

MATH 31

Topics in Algebra

Fall 2026 • Department of Mathematics • Dartmouth College

Instructor	Haohua Deng	Lectures	MWF 10:10–11:15
Email	haohua.deng@dartmouth.edu	Room	Carson Hall L01
X-hour	Th 12:15–1:05	Office Hours	M 2:30–4:00, W 3:00–4:00 Kemeny 344, or by appt.
Canvas	Assignments & Announcements	Final	Nov. 20–25, time TBA

Course description

This course is an introduction to fundamental algebraic structures. The majority of the course consists of an introduction to groups and rings: the definition and first examples of groups, cyclic and permutation groups, cosets and Lagrange's theorem, isomorphisms and homomorphisms, normal subgroups and quotient groups, group actions and the Sylow theorems, and an introduction to rings, ideals and quotient rings.

A central goal of the course is to develop your ability to read and write rigorous proofs. For many of you this will be the first course where the main object of study is the argument itself rather than a computation, and the workload is structured around that shift.

Prerequisite: Math 22 or Math 24. Not open to students who have taken Math 71. Because of this course's variable syllabus, it may not serve as an adequate prerequisite for Math 81; students contemplating Math 81 should consider Math 71 instead.

Textbook

Abstract Algebra: Theory and Applications, by Thomas W. Judson with contributions by Robert A. Beezer. The book is open-source and freely available at <http://abstract.ups.edu/>. **There is nothing to purchase.** Section numbers in the schedule below refer to this text.

Grading

Your final grade has four components: **homework 20%**, **two midterm exams 25% each**, and the **final exam 30%**.

Midterm replacement. You are allowed to replace your lower midterm exam score by your final exam score if the latter is higher. This applies automatically — you do not need to ask.

Score	Grade	Score	Grade
≥ 92	A	[70, 75)	C+
[90, 92)	A-	[65, 70)	C
[85, 90)	B+	[60, 65)	C-
[80, 85)	B	[50, 60)	D
[75, 80)	B-	< 50	E

This table does not apply to students taking the course under the Non-Recording Option. An independent standard will be announced for NRO-track students.

Approximate schedule

“Week” refers to a calendar week. The X-hour will be used when we need to catch up; it will not be used every week.

Wk	Dates	Topics	Sections
1	Sept. 14–18	Sets, functions and equivalence relations; induction; the division algorithm	§1.1–1.2, 2.1–2.2
2	Sept. 21–25	The integers mod n ; definition and examples of groups; subgroups	§3.1–3.3
3	Sept. 28–Oct. 2	Cyclic groups; roots of unity; permutation groups	§4.1–4.2, 5.1
4	Oct. 5–9	Midterm 1 (Mon., Oct. 5) ; dihedral groups and groups of motions	§5.2–5.3
5	Oct. 12–16	Cosets; Lagrange’s theorem; theorems of Fermat and Euler	§6.1–6.3
6	Oct. 19–23	Isomorphisms; Cayley’s theorem; direct products	§9.1–9.2
7	Oct. 26–30	Normal subgroups and factor groups; homomorphisms; the isomorphism theorems	§10.1–10.2, 11.1–11.2
8	Nov. 2–6	Midterm 2 (Mon., Nov. 2) ; group actions; the class equation; Burnside counting	§14.1–14.3
9	Nov. 9–13	The Sylow theorems; rings and integral domains	§15.1–15.2, 16.1
10	Nov. 16–17	Ring homomorphisms and ideals; quotient rings	§16.2–16.3

Classes end November 17th. The final examination will be held during the College’s final examination period, November 20–25, at the time assigned by the Registrar for our meeting period.

Homework

Homework sets are posted, submitted and graded on Gradescope, accessed through the Canvas course portal.

- A problem set will be posted at the beginning of each week; the deadline is 23:59 on Tuesday of the following week.
- **No late submission will be accepted.** Your lowest homework score will be dropped, which is intended to cover illness, travel and ordinary bad weeks.
- Solutions must be written in complete sentences. A correct idea presented as a string of symbols will not receive full credit.

Academic Honor Principle

We will strictly enforce Dartmouth's Academic Honor Principle.

On exams. Giving and/or receiving assistance during an examination violates the Academic Honor Principle.

On homework. Collaboration is both permitted and encouraged, but it is a violation of the honor code for someone to provide the answers for you. You must write up your solutions on your own, in your own words, and you should acknowledge whom you worked with.

Generative AI

You are welcome to use tools such as chatbots to assist with your learning (see the AI Dartmouth webpage at <https://ai.dartmouth.edu/>). AI-based assistance will be treated the same way as collaboration with other people: you are welcome to talk about your ideas and work with others, both inside and outside the class, as well as with AI-based assistants. However, all work you submit must be your own. You should never include in your assignments anything that was not written directly by you. Including anything you did not write without proper citation will be treated as academic misconduct. To help avoid misconduct, we ask that you refrain from directly asking AI the questions from the problem sets.

Chatbots are best used for gaining a cursory understanding of new material and discovering references, but can become an obstacle if you rely on them too heavily when reaching for a deeper understanding. In mathematics it is particularly easy to trick yourself into thinking you understand a concept just by reading it — much of the real learning happens when you tackle questions using your own understanding. This is especially true in a first proof-based course: constructing and writing a correct argument on your own is precisely the skill Math 31 exists to build. Leave that part to a chatbot and you will miss the course.

Accommodations and observances

Disabilities. Students with learning, physical, or psychiatric disabilities enrolled in this course who may need disability-related classroom accommodations are encouraged to make an office appointment to see the instructor before the end of the second week of the term. All discussions will remain confidential, although Student Accessibility Services may be consulted to discuss appropriate implementation of any

accommodation requested. At such a meeting please provide a copy of your disability registration form, which lists the accommodations recommended by SAS. Student Accessibility Services can be reached at student.accessibility.services@dartmouth.edu or (603) 646-9900; the office is in Carson Hall, Suite 125.

Religious observances. Some students may wish to take part in religious observances that fall during this academic term. If you have an observance that conflicts with your participation in the course, please speak with the instructor before the end of the second week of the term to discuss appropriate accommodations.