BASIC COMBINATORICS

Michael Krivelevich

Course number: 0366.3036.01
When and where: Mon. 15-16, Kaplun 319; Wed. 12-14, Schreiber 006.
Prospective audience: the course is intended for second and third year undergraduate students in Mathematics or Mathematics and Computer Science.
Prerequisites: first year courses in mathematics, most notably Discrete Mathematics.

Syllabus

1. Binomial coefficients and their properties. Binomial theorem. Catalan numbers and their interpretations.
2. Twelvefold way: number of functions from $[k]$ to $[n]$ satisfying certain restrictions. Stirling numbers of the first and of the second kind. Partitions and Bell numbers. Partitions of integers, Ferrers diagrams.
3. Partially ordered sets. Dilworth theorem. Lattices. Distributive and Boolean lattices. Möbius functions.
4. Designs. Latin squares. Block designs, constructions.
5. Systems of distinct representatives. Hall's theorem and its applications. Stable marriages.
6. Ramsey theory. Theorems of Ramsey and of Erdős-Szekeres. Ramsey numbers. Applications.
7. Extremal set theory. Theorems of Sperner, of Erdős-Ko-Rado, set pair systems.
8. Methods: probabilistic method, applications of linear algebra, topological methods.

Bibliography

1. K. Bogart, Introductory Combinatorics, 3^{rd} edition, Academic Press, 2000.
2. R. Brualdi, Introductory Combinatorics, 3^{rd} edition, Prentice Hall, 1999.
3. J. H. van Lint and R. M. Wilson, A Course in Combinatorics, Cambridge University Press, 1992.
4. L. Lovász, Combinatorial Problems and Exercises, 2^{nd} edition, North-Holland, 1993.