



## MATH 232: Discrete Mathematics

Spring 2020

Mt. Holyoke College

### Course Information:

Lecture Times: MWF, 1:30–2:45 PM

Lecture Location: 401 Clapp Lab

### Instructor:

Nathan Gray

Office: 417 Clapp Lab

Office Hours: TBA

Email: ngray@mtHolyoke.edu

**Prerequisites:** Passing grades in either MATH 102 (or above) or COMSC 101/151 are required.

**Textbook (required):** *How to Prove It: A Structured Approach*, 3rd ed., Daniel J. Velleman, Cambridge University Press, 2019. We will spend the majority of the semester covering chapters 1–7 of this book. During the last portion of the semester, we will use another reference to discuss some additional topics.

**Course Description:** This course is somewhat two courses built into one: It is an introduction to the foundations of mathematics, and it is an introduction to discrete mathematics.

By “foundations of mathematics,” we mean those topics in mathematics that form the basic language of all areas of mathematics (e.g., sets, relations, functions/maps, properties of the integers). By “discrete mathematics,” we mean those topics in mathematics that are inherently *discrete* in nature as opposed to *continuous* (as seen in calculus and analysis). In a way, *this course is “life after calculus.”*

A central goal of the course is to understand how to read, understand, and write proofs of mathematical statements. Proof writing is the heart of mathematics. It is perhaps the defining quality of mathematics—that which separates mathematics from every other area of science.

We will begin by learning some basic elementary logic before working through several different proof techniques. Then we will spend some time studying relations, functions (or maps), mathematical induction, and some introductory concepts in elementary number theory. The topics covered here will help students throughout the rest of their mathematical careers. During the last few weeks of the semester, we will switch gears and study some basic topics seen in discrete mathematics (e.g., counting techniques, elementary discrete probability, introductory graph theory).

In summary, the course topics include: basic elementary logic (logical statements, logical connectives, truth tables, valid arguments, quantifiers, logical equivalences); set theory (sets, set operations, families of sets, operations of families of sets); proof techniques; relations (Cartesian products, relations, partial orders, equivalence relations, set partitions); functions (injective and surjective functions, invertibility, images and preimages); mathematical induction (examples, strong mathematical induction); basic elementary number theory (divisors, multiples, greatest common divisors, prime factorization, modular arithmetic). Time permitting, we will discuss: counting techniques and elementary discrete probability; introductory graph theory.

### Homework, Quizzes, Exams:

*Homework:* There will be (almost) weekly homework assignments. The two lowest homework grades will be dropped at the end of the semester.

Students are expected to complete the assignments on their own. However, collaboration with classmates *before the write-up* is acceptable and encouraged, as long as each student writes and submits their own work. Collaboration during the write-up stage of an assignment, or handing in an assignment that is identical to a fellow classmate's work, is cheating and may result in a grade of zero for the assignment.

*Quizzes:* There will be (almost) weekly in-class quizzes. Each quiz is closed-book and closed-notes, will be given on the same day that homework is due, and will be on the material covered in that homework (the quiz could feature problems directly from the assignment, or it could be as simple as asking students to state definitions). The lowest two quiz grades will be dropped at the end of the semester.

*Exams:* There will be two midterm exams (part in-class, part take-home) and a final exam (part self-scheduled, part take-home). Rules regarding the take-home portions will be announced in lecture. The dates of the exams are:

- Exam 1: Friday, Feb. 21
- Exam 2: Monday, Mar. 30
- Final Exam: Friday, May 1–Tuesday, May 5.

**Grading Policy:** Grades for every student are a reflection of the student's mastery of the course material and the student's ability to communicate that mastery through written work.

Course grades will be based on homework, quizzes, and exams. Table 1 gives the weights of these grade items. Students may check their grades on the course Moodle site throughout the semester. **Warning: The grades displayed on Moodle are raw scores.**

Earning 90%, 80%, and 70% of the total points in the course will result in course letter grades *no stricter than* A–, B–, and C–, respectively. The boundaries (cut-offs) between letter grades may be relaxed at the instructor's discretion, depending on the distribution of course numeric grades. This grading scheme rewards hard work, leaving little room for miraculous recovery.

**Table 1.** Course Grades

Category	Grade Basis	Weight (each)	Weight (total)
Homework	lowest two dropped		20%
Quizzes	lowest two dropped		15%
Exams (×2)		20%	40%
Final Exam		25%	25%

**Course Load:** Mt. Holyoke College complies with federal regulations defining a credit hour. For this course, MHC expects all students to have 12 hours per week of academic engaged time throughout the semester; besides lectures, this weekly time amounts to **9 hours of additional academic work**.

**Course Help:** Studying mathematics, especially in a proof-based course like this one, can be difficult. Here is some advice:

- Read the relevant material in the textbook *before* lecture. Try to read and understand every statement mentioned in all of the definitions, examples, and proofs. *Reread* the same material after lecture. Then begin the homework assignment.
- For every homework assignment, work on its problems *on your own* for the first few days that it is assigned. During this period, you should not be discussing the problems with others.

Once you have completed as much of the assignment as you can, spend the last day or two discussing with one or more classmates the problems or issues you are having so that you get some further help. During this “collaboration phase” of the homework, you are **not** allowed to copy solutions directly from classmates. Your solutions must be written in your own words.

Your goal is to understand and write out every homework problem.

- **Do not search for homework solutions online.** This creates a dangerous habit; it also violates the MHC Honor Code.
- Attend office hours.

**Schedule:** A tentative schedule can be found on the course Moodle site. Students should consult the schedule and read the relevant material *before* it is presented in lecture. The schedule will be updated frequently.

**Attendance, Make-Up Policy:** Students should understand the importance of attending lectures and doing the assigned work. Some remarks:

- When writing each assignment, quiz, and exam, the instructor will assume that every student has attended every lecture and has read all the relevant material from the textbook.
- A student who misses a lecture is responsible for any announcements made during that time, and they should consult a classmate to determine what they missed. The instructor will **ignore** emails that are of the form, “I had to miss class today. What did you cover?”
- Late homework is **not** accepted.
- A legitimate absence due to a recognized MHC-related activity, a religious holiday, a verifiable illness, or an emergency will be reviewed on an individual basis. If a student must miss an exam, they must obtain permission from the instructor in advance.

**Electronics/Technology Policy:** No electronic devices are allowed to be used for this course.

**Disability Accommodations:** Mt. Holyoke College is committed to providing equitable access to learning opportunities for all students. If you have a disability and seek accommodations, please make an appointment with the instructor within the first two weeks of the semester so that appropriate arrangements can be made; documentation from the AccessAbility Services Office is required. You can contact AccessAbility Services in Mary Lyon Hall, or at [accessability-services@mholyoke.edu](mailto:accessability-services@mholyoke.edu), or at (413) 538-2634.

**Scholastic Dishonesty:** This includes: cheating on exams or quizzes; taking or using past/present exam materials without instructor permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain grades dishonestly. **All students are expected to follow the Honor Code.** If it is determined that a student has cheated, they may be given a grade of F for the course and may face additional sanctions from MHC.