Discrete Mathematics 21-228
Summer I, 2004 — MTWRF 1:30-2:50 — DH 2105

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Office Hours: MTWR, 3:00-3:50, PPB 342 (or by appointment)

Text: *Discrete Mathematics*, by Lovasz, Pelikan, and Vesztergombi
Course Website: http://www.math.cmu.edu/~doffner/teaching/228/index.html

Other Resources:
Books on reserve at the Engineering and Science Library:

- *Introductory Combinatorics*, by Richard A. Brualdi
- *Applied Combinatorics*, by Alan Tucker
- *A Textbook of Graph Theory*, by R. Balakrishnan and K. Ranganathan
- *Graph Theory*, by Russell Merris

On the Web:

- Alan Frieze's lecture notes from 2002:
  http://www.math.cmu.edu/~af1p/DM/DM.html
- David Pollard's lecture notes on probability:
  http://www.yale.edu/stat/pub/241.fall97/notes.html
- *generatingfunctionology*, and *East Side, West Side*, both by Herbert Wilf, both available at http://www.cis.upenn.edu/~wilf/

The **Prerequisite** for 21-228 is Concepts of Mathematics (21-127).

21-228 will introduce central ideas in the major areas of Discrete Mathematics: Enumeration, Discrete Probability and Graph Theory. The ideas studied are fundamental in all of mathematics, and have wide application in Computer Science, Operations Research, Computational Biology, and many other disciplines. Discrete Mathematics is an attractive subject in that many central questions can be easily stated and attacked, but yield surprisingly rich and elegant mathematical results (so this course should be a lot of fun!)

Outline of Schedule and Topics:
Week 1: Mathematical Preliminaries, and Basic Counting Techniques
Sets and Set Notation, Selection: Permutations and Combinations, Mathematical Induction, Asymptotic Notation (chapters 1,2)
Week 2-3: Enumeration and Advanced Counting Techniques
Pigeonhole Principle, Inclusion Exclusion, Binomial Coefficients, Pascal's Triangle, Stirling Numbers, Catalan Numbers, Recurrence Relations, Generating Functions (ch. 2-4)
Week 4: Discrete Probability

Independence, Random Variables, Conditional Probability, Expectation, Distributions (ch. 5)
Weeks 5-6: Graph Theory
Paths, Cycles, Connectivity, Trees, Optimization, Matchings and Hall's Theorem, Coloring, Planarity (ch. 7-10)

Homework will be assigned twice weekly, and is considered an important part of the course. Discussion of the assignments with anyone and everyone is encouraged, but all submitted work must be written independently. In particular, you are not permitted to see the actual pages that another student is submitting.

Tests: There will be four in-class exams (May 21, 28, June 11, 18), a 24-hour take-home midterm (June 4) and a 24-hour take-home final (June 25).

Grades: You may drop 1 test grade and 2 homework grades. Your grade will be determined by the following formula:
Homework: 20%, Midterm: 20%, Tests: 30%, Final: 30%

Suggestions for the Student:
(Logistics) This course will move quickly, as each period lasts 80 minutes, and the course meets five times per week. Thus it will behoove you to stay on top of the material, come to class on time, focused, and prepared to actively think about and do mathematics. Much of what we cover will not be in the textbook, so you will need to keep track of supplementary materials, and take clear notes.
(Discrete Mathematics) Many of the ideas we will discuss are beautiful in how elementary they are. One doesn't need to know much more than a few definitions and basic arithmetic to understand the solution to many interesting problems–the beauty (and difficulty) is in coming up with the "right" way to look at a problem, which can require considerable creativity. It may seem paradoxical, but in large part, this creativity comes from experience–from having seen these techniques applied to a variety of problems, and from having wrestled with many similar problems in the past. So my advice to you is this: You need to get your hands dirty. This will not be a course where you can succeed by simply memorizing the definitions and theorems, and following the examples in your notes and the text (though of course doing this will be quite helpful to you). You need to do the assigned problems carefully, and wrestle with them on your own (i.e. even if you are collaborating on a problem, do not cheat yourself out of the value of the problem by taking another person's solution before giving yourself a chance to honestly attack the problem yourself.). If you are stuck on a problem, allow yourself to sleep on it and look at it fresh the next day. You will surprise yourself with the ideas you come up with if you give yourself the chance to develop this creativity with your work over the course of the term.

Academic Honesty: The standards of academic honesty as stated in the Student Handbook will be strictly enforced.

Special Needs: If you require any special accommodations, please let me know well in advance.