MATH 268, Spring 2018: Combinatorics and Graph Theory

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Class Meetings

Mondays, Wednesdays, Fridays: 10:50 AM - 11:50 AM in Life Science 305

Expected Work Hours

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

Office Hours

Mondays 1:10 – 2:10 PM
Tuesdays 2:30 – 3:30 PM
Wednesdays 9:00 – 10:30 AM
Thursdays 9:00 – 10:00 AM
and by appointment (email me)

About the Course

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

The first half of the course surveys main topics in combinatorics, which is the study of counting discrete structures. We will focus on general counting methods, generating functions, and partitions. Combinatorics provides practice with precision in arguments, organizing information into an equation, and writing proofs.

The second half of the course surveys main topics in graph theory. These will include (but are not limited to) cycles, coloring, trees, networks, 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: *A Walk Through Combinatorics*; Mikl´os B´ona, 4th Edition
Other: basic calculator

Course Grades

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

Homework/Quizzes	28%
Presentations	12%
Exams (10% 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		

Academic Integrity

Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be your own work! Collaboration on presentations is required and permitted on homework. However, all homework solutions should be written up separately - you cannot simply copy a classmate's work or trade answers. Additional instructions will be provided on all tests and exams.

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 to an email server unless specifically told to do so. The use of laptops and other electronic devices, except for a calculator, during an exam is strictly prohibited. This includes tablets, smart phones, and iPods. 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.

Reading and 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!

Homework

A problem set will be due each Wednesday or Friday (excluding week 8). These will be assigned the previous week and each are 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 three daily homework assignments for the previous three class periods. Daily homework will include more computational type problems and you are welcome to ask questions about them at the beginning of class. The second part of each problem set is worth 16 points and will be graded based on correctness and presentation. Each week you will complete 4 problems, worth 4 points each, which will be carefully graded for correctness and completion of the solution. The third part of the problem set, worth 2 points, is for presentation of the problems.

For the first week we will have a single problem assigned on Monday, due Wednesday, to get you accustomed to the grading; it will be worth 10 points.

When you turn in your problem sets, make sure the four problems graded for correctness are on top and then below are your three daily assignments. Your homework should be neat, organized, and stapled. You can collaborate on problem sets but you must write up your own solution. If you are looking at another person's work when you are writing up your problem set, then you are in violation of the academic integrity policy of Roanoke College.

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 completion points.

Quizzes

There may be quizzes in this class. They may either be in-class quizzes or take-home quizzes. I may occasionally warn you about an upcoming quiz but you should be prepared to take a quiz on any given day. These will generally test definition knowledge and recognizing main concepts.

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) that will give 5-8 minute

presentations about once every two weeks. The presentations must be prepared as a group, but students will present the material on a rotating basis. Each group will also submit a written outline of the presentation or formal proof.

Only the person presenting will receive a grade for the presentation, but the entire group will be graded on the written portion. The written portion of the presentations count as a third of your overall presentation grade (4% of the course grade); the remaining two-thirds comes from your individual presentation to the class (8% of the course grade). You must present once during the combinatorics section of the course and once during the graph theory section.

Tests, Midterm, & Final Exam

Four in-class tests will be given, roughly according to the schedule on page 4. 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.

In addition, two take home exams will be given. The midterm will cover the combinatorics section of the course (Chapters 1 - 8) and the final exam will cover the graph theory section of the course (Chapters 9 - 12). These exams are more comprehensive and proof heavy and will include instructions regarding outside help. The midterm will be distributed at the end of Test 2 and is due at the start of class on Wednesday March 14 (the week after spring break). The final exam will be distributed at the end of Test 4 and is due by noon on Monday April 30th.

MCSP Conversations

The Department of Math, Computer Science and Physics offers a series of discussions that appeal to a broad range of interests related to these fields of study. These co-curricular sessions will engage the community to think about ongoing research, novel applications and other issues that face our discipline.

Members of this class are invited be involved with all of these meetings; however participation in **at least two** of these sessions is mandatory. 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. This reaction paper will be worth 10 points toward the homework grade. If you are caught leaving the talk early, you will receive a 0 on the assignment.

Attendance & Make-Up Work

Attendance is critical to the understanding of the material in the course; it is both required and expected. Any absence that is not discussed with the instructor prior to the missed class is considered unexcused. I will assume that if you accumulate 4 unexcused absences you are not interested in completing the course. After the 3rd unexcused absence, you, your advisor, and the registrar will be warned that another absence will result in your removal from the class (DF).

As noted above, late homework will only be accepted within 2 days of the original due date and will automatically lose the completion points. Take-home exams must be turned in on-time; a late-penalty (after grading) of $33\frac{1}{3}\%$ will be assessed per 24 hours late (rounded up); no exceptions.

When absent, excused or unexcused, you are responsible for all material covered in class. You will not be allowed to make up any work missed due to an unexcused absence.

Study Room The MCSP Study Room, 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)!

Community

Please feel free to become an active member of our department's community. Each of the three disciplines in our department has a student club and you should join! The Roanoke College Student Chapter of the Mathematical Association of America (or "Math Club" for short) meets every other week, plays and learns about games and hosts evening events and the annual Pi-Day celebration! Membership in our Math Club also grants membership into the MAA itself; one of the premiere professional mathematical organizations in the world.

In addition, our department offers a weekly tea time for students and faculty; feel free to stop by the MCSP Study Lounge (Trexler 271) for tea and cookies on Thursdays from 2:30 PM to 3:30 PM. Come meet other students as well as chat with the MCSP faculty members in a casual setting!

Accessible Education Services

AES is located in the Goode-Pasfield Center for Learning and Teaching in Fintel Library. 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 Dr. Sue Brown, Director of Academic Services and Acting Coordinator of Accessible Education Services, at 540-375-2247 or by e-mail at sbrown@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 Dr. Brown at your earliest convenience to schedule an appointment.

Tentative	Date	Section	Topic

	Mon	Jan 15	1.1	Introduction & Pigeon-hole
1	Wed	Jan 17	1.2	Pigeon-hole Principle
	Fri	Jan 19	2.1 – 2.2	Induction
	Mon	Jan 22	3.1	Permutations
2	Wed	Jan 24	3.2	Strings
	Fri	Jan 26	3.3	Choice Problems
	Mon	Jan 29	3	Chapter Summary *Presentation 1*
3	Wed	Jan 31	4.1	Binomial Theorem
	Fri	Feb 1	4.2	Binomial Theorem and Multinomials
	Mon	Feb 5	4.2	Multinomial Theorem
4	Wed	Feb 7	5.1	Compositions
	Fri	Feb 9		**Test 1**
	Mon	Feb 12	5.2	Set Partitions
5	Wed	Feb 14	5.3	Integer Partitions
	Fri	Feb 16	5	Chapter Summary *Presentation 2*
	Mon	Feb 19	7.1	Intersecting Sets
6	Wed	Feb 21	7.2	Sieve Formula
	Fri	Feb 23	8.1	Generating Functions
	Mon	Feb 26	8.2	Exponential Generating Functions
7	Wed	Feb 28	8	Chapter Summary *Presentation 3*
	Fri	Mar 2		**Test 2**
			Spring Break	
	Mon	Mar 12	9.1	Introduction to Graph Theory
8	Wed	Mar 14	9.2	Hamiltonian Cycles
	Fri	Mar 16	9.4	Isomorphisms
	Mon	Mar 19	10.1	Trees
9	Wed	Mar 21	9	Chapter Summary *Presentation 4*
	Fri	Mar 23	10.2	Minimum Spanning Trees
	Mon	Mar 26	10.3	Matrix Representations of Graphs
10	Wed	Mar 28	10.4	Number of Spanning Trees *Presentation 5*
	Fri	Mar 30		**No Class** (Good Friday)
	Mon	Apr 2		**Test 3**
11	Wed	Apr 4	11.1-11.2	Bipartite Graphs
	Fri	Apr 6	11.3	Matchings
	Mon	Apr 9	11.3.2	Stable Matchings
12	Wed	Apr 11	11.4	Two colors
	Fri	Apr 13		Graph Coloring
	Mon	Apr 16	12.1	Planar Graphs
13	Wed	Apr 18	12.3	Map Coloring

	Fri	Apr 20	Graph Theory Summary *Presentation 6*
14	Mon	Apr 23	**Test 4**
	Mon	Apr 30	**Final Exam due at noon**