Math 614 Enumerative Combinatorics Spring 2012

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Lectures MWF noon, CB 347
Office Hours: By appointment
http://www.math.uky.edu/~readdy/614

Text
Richard P. Stanley, *Enumerative Combinatorics. Vol. 1.* Second Edition, Cambridge Studies in Advanced Mathematics, 49, Cambridge University Press, Cambridge, 2011.

Prerequisite
Math 565 or permission of instructor.

Auditors
If you are sitting in on the course, you must register as an auditor for the course. Anyone who is not registered for the course, either for credit or as an auditor, will be asked to leave.

Material
An introduction to the basic notions and techniques in enumerative combinatorics. Topics include generating functions, principle of inclusion and exclusion, bijections, recurrence relations, partially ordered sets, the Möbius function and Möbius algebra, Lagrange inversion formula, the exponential formula and tree enumeration.

The material has applications to active areas of research including polytopal theory, hyperplane arrangements, computational commutative algebra, representation theory, symmetric functions, Coxeter groups and topology.

This is the second semester course in the Discrete Mathematics prelim sequence.

Course Outline

I. Generating Functions.
II. Stirling Numbers of the First and Second Kind.
III. Permutations and Permutation Statistics.
IV. q-analogues.
V. The Twelvefold Way.
VI. Principle of Inclusion-Exclusion.
VII. Partially Ordered Sets and Lattices.
VIII. The Fundamental Theorem of Distributive Lattices.
IX. The Incidence Algebra.
X. The Möbius Inversion Formula.
XI. The Möbius Function and Computational Techniques.
XII. The Möbius Algebra.
XIII. Semi-modular Lattices and Hyperplane Arrangements.

XIV. The Zeta Polynomial.
XV. Rank-selection.
XVI. R-labelings.
XVII. Eulerian Posets.
XVIII. Exponential Generating Functions.*
XIX. The Exponential Formula.*
XX. Tree Enumeration.*
XXI. Lagrange Inversion Formula.*
XXII. Other topics (symmetric chain decomposition, symmetric functions, ..), as time permits.

* Chapter 5 in EC II.

Homework
One problem will be posed during each lecture and is due at the start of the next lecture. No late homework will be accepted. Solutions should be written in complete sentences using correct English grammar and spelling, such as you would find in a mathematics textbook or journal article.

Students are encouraged to discuss homework problems and the course material with each other. You should not, however, discuss the homework with anyone outside of the class. The solutions you submit to be graded should be written in your own words. If you have worked with someone on a particular problem or problems, this should be indicated in your write-up.

Midterm and Final Exams
The date of the midterm (in-class) will be announced two weeks before. The final exam will be a take-home final and will be due during finals week. The final exam is cumulative.

Grading
Your course grade will be a weighted average of the letter grades on your homework, midterm and final exam. The distribution is as follows:

40% Homework
25% Midterm
35% Final Exam

Absences from class lectures will have a negative effect on your overall course grade. Each unexcused absence will result in a 2% reduction of your final course grade.

References on Reserve
R. P. Stanley, *Enumerative Combinatorics, Vol. 1,* Cambridge University Press, Cambridge, 1997.

R. P. Stanley, *Enumerative Combinatorics, Vol. 2,* Cambridge Studies in Advanced Mathematics, 62. Cambridge University Press, Cambridge, 1999.

J. H. van Lint and R. M. Wilson, *A course in combinatorics,* Second edition. Cambridge University Press, Cambridge, 2001.

Herbert S. Wilf, *Generatingfunctionology,* Second edition. Academic Press, Inc., Boston, MA, 1994.