

**MATH 582D**  
**Root Systems, Weyl Groups and Coxeter Groups**

Sara Billey

Winter 2009

Monday/Wednesday/Friday 11:30

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Root systems, Weyl groups, affine Weyl groups, Coxeter groups, invariant theory, and Kazhdan-Lusztig polynomials appear at the intersection between combinatorics, discrete geometry and representation theory. These topics are beautifully described in the proposed text book (see below) and are very relevant to current research. The goal of this course is to introduce students to the basic material in this area and connect with some of the current open problems.

This would be a one quarter course intended for first year graduate students or beyond. No combinatorics or representation theory is required. Therefore, an advanced undergraduate could also benefit from this course. Students taking Lie algebras during fall quarter will see how this topic grows out of that theory.

Outline:

1. Root systems and finite reflection groups
2. Classification of finite reflection groups using Dynkin diagrams/ Coxeter graphs.
3. Affine Weyl groups
4. Polynomial invariants of finite reflection groups
5. Kazhdan-Lusztig polynomials
6. Pattern avoidance in Coxeter groups
7. Chip firing games on Coxeter groups.
8. Open problems.

**Texts:** "Reflection Groups and Coxeter Groups" by James Humphreys.

**Prerequisites:** Math 402/3/4 (Undergraduate Algebra) or equivalent.

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