

**MATHEMATICS 126  
COMBINATORICS**

**Text:** *Applied Combinatorics*, by Fred S. Roberts.

A continuation of Math 111, covering more advanced techniques for discrete mathematics.

**TOPICS**

**SUGGESTED NO. OF  
50 MIN. CLASSES**

What is combinatorics? (Chapter 1).....1 Historical background. The study of finite mathematical structures, particularly problems of existence (construction), enumeration and optimization. The gateway between classical mathematics and science & technology.	1
Review of basic enumeration (Chapter 2).....1 Rules of Sum & Product, permutations & combinations, the binomial theorem, Pascal's triangle.	1
Advanced problems (Chapter 3).....3  Admissible colorings of a graph, chromatic polynomials, partitions of sets and integers, the number of placements of $m$ balls into $n$ cells, with indistinguishable balls and/or indistinguishable cells, the eight-fold way, "statistics" of physics.	3
Recurrence equations (Chapter 5).....3 Basic definitions and examples, characteristic equations & roots, general solution of a linear, $n^{\text{th}}$ order recurrence with constant coefficients, formula for Sterling numbers of the $2^{\text{nd}}$ kind.	3
Generating functions (Chapter 4).....5 Basic definitions and examples, Cauchy product, solutions of nonhomogeneous linear recurrences, derangements, applications to probability theory, the DeMoivre-Laplace theorem, Dubinski's formula for the Bell numbers.	5
The principle of inclusion and exclusion(Chapter 6).....4 Sieve of Aristothenes, derangements revisited, a formula for exactly $m$ of $n$ properties, the Erdos-Lehner theorem.	4
Polya theory (Chapter 7).....6 Permutation groups, equivalence classes under a group action, Burnside's lemma, induced actions of a group, the cycle index, Polya's theorem.	6
Ramsey Theory (Chapter 8).....4 The Pigeonhole principle, Ramsey's theorem and its generalizations, applications of Ramsey's theorem.	4