

## Combinatorics

**Department:** MATH

**Course Number:** 7016

**Hours - Lecture:** 3

**Hours - Lab:** 0

**Hours - Recitation:** 0

**Hours - Total Credit:** 3

**Typical Scheduling:** Every odd spring

**Description:**

Fundamental combinatorial structures including hypergraphs, transversal sets, colorings, Sperner families, intersecting families, packings and coverings, perfect graphs, and Ramsey theory. Algebraic and topological methods, applications

**Prerequisites:**

[Math 4022](#) or consent of the School

**Course Text:**

No text

**Topic Outline:**

Ramsey Theory - Ramsey's theorem (finite and infinite), Ramsey numbers, lower and upper bounds, graph Ramsey theory, Erdős-Szekeres' theorem, van der Waerden's theorem, Hales-Jewett's theorem

Hypergraphs - Sperner families, the Littlewood-Offord problem, Kruskal-Katona's theorem, intersecting hypergraphs (Erdős-Ko-Rado's theorem), saturated hypergraphs

Packing and Covering - The Chinese postman problem, Seymour's theorem and application to multicommodity flows, Lucchesi-Younger's theorem, introduction to polyhedral combinatorics

Colorings - Rado's selection lemma (compactness principle), graphs with large girth and chromatic number, algebraic approach to coloring, choosability, edge-colorings, perfect graphs

Topological Methods - The necklace problem, the chromatic number of Kneser graphs, Gyori's theorem

Matroid Theory - Axiom systems of a matroid, examples, Rado's theorem, matroid intersection, regular matroids and totally unimodular matrices