

Course: Math 8803 (Algebraic Methods in Combinatorics) Spring '10

- **Instructor:** Asaf Shapira
- **Time/Location:** ????, Tuesday/Thursday 13:30-15:00
- **Office hour and location:** Skiles 262, Tuesday/Thursday 13:30-14:30
- **Contact info:** asafico-at-math.gatech.edu
- **Prerequisites:** Math 4032 or Math 4022 or consent of School

Suggested Textbooks:

- *Linear algebra methods in combinatorics*, by L. Babai and P. Frankl, Department of Computer Science, University of Chicago, preliminary version, 1992.
- *Extremal Combinatorics with Applications in Computer Science*, by S. Jukna (Springer 2001).
- Several other more recent papers.

Course Objective: Algebraic methods have been used extensively in the last 3 decades in solving several long standing open problems like the Chromatic number of K^n and the Borsuk Conjecture. This course will provide a gentle introduction to these Algebraic methods, illustrated by examples and focusing on basic ideas and connections to other areas like Geometry and Theoretical Computer Science.

Tentative List of Topics:

- Basic dimension arguments.
- Spaces of polynomials.
- Eigenvalues of graphs and their application.
- The Combinatorial Nullstellensatz and the Chevalley-Warning theorem.
- Applications such as: Solution of Kakeya problem in finite fields, counterexample to Borsuk's conjecture, chromatic number of the unit distance graph of Euclidean space, explicit constructions of Ramsey graphs, Ray-Chaudhuri-Wilson Intersection Theorems, Explicit Constructions of Expanders.

General grading policy : Homeworks 100%

Homeworks will be assigned, collected and graded on a regular basis. You are strongly advised to (attempt to) solve all the homework problems. You are allowed to discuss your homework assignments with other students, but you are required to write the solutions on your own. In other words, you are **not** allowed to copy another student's solution.

Late submission of HWs is discouraged with a penalty of 20%.

Suggestions:

- Please feel free to ask questions at any time: before, after or during the class.

- Please make use of my office hours.
- Class participation and discussion is highly encouraged.

Academic Dishonesty: All students are expected to comply with the Georgia Tech Honor Code. Any evidence of cheating or other violations of the Georgia Tech Honor Code will be submitted directly to the Dean of Students. The institute honor code is available at <http://www.deanofstudents.gatech.edu/Honor/honorcode.txt>