

# Course 18.312: Algebraic Combinatorics

## Syllabus

**Instructor:** Gregg Musiker, Office 2-336

**Meeting time:** MWF 1:00 - 2:00, in 2-135

**Office hours:** (TBA) This week - Wed 2:00-3:00 and Fri 11:00-12:00.

**Grader:** Thanasin Nampaisarn

**Course Webpage:** <http://math.mit.edu/~musiker/18-312.html>

**Course Content:** This course is an introductory course in algebraic combinatorics. No prior knowledge of combinatorics is expected, but I will assume a familiarity with linear algebra and finite groups. We will cover a number of topics chosen to show the beauty and power of techniques in algebraic combinatorics. Rigorous mathematical proofs are expected.

- Rational Generating Functions and Recurrence Relations
- Walks in Graphs and the Radon Transform
- Adjacency and Laplacian Matrices of Graphs
- Introduction to Posets and Sperner's Theorem
- Partitions and Euler's Pentagonal Theorem
- Young Diagrams and q-binomial coefficients
- Young Tableaux and Introduction to Schur functions
- Robinson-Schensted-Knuth Algorithm and Applications
- Polya Theory and Group actions on boolean algebras
- Matrix Tree Theorem, Spanning Trees, and Eulerian Digraphs
- Additional Course Topics, Time Permitting (Additional topics will depend on the background and interests of the students.)

**Recommended Texts:**

"Topics in Algebraic Combinatorics", by Richard Stanley

Notes available on the course website.

"Enumerative Combinatorics", volumes 1 and 2, by Richard Stanley

I will direct you to the relevant material as we cover the topics in this book.

**Homework (45%) :** Homework will be assigned and collected in class, typically every week. Homeworks due on Wednesdays. Your lowest homework score will be dropped.

**Exams (30%) :** There will be two exams during the semester on Friday March 13th and Friday April 17th.

**Research Project (25%) :** Possible topics for final projects will be distributed later. You will be expected to write a 5-10 page expository paper on a topic in algebraic combinatorics related to the course material. Final projects will be due May 11th.

**Participation:** Participation in class is encouraged. Please feel free to stop me and ask questions. Otherwise, I might stop and ask you questions.