

Dear Students,

It has been a pleasure to teach you all this semester. I had taught many of you before but some of you I got to meet and teach for the first time which is always nice. You just saw the first glimpse of Combinatorics but I hope I could convey some aspects of the beauty of this subject - the surprise and elegance arising out of some very simple sounding counting problems.

I would consider this a successful course, if you gain confidence in your ability to read, understand, and write mathematical arguments, as compared to the beginning of the semester. And, you feel that you can read, understand, and apply any other topic/ technique in Combinatorics that you might need later on in your career. There is so much more to discover and learn in this oldest of mathematical topics - counting. We essentially reached the beginning of the 20th century in terms of development of Combinatorics, but this subject has exploded in the 20th century. I hope you have a strong foundation to build upon and learn these advanced topics in Combinatorics (and more generally in Discrete Math).

What next?

1) You can take courses at IIT that complement and supplement Math453: For example,

- Math 454 and Math 553: which introduce Graph Theory, the other important topic in Combinatorics, the mathematical structures that underlie Networks. Graph theory is the foundation of many fundamental methods in Algorithms, Machine Learning, and more in CS. I will be teaching Math 454 next semester.
- Math 554: which delves into Combinatorics of the last 50 years and how it uses ideas from Algebra, Analysis, Probability, Stochastic processes, Vector Spaces, and more to study challenging counting problems.

2) You can do some self study:

- Read later Chapters of the textbook, especially Sections 6.4 and 8.1-8.3.
- Read "A Course in Combinatorics" by Van Lint and Wilson. A quick and succinctly written run-through of many topics in Combinatorics.
- Read "Generatingfunctionology" by H. Wilf to learn more about Generating Functions. Available at <https://www.math.upenn.edu/~wilf/DownldGF.html>
- Read the book "Combinatorial Mathematics" by Douglas West, a comprehensive introduction to modern combinatorics.
- Read "Enumerative Combinatorics" (2 vols) by R. Stanley.

3) Have Fun :-)

- Read "Proofs from the BOOK" by Aigner and Ziegler (several editions up 6th), which has many chapters on beautiful combinatorics.
- Read and Do "Combinatorial Exercises" by L. Lovasz.

- Read relevant articles from the magazine Quanta:
<https://www.quantamagazine.org/tag/combinatorics>

And there is so so much more to explore and discover.
Don't hesitate to ask.

I am always available if you need any help learning mathematics at any time.

I hope to see you in my classes, or at least hear from you, in the future.

Related to this, I also want to dispel a notion many students have - that teachers only like or respect "A" students. Your teachers and mentors respect you as a person, not as a grade-producing blackbox. Majority of my past students who are still in touch with me, received grades like B,C,D, W, or even E. The point of saying this is that don't hesitate to ask your teachers for help regardless of what your grade or performance is. We do not know the circumstances of your life and your life's journey. We understand (and hopefully you do too) that the worth of a person does not come from their grade or money or any such extrinsic quality.

Our success is NOT measured by exams and grades, but by our individual progress on our own path to learning with understanding. Pursuit of knowledge, and learning with understanding gives us direction and can keep us calm and graceful under pressure of exams, projects, and such. I am purposefully using 'us' and 'our' here, because your teachers are fellow travelers on the same path; and wish for nothing more than you to join them on this journey.

Take care of yourselves.

best wishes,
Hemanshu