

Syllabus

MWF 11:00 – 11:50 a.m. (D13) and 12:00 – 12:50 p.m. (X13), 1LUMEB 3101

Text: Brualdi – Introductory Combinatorics (5th Edition)

Study section: Tuesday 8:00 – 10:00 a.m. (258/269 CAB).

Office hours: Tuesday 5:00 – 6:00 p.m. (258/269 CAB).

Office: 243 CAB. Email: lmattos@illinois.edu

Prerequisites: Prerequisite: MATH 347 or MATH 348 or equivalent experience.

Resources: Canvas is a medium for announcements.

The course webpage also can help: <https://lmattos.web.illinois.edu/math-413>

Exams: there are three midterms (evening 90 min exams, 100 points each) plus a final exam (200 points). The dates for the midterms are **September 18th, October 13th and November 6th at 7 p.m.**

Final exams:

D13: December 13th 8:00am– 11:00am

X13: December 15th 1:30pm–4:30pm

Homework: we will have weekly homework with 6 problems each. In total, there will be 11 of them and they will all have the same weight: 18 points. They will usually be announced every Wednesday morning, and the due dates will normally be Wednesdays before class. Our grader will randomly select 2 problems out of the 6 for correction. The point distribution is as follows: each problem chosen by the grader is worth 7 points and the remaining 4 problems are worth 1 point each, resulting in a total of 18 points. Please, submit your solutions in *gradescope*. The entry code is J3RRJ6. Failure in submitting your solutions into gradescope will be considered a late homework. See the late homework policy below.

Homework Expectations: all assignments being turned in must be clear, legible and well-organized. All work must be shown and well-explained; a final answer without supporting work and explanation may be worth nothing. All assignments must be turned in order. Failure to abide by the homework expectations may result in the homework not being accepted or only receiving partial credit. If two homework have identical solutions to a problem, both works are discarded. If you delay your homework in x days and j hours (with $x \leq 7$ and $j > 0$), then your score will be $(1 - (x + 1)/20) \cdot 18$ points. However, a late homework will be accepted at most twice during the semester from the same student. That is, your third late homework will receive 0 points. If there is official or medical reason then try to notify me in as soon as possible via e-mail.

Typing Homework: For each homework, additional 1 point will be added for typing it (no need to type pictures).

Requirements: homework has 198 points (plus up to 11 points in total for typing the assignments), tests 300 points and final exam 200 points. The total maximum is 709 points. The homework provides practice finding proofs and writing proofs; writing up the solutions is among the most effective ways of keeping up with the material in the course. The threshold for A+ is 90% of 698, for A is 85%, for A- is 80%, for B+ is 75%, for B is 70%, for B- is 65%, for C+ is 60%, for C is 55% points, for C- is 50%, etc.

LIST OF TOPICS:

Chapter 1. What is Combinatorics?

- Dominos and chess
- The game of Nim

Chapter 2. Permutations and Combinations

- Four basic counting principles - addition, multiplication, subtraction and division principles
- Permutations
- Circular permutations and combinations
- Binomial identities
- Combinations of multisets

Chapter 3. The Pigeonhole Principle

- Pigeonhole principle
- Stronger form of pigeonhole principle
- Ramsey theory

Chapter 5. The Binomial Coefficients

- Pascal's triangle and binomial theorem
- Unimodality of Binomial coefficients
- Sperner's theorem
- Multinomial coefficient
- Newton's binomial theorem

Chapter 6. The Inclusion–Exclusion Principle and Applications

- The Principle of inclusion and exclusion
- Derangements
- Permutations without forbidden fixed position
- Permutations without forbidden relative position

Chapter 7. Recurrence Relations and Generating Functions

- Fibonacci numbers
- Generating functions
- Exponential generating functions
- Homogeneous linear recurrence relations
- Nonhomogeneous recurrence relations

Chapter 8. Special Counting Sequences

- Catalan numbers
- Difference sequences and Stirling numbers
- Partition numbers