

Combinatorics V63.0240, Spring 2009.

Instructor: Dr. Ron Peled.

Syllabus

Text: Introductory Combinatorics / Richard A. Brualdi. 5'th edition.

Prerequisite: V63.0122 Calculus II with a grade of C or better and/or the equivalent.

1. Introduction: What is combinatorics? Magic squares and cubes, Perfect covers of chessboards, the four color theorem.
2. Permutations and Combinations.
3. The pigeonhole principle (including applications to Erdos-Szekeres sequences, the Dirichlet approximation theorem and to Ramsey theory).
4. Properties of Binomial coefficients.
5. The inclusion-exclusion principle and applications.
6. Recurrence relations and generating functions. Combinatorial identities.
7. Special counting sequences (including Catalan numbers, Stirling numbers and Partition numbers).
8. Systems of distinct representatives (Hall's marriage theorem) and stable marriages (Gale-Shapley algorithm).
9. Introduction to Graph theory (including Eulerian paths, Hamiltonian paths, trees and Cayley's formula, chromatic number of graphs, planar graphs - statement of 4 color theorem and proof of 5-color theorem).
10. Digraphs and networks (including the Ford-Fulkerson Max flow - Min cut theorem).
11. Counting in the presence of symmetry - Burnside's theorem.

We will cover as much of the above outline as time will permit.