Math 606: Topics in Discrete Mathematics
Fall 2006

Professor: Dan Singer
Office: Wissink Hall 263

Time and Place: Monday, Tuesday, Thursday, 11:00-11:50am, Trafton C310

Course Description: This course will be a comprehensive introduction to contemporary methods of algebraic combinatorics. Topics will include generating functions, recursive formulae, partitions, plane partitions, lattice paths, determinant evaluations, and basic hypergeometric series.

Textbook: *Proofs and Confirmations: The Story of the Alternating Sign Matrix Conjecture,* David M. Bressoud, 1999, Cambridge University Press.

Coverage: Chapters 1 through 7

Instructional Methods: Lectures, lecture notes, question and answer period, problems worked out by students in class, problems written up and submitted by students.

Grading Criteria: Exams 40%. Homework assignments 40%. Class presentations 20%. All assignments awarded on a 100 point scale. 90-100 points for A, 80-89 points for B, 70-79 points for C, 60-69 points for D, 0-59 points for F.

Tentative Schedule:

Weeks 1 and 2
Chapter 1: The Conjecture
Section 1.1: How many are there?
Section 1.2: Connections to plane partitions
Section 1.3: Descending plane partitions

Weeks 3 and 4
Chapter 2: Fundamental Structures
Section 2.1: Generating functions
Section 2.2: Partitions
Section 2.3: Recursive Formulae
Section 2.4: Determinants
Exam 1

Weeks 5, 6, 7
Chapter 3: Lattice Paths and Plane Partitions
Section 3.1: Lattice paths
Section 3.2: Inversion numbers

Section 3.3: Plane partitions
Section 3.4: Cyclically symmetric plane partitions
Section 3.5: Dodgson's algorithm
Exam 2

Weeks 8 and 9
Chapter 4: Symmetric Functions
Section 4.1: Schur Functions
Section 4.2: Semistandard tableaux
Section 4.3: Proof of the MacMahon conjecture

Weeks 10 and 11
Chapter 5: Hypergeometric Series
Section 5.1: Mills, Robbins, and Rumsey's bright idea
Section 5.2: Identities for hypergeometric series
Section 5.3: Proof of the Macdonald conjecture
Exam 3

Weeks 12 and 13
Chapter 6: Explorations
Section 6.1: Charting the territory
Section 6.2: Totally symmetric self-complementary plane partitions
Section 6.3: Proof of the ASM conjecture

Weeks 14, 15, 16
Chapter 7: Square Ice
Section 7.1: Insights from statistical mechanics
Section 7.2: Baxter's triangle-to-triangle relation
Section 7.4: Forward
Exam 4

Exam 4 will be given during finals week, Friday, December 15, 10:15 a.m. - 12:15 p.m.