Math 280: Graph Theory
Instructor: David Zureick-Brown ("DZB")

All assignments
Last updated: June 16, 2024
Gradescope code: VD5BZK

Show all work for full credit!
Proofs should be written in full sentences whenever possible.

Contents

Assignment 1:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 2:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 3:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 4:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 5:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Midterm 1 study guide

In class on Thursday, Sept ??

Content: The questions will all be either

1. homework problems,
2. suggested problems,
3. problems we worked in class, or
4. minor variations of one of these.

Problems with very long proofs or that involved some unusual trick will not be on the exam.

You are allowed to use any previous problem from class or from the homework (e.g., "additivity of divisibility" or "the 2 out of 3 rule") on the exam without reproving it, unless otherwise noted on the exam. (E.g., if I ask you to prove "additivity of divisibility" on the exam, you will need to prove this using only the definition of divisibility, and I will remind you of this in the statement of the problem.)

A typical exam will have one or two questions from each week of the course and will cover **assignments 1-5**. You can expect problems about following:

- TBA.

Assignment 6:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 7:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 8:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 9:

*Due by **Friday**, 11:25am eastern, on Friday, April 19*

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: Due by **Friday**, 11:25am eastern, on Friday, April 19, via Gradescope (VD5BZK):

1. TBA

Midterm 2 study guide

In class on Tuesday, Sept ??

Content: The questions will all be either

1. Definitions,
2. homework problems,
3. suggested problems,
4. problems we worked in class, or
5. minor variations of one of these.

Problems with very long proofs or that involved some unusual trick will not be on the exam.

You are allowed to use any previous problem from class or from the homework (e.g., "additivity of divisibility" or "the 2 out of 3 rule") on the exam without reproving it, unless otherwise noted on the exam. (E.g., if I ask you to prove "additivity of divisibility" on the exam, you will need to prove this using only the definition of divisibility, and I will remind you of this in the statement of the problem.)

Assignment 10:

Due by 12:55pm, eastern, on Thursday (tentative), Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Assignment 11:

Due by 12:55pm, eastern, on Tuesday, Sept ??

Suggested readings for this problem set: TBA
All readings are from Harris, Hirst, and Mossinghoff, *Combinatorics and Graph Theory*.

Assignment: due Thursday (tentative), Sept ??, 12:55pm, via Gradescope (VD5BZK):

1. TBA

Final exam study guide

Final exam is **May 13**, 9-11am, in SMUD 014.

The **last day of class** is Tuesday, May 7.

There will be **office hours** before the exam. I will send out a survey to find a time that works for everyone who is planning to attend.

The final exam will be comprehensive.
The exam will be, roughly 8-10 questions, with multiple parts. Some questions will be "prove or disprove". For disproofs, please write out a counterexample as your disproof.

Content: The questions will all be either

1. Definitions,
2. homework problems,
3. suggested problems,
4. problems we worked in class, or
5. minor variations of one of these.

Problems with very long proofs or that involved some unusual trick will not be on the exam.

You are allowed to use any previous problem from class or from the homework (e.g., "additivity of divisibility" or "the 2 out of 3 rule") on the exam without reproving it, unless otherwise noted on the exam. (E.g., if I ask you to prove "additivity of divisibility" on the exam, you will need to prove this using only the definition of divisibility, and I will remind you of this in the statement of the problem.)

Some problems will be calculations, e.g., compute $2^{100} \mod 11$, or $\gcd(12345, 67890)$. Some will be proofs of basic properties (like additivity of transitivity of divisibility, or Euclid's lemma). Most of the problems won't be very long (e.g., I will not ask you to paramaterize pythagorean triples), but I might include one medium length proof (like the infinitude of primes).

A typical exam will have one or two questions from each week of the course (with more emphasis on material since the most recent exam). You can expect problems about (a subset of) the following:

- Definitions (e.g., the definition of a divides b)
- Divisibility
- GCD and LCM
- Euclidean Algorithm
- Linear Equations
- Prime numbers
- Modular arithmetic

- Modular linear equations
- Solving congruence equations
- Inverses
- Fermat's little theorem
- Euler's theorem
- Order
- $\phi(n)$
- Computations involving powers
- Fast squaring
- Polynomials mod p
- Wilson's theorem.
- Quadratic reciprocity
- Primitive roots

TWO problems will be to state and prove two of the following theorems from class (your choice):

- Infinitude of the primes.
- Linear equation theorem (about when the linear equation $ax = b \mod n$ has a solution, and how many solutionts it has).
- Linear combination theorem ($ax + by = n$ has a solution if and only if $n \mid \gcd(a, b)$).
- Fundamental Theorem of Arithmetic.
- Fermat's little theorem
- Euler's theorem
- Wilson's theorem.
- Chinese remainder theorem.
- Let $\gcd(a, n) = 1$. Prove that $a^k \equiv 1 \mod n$ if and only if $o_n(a) \mid k$.
- Prove that primitive roots don't exist mod n if $n = 4p$.
- Euler's formula for $\left(\frac{a}{p}\right)$.
- State formula for $\left(\frac{-1}{p}\right)$ (the one with two cases) and prove that it is correct.