Course: Math 4032 (Combinatorial Analysis) Spring 2013

Instructor : Prasad Tetali, office: Skiles 234, email: tetali@math.gatech.edu
Office Hours: Wed. Fri. 1:00 − 2:00 pm; Thurs. 2:00 − 3:00 pm

Course Outline:

Suggested Text books:
(**1**) *Extremal Combinatorics : with applications in computer science*, by Stasys Jukna (Springer 2001). (**2**) *Combinatorics: Topics, Techniques, Algorithms* by Peter Cameron, (Cambridge University Press, 1996 (reprinted)).

Another good source: (**3**) *A Course in Combinatorics,*, by J.H. van Lint and R.M.Wilson. Cambridge University Press (Second Edition, 2001).

Course Objective.
• Introduction to advanced topics in combinatorics; to demonstrate the strength (and joy) of combinatorics when used in conjunction with other branches of mathematics such as analysis, probability and algebra/linear algebra.

Topics include the following: Most topics will be discussed for about a week.
Revisiting
• Binomial coefficients, identities and estimates
• Pigeon-hole and Inclusion-Exclusion Principles
• Recurrence relations and Generating functions.
Introducing
• Extremal Combinatorics : Mantel, Turán theorems, Sperner's Theorem, Kruskal, Katona, Erdös-Ko-Rado etc., basic Ramsey theory
• The Probabilistic Method: first moment method, probabilistic proofs of Sperner's lemma etc.
• Linear algebraic methods : rank, dimension based arguments
• Enumerative combinatorics : Matrix-Tree theorem, de Bruijn sequences, Gessel-Viennot Lemma, hook-length formula
• Lattices and Mobius inversion
• Algebraic methods: Burnside lemma, Polya's theory of counting (under symmetries).
Miscellaneous topics including
• Permanents, (0,1)-matrices, Hadamard matrices and Reed-Muller codes, Projective and Combinatorial geometries, ...

Test 1: February 11th, **Test 2**: April 3rd, **Final exam**: April 29th (Mon.) 11:30–2:20pm.

No make-up tests will be allowed.
Homeworks will be assigned, collected and graded on a regular basis. You are strongly advised to (attempt to) solve all the homework problems. **Late submission of HWs suffer a penalty of 20%, and none are accepted after 3 days beyond a deadline!**

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.