MATH 454: COMBINATORIAL THEORY

Rutgers University
Summer 2021

Instructor:	George Spahn	**Time:**	MTWTh 12:20 – 2:20 PM EDT
Email:	gs828@rutgers.edu	**Place:**	Zoom (link on canvas)

Course Page: canvas.rutgers.edu

Office Hours: Monday 10:20-12:20 (before class), Tuesday + Thursday 2:20-4:20 (after class)

Textbook: Discrete Mathematics: an Open Introduction 3rd Edition by Oscar Levin: Link to the book

There will also be supplemental readings uploaded to canvas.

Prerequisites: Calc 2 and Linear Algebra

Learning goals:

1. Discover combinatorial concepts by generating examples and making conjectures.

2. Communicate about mathematics in a clear and articulate manner, both orally and in writing, in large discussions and in small groups.

3. Apply the theorems and proof techniques discussed in class to discrete problems with demonstrated examples to real-world scenarios.

Inclusivity: As students, we are mathematicians, but before that we are people. We each have our own identities and backgrounds, and I see this as a source of strength. With this in mind, I would like to encourage you to first bring your identities to class, and second to listen to each other, so that as a group we can expand our perspective and learn new ways to approach difficult problems.

Technology Requirement: You are required to have a computer, webcam, and microphone. Be prepared to turn your webcam and microphone on during every class. You will not often be required to, but you should be able to if you are asked. If doing this isn't easy (e.g. loud home, family members around, etc), let me know so we can discuss how you can participate as well as your situation allows. Please refer to the math department website for details about the requirements and recommendations.

Course Outline:

- Week 1: Set Theory and Functions, Basic Counting Principles, Binomial Coefficients

- Week 2: Combinations and Permutations, Combinatorial Proofs, Balls and Boxes Problems, Inclusion-Exclusion, Bijective Proofs

- Week 3: Induction, Sequences, Recurrence Relations, Generating Functions, Midterm

- Week 4: Generating Functions, Graph Theory

- Week 5: Ramsey Theory, Combinatorial Designs, Discrete Probability, Probabilistic Methods

- Week 6: Smorgasbord of Remaining/Additional Topics, Final Exam

Course Policies

Disclaimer: The policies described here are subject to change. Bear in mind we are trying to cram a full semester's worth of material into 6 weeks.

Grade Breakdown:

- (10%) Participation

- (10%) Daily Problem Sets

- (15%) Weekly Problem Sets

- (5%) Informal Presentations

- (10%) Quizzes

- (20%) Midterm

- (30%) Final

Point ranges for letter grades will be determined after the final exam, but the cutoffs will be no higher than the customary 90% for an A, 80% for a B, etc. Rubrics for all components will be uploaded to canvas.

Participation: To receive credit, you will need to be present during the lecture time and actively participating. You will need to be communicating with your microphone on for the duration of class. You must come to class prepared, which includes doing the assigned reading and problems before class. There will be a rubric uploaded to canvas with more details. If your absence is unavoidable (e.g. religious holiday, personal emergency), speak to me beforehand about turning in work, and speak to me and your classmates about the material you missed.

Daily Practice Problems: After every class, you will be assigned practice problems and reading to review the new topics. These are due the following day before class and will inform our beginning-of-class discussions. DPs will be graded for completion but not correctness (as in, I'll glance to make sure you wrote some reasonable-looking words, not just nonsense). You may type your solutions or take pictures, however please combine everything to a single file and upload to canvas.

Weekly Problem Sets: After every class, two-ish problems will be posted for the weekly pset. The entire set is due on Monday before class. You may type your solutions or take pictures, however please combine everything to a single file and upload to canvas.

Informal Presentations: Throughout every class, there will be a chance for individuals and groups to share their work with the rest of the class (e.g. on DPs, on the in-class worksheets, on recommended exercises from the reading).

Quizzes: There will be four timed and proctored quizzes during class, likely on each Thursday that there are no exams. They will be on basic concepts and be at or below the level of the daily problems. You will be told the date and time of the quiz in advance, as well as the topics it will cover. You must have your webcam on during the entire quiz. We will discuss quiz protocol in more detail during class.

Exams: There will be one midterm exam and one final exam. Students will need to have webcams on during exams for authentication purposes. Exams may have a take-home component with an oral exam follow up.

Midterm: Thursday, June 17
Final Exam: Thursday, July 8

If for any reason a student will not be able to take an exam, or finds themselves in a situation, medical or otherwise, in which they will not be able to perform at their usual proficiency, they should notify the instructor right away and explain the situation. The instructor must be notified as soon as possible, and especially before the exam.

Collaboration: For problem sets, collaboration is allowed and encouraged. Learning how to collaborate successfully is an important skill for mathematicians! However, the written work you submit must be written on your own (see below).

Academic Integrity: All students are expected to be familiar with the university's academic integrity policies, found at Rutgers Official Website. In particular, copying work from the internet or another student and submitting it as your own is a violation. I take this very seriously, don't risk getting caught!

Late Policy: Late submissions for weekly problems will be accepted once, up to 24 hours after the deadline, without questions or penalty. To turn in subsequent late work or work more than 24 hours after the deadline, you must meet with me outside of class to discuss it. Credit will be awarded only if the circumstance was unavoidable. Late submissions for the daily problems will not be given credit, since the solution will be discussed in class.

Student Resources

Disability Services: (848) 445-6800 // https://ods.rutgers.edu
Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter and discuss the accommodations with me as early as possible. To begin this process, complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/registration-form

Counseling, ADAP & Psychiatric Services (CAPS): (848) 932-7884 // http://health.rutgers.edu/medical-counseling-services/counseling/
CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students' efforts to succeed at Rutgers University.
All CAPS locations are physically closed but are providing services remotely, including individual therapy and virtual workshops.

Just In Case Web App: www.justincaseforcolleges.com
Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD.

Violence Prevention & Victim Assistance (VPVA): (848) 932-1181 // www.vpva.rutgers.edu
The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.