MATH 268, Spring 2016: Combinatorics and Graph Theory

Instructor

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Class Meetings

Tuesdays, Thursdays: 10:10 AM - 11:40 AM in Trexler 374
This course expects you to spend at least 12 hours of work each week inside and outside of class.

Office Hours

Mondays, Thursdays: 9:00 - 10:00 AM
Tuesdays: 1:00 - 2:00 PM
Wednesdays, Fridays: 10:45 - 11:30 AM
and by appointment (email me)

About the Course

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

The first 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.

The second 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 recurrence relations. Combinatorics provides practice with precision in arguments, organizing information into an equation, and writing 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: *Applied Combinatorics*; Alan Tucker, 6th 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 or any other electronic device, 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.

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

Homework will be assigned regularly in this class (virtually every class period). It will be due at the start of the class period immediately following the assigning of homework. Typical problems will include constructions and calculations, informal arguments, and formal proofs. One to three problems will be graded for correctness (6 points), while the remainder will be graded for completion (4 points), for a total of 10 points.

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 a week. 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 at least 3 times by the end of the semester.

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 two 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 graph theory section of the course (Chapters 1 - 4) and the final exam will cover the combinatorics sec-

tion of the course (Chapters 5 - 8). 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 Tuesday March 15 (the week after spring break). The final exam will be distributed at the end of Test 4 and is due by noon on Thursday April 28.

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 counted as a quiz. 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).

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.

Other Stuff

The MCSP Department hosts a weekly tea time for students and faculty; please feel free to stop by the MCSP Study Lounge (Trexler 271) for tea and cookies on Thursdays from 2:30 to 3:30 PM. Also, our Student Chapter of the Mathematical Association of America (Math Club) is looking for members to have fun hanging out and talking about some fun math topics! We meet every other Tuesday in Trexler 271 from 12:00 to 1:00 PM.

Tentative Course Schedule

Week	Dates		Section	Topic
1	Tue	Jan 19	1.1 – 1.2	Preliminaries, Graphs, Isomorphisms
	Thu	Jan 21	1.3 – 1.4	Edge Counting, Planar Graphs
2	Tue	Jan 26	2.1	Euler Cycles
				Presentation 1
	Thu	Jan 28	2.2 – 2.3	Hamilton Circuits, Graph Coloring
3	Tue	Feb 2	2.4	Coloring Theorems
				Presentation 2
	Thu	Feb 4	3.1 – 3.2	Properties of Trees, Search Trees, and Spanning Trees
4	Tue	Feb 9		**Test 1**
	Thu	Feb 11	3.3 – 3.4	Traveling Salesman Problem, Tree Analysis
5	Tue	Feb 16	4.1 – 4.2	Shortest Paths and Minimal Spanning Trees
				Presentation 3
	Thu	Feb 18	4.3 – 4.4	Network Flows; Algorithmic Matching
6	Tue	Feb 23	4.5	Transportation Problem
				Presentation 4
	Thu	Feb 25	5.1 – 5.2	Two Counting Principles; Arrangements& Selections
7	Tue	Mar 1		**Test 2**
	Thu	Mar 3	5.3 – 5.4	Arrangements & Selections with Repetition; Distributions
				Spring Break
8	Tue	Mar 15	5.5	Binomial Identities
				Midterm due
	Thu	Mar 17	6.1	Generating Functions
				Presentation 5
9	Tue	Mar 22	6.2 – 6.3	Calculating Coefficients; Partitions
	Thu	Mar 24	6.4 – 6.5	Exponential Generating Functions; Summation Method
10	Tue	Mar 29	7.1	Recurrence Relation Models
				Presentation 6
	Thu	Mar 31		**Test 3**
11	Tue	Apr 5	7.2 – 7.3	Divide-and-Conquer; Solution of Linear Recurrence Rel.
	Thu	Apr 7	7.3 – 7.4	Solution of Inhomogeneous Recurrence Relations
12	Tue	Apr 12	7.5	Solutions with Generating Functions
				Presentation 7
	Thu	Apr 14	8.1 – 8.2	Counting with Venn Diagrams; Inclusion-Exclusion
13	Tue	Apr 19	8.2 – 8.3	Rook Polynomials
				Presentation 8
	Thu	Apr 21		**Test 4**
	Thu	Apr 28		**Final Exam due by noon**