

Math 345: Combinatorics  
Fall Term 2010  
Course Description

September 4, 2012

**Instructor:** John Schmitt

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

Office Hours: Monday 1:30-2:45pm, Tuesday 1:30-3pm, Friday 1:30-2:45pm, when my office door is open or by arrangement

**Meeting times:**

Section A, MWF, 10:10-11:00 am, Warner Hall 506

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

**Supplemental texts available in Davis Family 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*. Please see the accompanying “thoughts” on homework.

Also, beginning with the third homework assignment, you will need to have at least one problem from each assignment typeset using the mathematical typesetting tool L<sup>A</sup>T<sub>E</sub>X. In

asking this of you, I assume that as you are enrolled in this you have a future in the mathematical sciences. This tool is indispensable for such a future. L<sup>A</sup>T<sub>E</sub>X is available for the Mac via TeXShop, available for free download here, <http://pages.uoregon.edu/koch/texshop/>. For those with a PC, MikTeX and TexnicCenter are available from the following locations <http://miktex.org/2.9/setup> and <http://www.texniccenter.org/resources/downloads/29>.

**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. Also, please inform me if you are color-blind as the use of colors can be an important part of a lecture.

**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 determined at the end of the semester.

**Midterm exam schedule:**

Thursday evening, October 11, 7–9pm

Thursday evening, November 15, 7–9pm

**Final exam:**

Tuesday, December 11, 9am–12pm

This is the only time the exam will be administered, please make plans accordingly.

**Open problems:**

Mathematics is a living subject. According to the celebrated mathematician Paul Erdős, the point of life 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/](http://www.dmoz.org/Science/Math/Combinatorics/Graph_Theory/Open_Problems/)

**Our textbook author:** The author of the text, Richard Brualdi, has a website <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,
- have fun!