# Math 432
# Applied Combinatorics

4.0 Units, Spring 2018
MWF 12:00-12:50pm

**Location:** KAP 414

**Instructor:** Sami Assaf
**Office:** KAP 438-C
**Office Hrs:** Mondays 1-3pm
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## Course Description
This course surveys a variety of topics in combinatorics, beginning with basic counting techniques, e.g. Pigeonhole Principle, and elementary proof techniques, e.g. mathematical induction and counting in two ways. We apply these to basic enumeration of subsets, arrangements, and derangements. We develop advanced counting techniques of generating functions and solving recurrence relations. We study the basics of graph theory and algorithms on graphs, as well as probabilistic methods.

## Learning Objectives
Student will learn to count and develop mathematical maturity as they learn advanced counting techniques. By the end of the course, students should be proficient with basic enumeration questions and combinatorial algorithms and most will be adept at solving common "interview puzzles".

**Prerequisite(s):** MATH 225 or MATH 226 or MATH 227

## Course Notes
Homework, exam solutions, and lecture notes will be disseminated through Blackboard.

## Required Readings and Supplementary Materials
Required: Miklós Bóna, *A Walk Through Combinatorics*, 3rd edition.
Recommended: Donald Knuth, *The Art of Computer Programming, Volume 4A*

## Description and Assessment of Assignments
Students are expected to complete weekly problem sets that reinforce and expand on topics covered in lecture. There will be twelve problem sets each worth 20 possible points, and students receive full points for the term if they earn 200 total points. There will be two in-class midterm exams, on February 14 and April 4, and a final exam on Friday May 4 from 11am-1pm.

## Grading Breakdown

| Assignment | % of Grade |
|---|---|
| Homework (12 assignments) | 50% |
| Midterm I (Wed 2/14) | 12.5% |
| Midterm II (Wed 4/04) | 12.5% |
| Final Exam (Fri 5/04) | 25% |
| **TOTAL** | **100%** |

## Assignment Submission Policy
Homework is due in class on Wednesdays. Late homework will be penalized 10% per day.

## Course Schedule: A Weekly Breakdown

|          | Topics/Daily Activities      | Readings   | Deliverable/Due Dates   |
|----------|------------------------------|------------|-------------------------|
| **Week 1**   | Mathematical induction       | Ch 1 & 2   | Homework 1 (1/17)       |
| **Week 2**   | Elementary counting          | Ch 3       | Homework 2 (1/24)       |
| **Week 3**   | Binomial Theorem             | Ch 4       | Homework 3 (1/31)       |
| **Week 4**   | Partitions and permutations  | Ch 5 & 6   | Homework 4 (2/07)       |
| **Week 5**   | Sieve methods                | Ch 7       | Homework 5 (2/14)       |
| **Week 6**   | Review                       |            | Midterm 1 (2/14)        |
| **Week 7**   | Generating functions         | Ch 8       | Homework 6 (2/28)       |
| **Week 8**   | Graph theory                 | Ch 9       | Homework 7 (3/07)       |
| **Week 9**   | Matrix-Tree Theorem          | Ch 10      | Homework 8 (3/21)       |
| **Week 10**  | Matchings and colorings      | Ch 11      | Homework 9 (3/28)       |
| **Week 11**  | Ramsey theory                | Ch 13      | Homework 10 (4/04)      |
| **Week 12**  | Review                       |            | Midterm 2 (4/04)        |
| **Week 13**  | Combinatorial algorithms     | Ch 19      | Homework 11 (4/18)      |
| **Week 14**  | Complexity                   | Ch 20      | Homework 12 (4/25)      |
| **Week 15**  | Review                       |            |                         |
| **Final**    |                              |            | Final Exam (5/04)       |

## Statement on Academic Conduct and Support Systems

### Academic Conduct

Plagiarism  presenting someone elses ideas as your own, either verbatim or recast in your own words  is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu/ or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community  such as a friend, classmate, advisor, or faculty member  can help initiate the report, or can initiate the report on behalf of another person. The *Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

### Support Systems

A number of USCs schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The *Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu/ will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.