

Math 27 -- Combinatorics -- Spring 2025

Syllabus and General Course Information

Professor: Noah Aydin **Office:** RBH 319 **Phone:** 5674 **E-mail:** aydinn@kenyon.edu
Class Times: TR: 1:10-2:30 pm **Classroom:** RBH 203
Office Hours: MWF 10-11:45 am and by appointment. See [my weekly schedule](#), request appointment by email
Class web page: <http://www2.kenyon.edu/depts/math/aydin/teach/227>
Textbook: *An Invitation to Combinatorics* by S. Shahriari, Cambridge University Press, 2022, ISBN 9781108476546

Course Description and Objectives: This course is an introduction to combinatorics, one of the active and important branches of modern mathematics. Combinatorics is concerned with the existence, enumeration, analysis, and optimization of discrete structures. It is an exciting, active, and applicable area of mathematics which blends the use of general principles with ad hoc arguments. Unlike many other areas of mathematics -- e.g., analysis, algebra, topology--the core of combinatorics is neither its subject matter nor a set of "fundamental" theorems. More than anything else, combinatorics is a collection of techniques, attitudes, and general principles for solving problems about discrete structures. This course will be an introduction to the techniques and methods of combinatorics. In the process of learning how to solve combinatorial problems, you will develop an appreciation for the fun, power, and the vast scope of this area of mathematics. Combinatorial techniques are useful in a broad range of fields including computer science, many other areas of mathematics, linguistics, engineering, natural and social sciences, biological sciences, and operations research.

The course will focus on problem solving. Active learning methods will be used throughout the semester. The main topics for the course are: (1) Induction and Recurrence Relations, (2) The Pigeonhole Principle and Ramsey Theory, (3) Permutations and Combinations, (4) Binomial coefficients, (5) Stirling Numbers, (6) Integer Partitions, (7) The Inclusion-Exclusion Principle, (8) Generating Functions, and (9) Graph Theory.

Course Learning Goals: Math 227 serves [the general student learning goals of Mathematics department](#) in the following ways.

1. Understand the mathematical derivations and appropriate uses of combinatorial counting techniques.
2. Recognize various types of distribution problems in pure and applied mathematics and solve problems related to them.
3. Derive recurrence relations and solve them by appropriate techniques.
4. Recognize basic graph concepts and features such as connectedness, trees, cycles, components, and isomorphism.
5. Apply graph-colorings to address combinatorial questions in graph-theoretic models.
6. Understand the vast utility of generating functions, and how their algebra relates to operations on sequences.
7. Employ criteria for existence problems, such as the pigeonhole principle, Ramsey property, and tests of connectedness in graphs.
8. Employ combinatorial techniques of optimization, such as finding the minimum number of monochromatic triangles in a graph.
9. Clearly write about combinatorial concepts, problems, and solutions.
10. Read combinatorial material with clarity, understanding, and persistence.

Grading and Evaluation Criteria:

Final grades will be determined based on the performance in the following components.

Component	Percentage
Written Homework (weekly)	20
Daily Quizzes	20
Class Participation & Presentations (daily)	10
Mini midterm Project	5
Midterm Exam 1	12
Midterm Exam 2	12
Final Presentation	7
Final Paper	14

Class Format, Daily Reading and Quizzes. This course will be based on the flipped classroom model. There will not be traditional lectures in class meetings. Instead, lectures will be delivered via recorded videos that accompany the textbook. For each class meeting, you will read one or two sections from the textbook and watch the accompanying video lecture(s) BEFORE the class. To encourage you to do the readings before class, there will be a short quiz at the beginning of each class based on the readings and the videos. The weight of each quiz will be very small and a number of low scores will be dropped. Many of the quizzes will be on Moodle, so bringing a laptop to class is necessary. Most of the class time will be devoted to solving problems in groups and presentations and discussions of those problems. The problems will be either from the textbook (more likely) or given in handouts. Note that daily quizzes and participation are a significant part of the

course grade. One of the most important and useful skills that you can pick up in a math class is to learn how to *read a math book*. Reading math is difficult and, unlike some other types of reading, you have to constantly stop, think about the material, maybe write stuff on paper in order to figure things out for yourself, and, often, reread what you have already read to catch the subtle points. It is essential that you push yourself to read the text. Video lectures are provided as a supplementary resource. While doing homework problems you may need to read the relevant material again in the text and/or watch the relevant lesson.

Textbook Video Lectures: For most of the material that we will cover, in addition to the text, there will be video lectures covering the same material, and following the text closely. When watching the videos, you can slow down or speed up the pace, you can go back to re-watch confusing parts, and you can take breaks whenever you want to. As such, you may find learning from the videos “easier” than reading the text. However, you should not skip reading. Video lectures and readings are complementary, not identical. Questions on quizzes assume that you did both the reading and watching the videos. When the video says “pause and do some computation, then resume”, you should do so.

Written Homework Assignments: The only way to learn mathematics is by doing problems. *The one who does the work does the learning*. Homework sets will be assigned weekly and will be due at the beginning of the class. The details are available on the [course calendar page](#). You are encouraged to discuss problem concepts and solution techniques with your fellow students, but you need to write up solutions independently and what you submit as homework must be your own work. You are responsible to learn and follow [Math Department’s guidelines on collaboration on Homework](#). Homework solutions should be legible and presented in a logical fashion, with problem number clearly indicated. Messy work that is difficult to follow may receive no credit. You should often accompany your mathematical work with explanations and ideas written in complete sentences. Excellent performance on written homework is perhaps the most important indicator of success in this course. The payback from hours of hard work on homework assignments will be a deeper understanding of combinatorics and, ultimately, the likelihood of a high grade in the course.

Exams and Papers: There will be two midterm examinations. The first one is scheduled for Thu, February 27 (week 7), and it will be in-class. The second exam will be a take-home and will be given in week 12. Instead of a final examination, there will be a final project with two components: a paper and a presentation. Every student in class will present their final project during the last week of class, and the final paper will be due at the official final exam time for this course, which is Monday, May 5 at 9:30 pm. More details, guidance, and a timeline on the final project are available on [this page](#). Additionally, there will be a smaller writing project that will be assigned right after the spring break.

Late and Make-up Policy: All assignments must be turned in at the beginning of the class period on the assigned due date, unless specified otherwise by the instructor. There will be no make-up for daily quizzes. Several low quiz scores will be dropped at the end of the semester. For weekly homework assignments, each student will be allowed one “free” 24-hour extensions on homework assignments; no reasons need to be provided. Simply email the professor in advance of the due date to say you’d like to use your one-time extension. After that, late homework will not be accepted. For the midterm exam, a make-up can only be granted with an official notice from one of the deans (the dean of academics or the dean of students).

Attendance, Engagement and Tardiness: Active participation in class activities as part of your group is critical for your success in this course. You should be FULLY engaged and committed for your own learning. Hence, coming to class every day is critical. Being late to the class is disruptive. Each unexcused absence will lower your participation grade by 7%. According to [Math Dept’s Class Attendance Policy](#), a total of 6 absences (whether excused or not) will result in expulsion from the course. Tardiness and walking out of the classroom are distracting for everyone. Unless there is a real emergency, please do not leave the classroom before the class is over. Two tardiness or leaving the room during the class will count as an unexcused absence.

Academic Honesty and Generative AI: The [rules set forth in the 2024-2025 Course Catalog](#) apply to all aspects of this course. Any work submitted for credit must result directly from your own understanding, thoughts, and ideas. Presenting the work of others as your own is strictly prohibited. You must follow the guidelines given in this document in general and [Math Department’s guidelines for written homework](#) in particular. Though collaboration is encouraged, you must write your solutions independently. Everything you turn in for grade must be your own work and must reflect your true understanding. Using chatGPT or other generative AI tools is strictly prohibited for any of the assignments or exams in this course. There are many reasons behind this policy most important of which being to promote your own understanding and critical thinking. Any violation of this policy will be reported as an academic infraction. If you have any questions, please ask your professor for clarification.

Inclusivity: Demonstrating respect for each other is central to including all members of our class. While this respect can be shown in many ways, I highlight a few here.

- Students will be invited to share their names and pronouns in class, and it is expected that class members will use these self-disclosed identifiers.
- We will refrain from eating and drinking in the classroom.
- During the group work, class discussions and presentations, we will be respectful in addressing other people and their work. Respectful and constructive criticism of work is essential to the learning process and growth.

If you are facing an unsafe or hostile environment in our class in any way, please let me know as soon as is comfortably possible.

Accessibility and Accommodations: Students who anticipate they may need accommodations in this course because of the impact of a learning, physical, or psychological disability are encouraged to meet with me privately early in the semester to discuss their concerns. In addition, students must contact [Student Accessibility and Support Services](#) (SASS) (740-427-5041 or sass@kenyon.edu), as soon as possible, to verify their eligibility for reasonable academic accommodations. Though I am happy to help you in any way I can, I cannot make any special accommodations without proper authorization from the SASS staff. Except in extraordinary circumstances (and at the very start of the course), accommodations must be certified and discussed with me at least one week before they are to take effect.

Non-Discrimination, Civil Rights and Title IX Compliance

Kenyon College does not discriminate in its educational programs and activities on the basis of race, color, national origin, ancestry, sex, gender, gender identity, gender expression, sexual orientation, disability, age, religion, medical condition, veteran status, marital status, genetic information, or any other characteristic protected by institutional policy or state, local, or federal law. The requirement of non-discrimination in educational programs and activities extends to employment and admission. As a faculty member, I am deeply invested in the well-being of each student I teach. I am here to assist you with your work in this course. If you come to me with non-course-related concerns, I will do my best to help. However, it is important for you to know that *all faculty, are considered Mandated Reporters* of any incidents of harassment, discrimination, and intimate partner violence and stalking. Meaning, I must report any such discussion to the Civil Rights/Title IX coordinator. I cannot keep information involving sexual harassment, sexual misconduct, interpersonal violence, or any other form of harassment or discrimination based on a protected characteristic, confidential. The Health and Counseling Center, the College chaplains, and the staff at New Directions Domestic Abuse Shelter & Rape Crisis Center are confidential resources. For further information, please refer to the following Kenyon College policies: [Discrimination, Sexual Misconduct & Harassment](#); Title IX, VAWA [Civil Rights Policy ADA & Section 504 Student Grievance Procedures](#)

Class Norms

- We are a community of learners and we help and support each other
- We are fully present and fully engaged
- Everyone should speak. Do not be shy to speak
- We are respectful of each other
- We offer friendly and constructive criticism
- Everyone has something to learn
- Everyone has expertise to offer
- Asking questions is essential for the learning process
- No human being is absolutely correct on all matters at all times (this certainly includes your professors)
- Not questioning an incorrect or invalid solution/argument is not helpful for anyone

How to Study for this Class

- Regular work and genuine engagement in the material are the most important aspects of deep learning in any math class.
- Read the assigned sections from textbook and watch the accompanying video, when there is one available, BEFORE the class. When the video says “pause and do some computation, then resume”, you should do so. You may not understand everything in the first reading but that’s OK. Do your best. Take notes to ask questions in class.
- Come to the class and actively participate in problem solving other class activities and discussions. Do not hesitate to ask and answer questions, or contribute to class discussions in other ways. Daily quizzes and presentation of problems in class are significant part of your grade.
- Start doing homework problems early. Do not wait until the last minute.
- Do homework problems regularly. Do a few problems every day instead of trying to do everything the last night.

- If you have any questions, some see Prof. Aydin during the regular office hours (no appointment needed) or make an appointment. See [Prof Aydin's weekly schedule](#) to find a mutually convenient time.
- You are welcome to chat with Professor Aydin for matters outside the course content as well.
- Form study groups. Research shows studying in groups is really beneficial. BUT make sure that you write your own solutions independently at the end. Follow [Math Dept's guidelines](#) on healthy collaboration.

Book Recommendation on Learning and Study Habits

The New Science of Learning: How to Learn in Harmony With Your Brain, by T. Doyle, and T. Zakrajsek
<http://www.goodreads.com/book/show/17783567-the-new-science-of-learning>

The 5 Elements of Effective Thinking, by E. B. Burger, and M. Starbird
http://www.goodreads.com/book/show/14891980-the-5-elements-of-effective-thinking#other_reviews