

<b>MA2273 COMBINATORICS Term D'14</b>
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Office Hours: Monday: 11:00am-Noon  
Tuesday: 3:00pm-4:00pm  
Friday: 10:00am-11:00am

**Peer Learning Assistants:** Stephen Peters: email: [stephen\\_peters@wpi.edu](mailto:stephen_peters@wpi.edu)  
Pitchaya Wiratchotisatian: email: [pwiratchotisatia@wpi.edu](mailto:pwiratchotisatia@wpi.edu)

**Text:** “Introductory Combinatorics”, 5<sup>th</sup> edition, by Richard A. Brualdi, published by Prentice Hall, available also as an electronic textbook at WPI bookstore or at [www.coursesmart.com](http://www.coursesmart.com). A copy of the text is on reserve at Gordon Library.

**Schedule:** Lecture: M, T, R, F: 9:00am-9:50am, GH227  
Review Session: W: 9:00am-9:50am, GH227 (Stephen)  
Group Study: R: 3:00pm-4:50pm, SH306 (Pitchaya)  
Math Tutoring Center, SH002: Stephen on Mondays 11-12; Pitchaya on Thursdays 10-11.

The Review Session and Group Study, while not officially scheduled, are intended to help you understand the syllabus problems and assignments. The Group Study is less formal than the Review Session, but you are encouraged to participate in either or both.

**About This Course:**

Combinatorics is a vast and growing area of mathematics with ongoing new discoveries and with a wide range of applicability. The main aim of this course is to improve our ability to analyze and solve problems. We will learn several fundamental concepts and techniques, and an important outcome will be the capacity to approach a given problem from several points of view. This course may be different from other mathematics courses because problem statements are ambiguous at times and solutions are not necessarily unique. In spite of this, it is hoped that this course will provide an opportunity for mathematical discovery and will rekindle an appreciation for the “fun” side of mathematics.

**Requirements:**

Three tests are scheduled on the syllabus, each accounting for 27% of your grade. The remaining 19% will be determined by special homework assignments and occasional quizzes. Tests may involve a take-home component which is to be done independently. On the other hand, working in pairs or triples is encouraged for homework assignments. Grades of A, B, C are guaranteed by final averages of 90, 80, 70 percent respectively, with adjustments for effort, attendance and class contribution.

**Academic Honesty:**

You are strongly encouraged to work together on syllabus problems and assignments. However, you are required to work independently on quizzes and tests, and possibly in other circumstances. This means that you are not allowed to compare results or have any form of communication with others about the test except possibly with the instructor, during the test period. Check with the instructor if you are not certain about what is allowed during tests. You are expected to be familiar with the WPI Academic Honesty Policy.

(See <http://www.wpi.edu/offices/policies/honesty>)

**Special Needs:**

If you have a disability or medical condition that requires special consideration, please let me know. Students in this situation should also contact the Office of Disability Services (ODS) located in the West Street House, 157 West St; 508-831-4908. Students who because of extraordinary circumstances, such as illness or religious reasons cannot meet a course requirement should notify me, preferably well in advance.

(See <http://www.wpi.edu/offices/disabilities.html>)

**Syllabus:**

As you know, mathematics is not a spectator sport, and it is best learned with lots of practice. The following exercises are recommended for you to achieve proficiency. Other topics may be added and some may be deleted. Be aware of changes in content and of possible changes in test dates. You have the responsibility of determining what material has been covered and emphasized, which syllabus problems to attempt and when. Do not wait until the end of each chapter to attempt these problems, but instead, try to work on problems on a daily basis. This will give you time to digest the material.

**Chapter 1      What is Combinatorics?**

- 1.2    Magic Squares
- 1.4    The Problem of the 36 Officers
- 1.8    Exercises p.20 3, 10, 15, 22, 40

**Chapter 2      Permutations and Combinatorics**

- 2.1    Four Basic Counting Principles
- 2.2    Permutations of Sets
- 2.3    Combinations of Sets
- 2.4.   Permutations of Multisets
- 2.5    Combinations of Multisets
- 2.6    Finite Probability
- 2.7    Exercises p.60 1, 3, 5, 8, 11, 13, 16, 17, 21, 30, 32, 36, 38, 39, 40, 41, 44, 45, 47, 56, 60

## Chapter 3 The Pigeonhole Principle

- 3.1 Pigeonhole Principle: Simple Form
- 3.2 Pigeonhole Principle: Strong Form
- 3.3 A Theorem of Ramsey
- 3.4 Exercises p.82 1, 4, 9, 10, 14, 15, 16, 17, 20, 21

## Chapter 5 The Binomial Coefficients

- 5.1 Pascal's Triangle
- 5.2 The Binomial Theorem
- 5.4 The Multinomial Theorem
- 5.5 Newton's Binomial Theorem
- 5.7 Exercises p.154 2, 3, 5, 6, 7, 8, 10, 11, 12, 15, 22, 23, 24, 26, 39, 40, 46

### ***Test 1 Monday, March 31***

## Chapter 6 The Inclusion-Exclusion Principle and Applications

- 6.1 The Inclusion-Exclusion Principle
- 6.2 Combinations with Repetition
- 6.3 Derangements
- 6.4 Permutations with Forbidden Positions
- 6.5 Another Forbidden Position Problem
- 6.7 Exercises p.198 1, 3, 4, 6, 7, 9, 11, 12, 15, 19, 21, 22, 24, 28, 32, 36

## Chapter 7 Recurrence Relations and Generating Functions

- 7.1 Some Number Sequences
- 7.2 Generating Functions
- 7.3 Exponential Generating Functions
- 7.4 Solving Linear Homogeneous Recurrence Relations
- 7.5 Nonhomogeneous Recurrence Relations
- 7.6 A Geometry Example
- 7.7 Exercises p.257 1, 4, 5, 8, 11, 12, 13b,e, 14d, 17, 18, 19, 22, 26, 27, 31, 33, 35, 38b, 43, 48a,c

### ***Test 2 Thursday, April 17***

## Chapter 8 Special Counting Sequences

- 8.1 Catalan Numbers
- 8.2 Difference Sequences and Stirling Numbers
- 8.3 Partition Numbers
- 8.4 A Geometric Problem

8.5 Lattice Paths and Schröder Numbers

8.6 Exercises p.315 1, 2, 6, 8, 11, 12a,c, 15, 16, 19, 36

## Chapter 10 Combinatorial Designs

10.1 Modular Arithmetic

10.2 Block Designs

10.3 Steiner Triple Systems

10.4 Latin Squares

10.5 Exercises p.388 3, 10, 19, 20, 21, 28, 31, 36, 42, 47, 48, 52, 55

***Test 3 Tuesday, May 6***