Math 301: Combinatorics

Course: 21-301: Combinatorics
Instructor: Michael Tait
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Material Covered: The course will explore topics in enumeration, probabilistic methods in graph theory, extremal graph theory, and algebraic methods in combinatorics. The course will look roughly like the following:

- First principles of counting, bijections, binomial coefficients, estimation, inclusion-exclusion.

- Basics of graph theory

- First exam

- Extremal graph theory: Math competition inequalities, Turán's theorem, degenerate Turán problems, lower bounds from geometry.

- Ramsey theory.

- Second exam

- Probabilistic methods: First and second moment method, Lovász Local Lemma, Chernoff Bound, martingales, applications in graph theory.

- Linear algebra in combinatorics: Even/odd town problem, Erdős-Ko-Rado theorem, sets with few distances, combinatorial nullstellensatz

- Third exam

Textbook: I will pull material from several textbooks, including

- *Applied Combinatorics* by Keller and Trotter

- *Invitation to Discrete Mathematics* by Matoušek and Nešetril

- *A Course in Enumeration* by Aigner

- *The Probabilistic Method* by Alon and Spencer

- *Linear Algebra Methods in Combinatorics* by Babai and Frankl

- *Graph Theory with Applications* by Bondy and Murty

- *A Walk Through Combinatorics* by Bóna

I am also available by email. If you want to make an appointment with me I will do my best to accomodate your schedule. You will increase your chances of being able to meet with me by giving me advanced notice (more than 24 hours) and by trying to schedule with me MWF in the mornings or directly after lecture.

I have also placed *A first course in graph theory and combinatorics* by Cioabă and Murty on reserve in the library.

Homework: Homework is required to be typed. I recommend using LaTeX; please ask me if you need help figuring out how to do this. If you need to draw a figure in your homework, feel free to hand draw it and scan it in to your homework document.

Collaboration on homework is allowed but discouraged, especially at first. I recommend that you try all of the problems yourself before seeking help. However, if you are stuck on a problem, by all means ask me or another student. You must note on your homework anyone you collaborated with or any outside materials that were used (you will not be penalized for any reasonable amount of collaboration).

The best way to learn mathematics is by *doing mathematics*. This means that you should expect to spend several hours per week solving homework problems and doing practice exercises. There will be weekly homework that is graded and I will also suggest problems from the texts that you should know how to solve but do not need to write.

Pop Quizzes: I will give 5 minute pop quizzes that are based on homework material throughout the semester.

Grades: Your cumulative average will be the following weighted average

- 50% Homework and quizzes (the lowest 2 of each will be dropped)

- 20% best 2 exams

- 10% worst exam

After your weighted average is calculated, letter grades will be assigned based on the standard grading scale:

A	A-	B+	B	B-	C+	C	C-
93	90	87	83	80	77	73	70

I may adjust the above scale to be more lenient (depending on the overall class performance) but guarantee that I will not adjust the scale to make it harder to get a better grade. Please note:

Tips for success: First and most importantly, expect to spend at least 12 hours per week working for this course. If you spend enough time solving problems and reworking your notes, you will understand the concepts of the course. You should come to class prepared and eager to learn. I will let you know what we will be covering next, and you should skim over these sections before lecture. You will be surprised the difference that a 15 minute head start makes in how much you understand during a lecture. Plan to start your homework early, and that way you can ask me questions before it is due. I am always available by email, and this is the best way to get into contact with me. Mathematics can be very frustrating if you are lost and confused, but very exciting and fun if you are on top of things. I promise that you will enjoy this class more if you are doing well!