

Math 206A: Posets and Related Topics

Fall 2026

MWF 2:00–2:50 pm, MS 5127

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Course Description. Partially ordered sets (posets) are fundamental structures in combinatorics. We will study the basic structural and enumerative theory of finite posets, with an emphasis on chains and antichains and connections to hyperplane arrangements, bipartite matchings, and matroids. The rough plan is:

posets $\longrightarrow$ chains and antichains $\longrightarrow$ matchings $\longrightarrow$ transversal matroids.

Prerequisites. Undergraduate combinatorics and linear algebra. Familiarity with Math 180 and 184.

Topics.

1. Basic poset theory: chains, antichains, order ideals, and linear extensions.
2. Lattices and Birkhoff's theorem.
3. Möbius inversion and incidence algebras.
4. Applications to hyperplane arrangements: characteristic polynomials and the finite field method.
5. Ranked posets, q -analogues, and Sperner theory.
6. Extremal properties of chains and antichains: Dilworth's theorem and the Greene–Kleitman theorem.
7. Bipartite matchings: Hall's and König's theorems.
8. Matroid basics; chromatic polynomials and Tutte polynomials of graphs and matroids.
9. Transversal matroids and Rado's theorem.

References.

- R. P. Stanley, *Enumerative Combinatorics, Vol. 1*, Chapter 3.
- D. B. West, *Combinatorial Mathematics*, Chapter 12 and Section 6.1.
- J. Oxley, *Matroid Theory*, 2nd ed., Sections 1.1–1.4, 1.6–1.8, and 11.2.
- R. P. Stanley, *An Introduction to Hyperplane Arrangements*