - 11:40 AM in Trexler 374

Student Hours Drop-in times are Wednesdays 10am-11am and Thursdays 9am–10am. You are welcome to stop by my office and chat anytime my door is open, but if you want dedicated time, please set-up an appointment using `https://roanoke.campus.eab.com/pal/kcCpQTBr6y`

About the Course This course consists of two distinct though related concepts in discrete mathematics - combinatorics and graph theory.

The first third of the course surveys main topics in combinatorics, which is the study of counting discrete structures. Combinatorics provides practice with precision in arguments, organizing information into an equation, and writing proofs.

The last two-thirds of the course surveys main topics in graph theory. These will include (but are not limited to) graph routes, trees, connectivity, matching, coloring, and planarity. Graphs provide practice with modeling a problem using a mathematical structure, organizing information so a solution can be found, and writing proper mathematical proofs.

Intended Learning Outcomes By the end of this course, successful students will be able to construct valid proofs that proceed efficiently from hypothesis to conclusion; identify properties of graphs; analyze problems to construct appropriate graph theoretic models; analyze counting problems to identify appropriate solution techniques; and present solutions orally and in writing.

Required Materials
Textbook: *Graph Theory: An introduction to Proofs, Algorithms, and Applications* by Karin Saoub (ISBN: 978-0-367-74375-8)
Online Resource: *Combinatorics* by Joy Morris available at `http://www.cs.uleth.ca/~morris/Combinatorics/Combinatorics.pdf)`
Other: basic calculator
All work should be completed neatly in pencil or typed.

Course Grades The following table lists the weights for the various forms of assessment for this class.

Problems Sets	20%
Combinatorics Presentation	5%
Graph Theory Presentation	5%
Applications Presentation	10%
Tests (20% each)	60%

A grade scale will be determined after final grades are computed, but will be no worse than the scale given below. Attendance and class participation will be considered when determining marginal grades.

		B+	87-89	C+	77-79	D+	67-69		
A	94-100	B	83-86	C	73-76	D	63-66	F	0-59
A-	90-93	B-	80-82	C-	70-72	D-	60-62		

Expected Work Hours

This course expects you to spend at least 12 hours of work each week inside and outside of class.

Academic Integrity

I subscribe to the academic integrity policies as outlined in Academic Integrity at Roanoke College. Students are expected to be familiar with these policies. As in real life, failure to learn the rules is not an excuse. Please contact me if you have any questions. Be aware that I am contractually obligated to report students if I suspect that they have engaged in academic dishonesty.

During in-class activities, it is fine – and even encouraged – to discuss and learn from one another. Outside of class, discussion of material with classmates can greatly improve your own understanding. There is a difference, however, between telling someone the answer and showing them how to find it or generate it on their own. Therefore, all discussions about course work should be limited to general concepts, not specific instructions of what to write, say, or do to complete an assignment. Misrepresentation of your contribution to a group effort will be considered a violation of the academic integrity policy.

Since a central goal of this subject is to help you become independent and critical thinkers, you are discouraged from using AI tools or other online resources to create explanations or proofs in your assignments, activities, responses, etc. Copying and pasting directly from a web site and claiming it as your own work is the same as copying and pasting directly from a book – both are violations of the academic integrity policy and will be treated accordingly. Any work submitted using AI tools will be treated as though it was plagiarized. If any part of this is confusing or uncertain, please reach out to me for a conversation before submitting your work.

Cell phones must be turned off prior to entering the classroom. Laptops may be used for note-taking during regular class sessions, if this seems useful to you, but you may not log on to the internet or your email unless specifically told to do so. The use of laptops and other electronic devices during an exam is strictly prohibited. Any use of such devices during a quiz or exam will be considered a breach of academic integrity. Note that looking at or using your cell phone during a test or quiz is considered a violation of Academic Integrity regardless of your purpose or intent in doing so.

Attendance & Make-Up Work

Attendance is critical to the understanding of the material in the course and some days include presentations and discussions that cannot be made-up; however, you should not attend class if you are ill. I will contact you if I have concerns with your class attendance or for repeated unexcused absences. Failure to address these concerns may result in lowering your overall course grade by up to 10 points.

When absent, excused or unexcused, you are responsible for all material covered in class.

Policies for late work are outlined in the sections below. For rare circumstances outside your control, such as illness, contact me as soon as possible so we can devise a plan for you to complete your work in a timely manner.

Reading & Participation

The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. The last page of the syllabus is a day by day outline of the sections that will be discussed in class (this is subject to change as needed). You are fully expected to have read the upcoming section before the class meeting! The best way to be an active participant in the classroom is to attempt the daily practice problems that are posted on Inquire.

Problem Sets

A problem set will be due each week, as shown on the schedule on the last page, and is worth a total of 25 points. There are three parts to each problem set. The first part is worth 7 points and will be graded based on effort and completeness. This part consists of the two daily homework assignments for the previous two class periods. Daily homework will provide practice on the topics recently learned in-class and most questions will have solutions worked at the beginning of class. The second part of each problem set is worth 16 points (4 problems worth 4 points each) and will be graded based on the clarity of explanation and correctness of computations or proofs. The third part of the problem set, worth 2 points, is for presentation of the problems.

When you turn in your problem sets, make sure the four problems graded for correctness are on top and then below are your two daily assignments. Your homework should be neat, organized, and stapled. You can collaborate on the daily homework problems, but you should write up your own solution to the 4 graded problems.

If you will be absent, turn in your homework before the class period it is due, or have a friend turn it in for you. *Late homework will only be accepted within 2 days of the original due date and will automatically lose the 7 points for completion.*

Presentations

You will be responsible for presenting some of the material in this class. You should not start on the presentation the night before it is due! These will focus on more in-depth proofs, interesting problems, or puzzles not previously introduced to the class. Students will be in small groups (around 3 students per group). There will be two different types of presentations: topic based and application based.

For the topic based presentations, groups will give 5-8 minute presentations closely related to the material we have been studying recently. The first round of presentations will be combinatorics based and occur at the end of the combinatorics portion of the course (September 23). The second round of presentations will be split amongst various days in the graph theory portion of the course, and will provide additional insight into topics recently covered in class.

For the application based presentation, each group will present on an application of graph theory. These presentations should outline not only the way in which graph theory is used to answer a question, but also provide an example of its use. These will be 15-20 minutes in length and occur during our final exam block on Thursday December 11. A presentation proposal will be due November 20.

Tests & Final Exam

Three in-class tests will be given, roughly according to the schedule on page 5. Each test will focus on material from the most recent chapters studied. However, as with most mathematics classes, each test will require you to understand and remember things from the past.

There will be no Final Exam in this course. The Application Presentation will occur during our Final Exam block on December 11.

Co-Curricular Engagement

The College offers a wide variety of lectures and talks. These co-curricular sessions engage the community to think about ongoing research, novel applications, and other issues that face our world.

Members of this class are required to participate in **at least two** co-curricular events. After attending, students will submit a one page paper reflecting on the discussion to Inquire *within one week of the presentation.* This should **not** be a regurgitation of the content, but rather a personal contemplation of the experience and how the lecture or event was related to our course or mathematics in general.

Failure to submit a reaction paper will result in a 1% reduction in your final grade. Additional events may be attended, and subsequent reflection papers may be submitted for extra credit, with .5% added to your course average for each additional attended, up to 2% total.

Classroom Etiquette

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

Study Room & Trexler Tea

The Study Room in Trexler 271 can be used by you and your friends to meet up so that you can work on homework together or prepare for tests. It is open virtually 24 hours a day, 7 days a week (very occasionally there are meetings in that room). Your student ID card should grant you access to Trexler Hall any time of day if the doors happen to be locked (use the card access point located by the first floor entrance facing the parking lot). Take advantage of this area and time, especially during weekdays when I am around (which is generally a lot)!

In addition, we offer a weekly Trexler Tea for all students and faculty; feel free to stop by the study room for tea and cookies on Thursdays from 2:20 PM to 3:20 PM. Come meet other students as well as chat with faculty members in a casual setting!

Writing Center & Subject Tutoring

The Dr. Sandee McGlaun Writing Center and Subject Tutoring, located in the lower level of the Fintel Library (Room 5), offers free one-on-one support in writing, oral presentations, and course content such as Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, and Social Sciences. Open Sunday–Thursday from 4–9 PM, students can stop by or schedule through Navigate by selecting "Schedule an Appointment" → "Writing Center and Subject Tutoring" → "Writing Support" or "Course Tutoring" → preferred date and tutor. Contact `subject_tutoring@roanoke.edu` or 540-375-2590 for more information.

Accessible Education Services

AES is located on the first floor of the Bank Building. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Dustin Persinger, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at `aes@roanoke.edu` to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Dustin Persinger at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester. The testing center, also located on the first floor of the Bank Building, can be reached at 540-375-2247.

Tentative Course Schedule

The schedule below is tentative and subject to change. It should give you an idea of the timing of the topics covered, assignments, and tests. Assignment due dates are approximate and any updates will appear on Inquire. The Graph Theory Presentations will occur during weeks 7-12, where the exact timing will align with each group's topic. More information will be provided in-class and on Inquire.

Daily Practice Problems and weekly Problem Sets (PS) will be posted on Inquire. Problem Sets will be turned in at the start of class on the day listed unless otherwise stated on Inquire.

	Date		Section	Topic	Assignment
1	Thu	Aug 28	2, 3A, 3B	Product/Sum Rule, Permutations & Combinations	
2	Tue	Sep 2	3C, 4A	Binomial Theorem, Bijections	
	Thu	Sep 4	5	Repetitions and Arrangements	PS 1
3	Tue	Sep 9	4B	Combinatorial Proofs and Counting Technique Workshop	
	Thu	Sep 11	7A, 7B	Generating Functions	PS 2
4	Tue	Sep 16	7C	Generating Functions for Counting	
	Thu	Sep 18	10B	Inclusion-Exclusion	PS 3
5	Tue	Sep 23		*Combinatorics Presentations: All groups*	
	Thu	Sep 25	1.1, 1.2, 1.4	Introduction to Graph Theory and Matrices	PS 4
6	Tue	Sep 30		**Test 1**	
	Thu	Oct 2	1.3, 1.5, 2.1	Isomorphisms, Proofs and Eulerian Graphs	PS 5
7	Tue	Oct 7	2.1, 2.2	Eulerian and Hamiltonian Graphs	
	Thu	Oct 9	2.2	Hamiltonian Graphs	PS 6
				Fall Break	
8	Tue	Oct 21	3.1 - 3.3	Tree Properties and Rooted Trees	
	Thu	Oct 23	4.1, 4.2	Connectivity and Menger's Theorem	PS 7
9	Tue	Oct 28	4.3	Network Flow	
	Thu	Oct 30	5.1	Matching	PS 8
10	Tue	Nov 4		**Test 2**	
	Thu	Nov 6	5.2, 5.3	Augmenting Paths, Stable Matching	PS 9
11	Tue	Nov 11	5.4	Factors	
	Thu	Nov 13	6.1, 6.2	Graph Coloring	PS 10
12	Tue	Nov 18	6.4	On-line Coloring/Brooks' Theorem	
	Thu	Nov 20	7.1	Planarity and Kuratowski's Theorem	PS 11
				Class time: 9:40-10:40	*Proposal due*
13	Tue	Nov 25	7.1. 7.2	Planarity & Graph Coloring	
	Thu	Nov 27		**No Class - Thanksgiving Break**	
14	Tue	Dec 2	7.2	Graph Coloring Revisited	PS 12
	Thu	Dec 4		**Test 3**	
	Thu	Dec 11		**Applications Presentations: All groups 8:30-11:30 AM**	