

Math 345: Combinatorics

Spring Term 2009

Course Description

February 6, 2009

Instructor: John Schmitt

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My (and course) webpage: <http://community.middlebury.edu/~jschmitt/>

Office Hours: Monday 3-4 pm, Tuesday 10-11 am, Wednesday 3-4 pm, Friday 10-11, or by arrangement

Meeting Times:

Section A, MWF, 1:45-2:35 pm, Warner Hall 208

Textbook: *Introductory Combinatorics, Fifth Edition* by Richard Brualdi, Prentice Hall, NJ, 2008.

Supplemental Texts available in Starr Library

- *A Course in Combinatorics*, Van Lint and Wilson
- *Enumerative Combinatorics*, R. Stanley
- *Introductory Combinatorics*, K. Bogart
- There are many others.

Homework: Homework will be assigned on a weekly basis. The content of this course is best learned by *practicing problems*. I **encourage you to work together**. However, the write-up of homework solutions *should be done on your own*.

Quizzes: I reserve the right to give quizzes. If given, they will be short in length and cover recent homework problems, assigned reading, or class discussion.

Special Needs: If you require special arrangements for class or during tests/exams please talk to me as soon as possible to make such arrangements.

Grading Percentages:

Homework/Quizzes	25
Midterm 1	25
Midterm 2	25
Midterm 3 (Final)	25

Assignment of Grades:

The assignment of grades will follow the scheme below.

90 and above	A
80 - 89	B
70 - 79	C
60 -69	D
below 60	F

Plus and minus will be assigned at my discretion. (I reserve the right to curve upwards.)

Midterm Exams:

Tentative Schedule:

Thursday evening, March 12

Thursday evening, April 16

Final Exam:

Monday, May 18th, 2-5 pm

The final exam will be administered **at this time only**, please make plans accordingly.

Open problems:

Mathematics is a living subject. The point of life, according to Erdős, is “to prove and conjecture.” Therefore, anyone solving an unsolved problem in combinatorics (including graph theory) will automatically receive an A for the course. The problem must appear in a peer-reviewed mathematics publication (or approved website) and you must be “current” with all your work.

Approved websites include:

- <http://garden.irmacs.sfu.ca>
- <http://www.math.uiuc.edu/~west/openp/>
- http://www.dmoz.org/Science/Math/Combinatorics/Graph_Theory/Open_Problems/

Our author: The author of the text, Richard Brualdi, has a website

<http://http://www.math.wisc.edu/~brualdi/>, with a link for info and updates on our

text. Anyone finding a previously unreported typo or error in the text will receive 1 percentage point bonus on an exam.

Absences: Please see me as far in advance as possible for absences that will occur on the day of an exam. Any such absences, or unforeseen ones, must be documented in writing by the appropriate person.

Honor Code: The Honor Code will be observed throughout this class and for all examinations. Exams will be “closed notes, closed books,” unless otherwise noted. If you have a question about how the Honor Code applies to this class please ask. In particular, failure to comply with the homework policy (see above) will be considered a violation of the honor code.

Outline of Topics

1. Introductory Problems
Chessboard covers, magic squares, Euler's 36 officers, and others
2. Permutations and Combinations
Basic counting principles
3. The Pigeonhole Principle
Simple and strong form, and Ramsey's Theorem
4. Generating Permutations and Combinations
5. The Binomial Coefficients
Pascal's formula, the binomial theorem
6. Principle of Inclusion-Exclusion
7. Recurrence Relations and Generating Functions
8. Special Counting Sequences
Catalan and Stirling numbers
9. Combinatorial Designs
Block designs, triple systems and latin squares
10. Pólya Counting (if time permits)
Burnside's lemma, Pólya's counting formula

Goals of the Course

- Gain an understanding of the fundamental concepts of combinatorics.
- Gain an understanding of how counting arguments may be used within mathematics.
- Develop the ability to write a logical and coherent proof.
- Introduce topics suitable for a senior thesis.
- Develop a desire for further study in related areas, including graph theory and computer science.
- Gain an appreciation for combinatorial applications to the physical, biological and social sciences, etc.
- Appreciate the beauty and sophistication of combinatorial arguments.