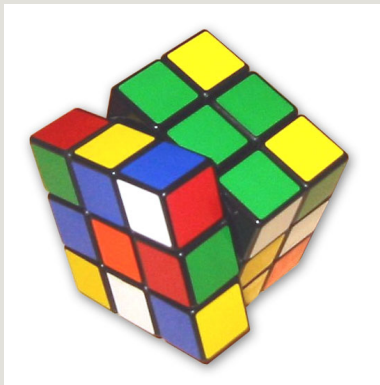




MATH 350: Groups, Rings, and Fields

Classroom:
Seeley Mudd 204

Instructor Info —



Miriam Kuzbary



Pronouns: She/Her/Hers



Call me: Prof. Kuzbary,
Dr. Kuzbary, or Prof./Dr. K.



Office Hours:
Mon 11:30am-12pm
Mon 3:30-5pm
Wed 2-3pm
Thu 1-2pm
Fri 11:30am-12pm
By appointment through Moodle
link



Office: SMUD 303



Course Website: On Moodle



mkuzbary@amherst.edu

Course Info —



Prereq: MATH 211 and either
MATH 271 or 272, or consent of
the instructor.



Mon, Wed, Fri



10:05am-10:55am on regular
days
10:05am-11:20am on quiz and
exam days



SMUD 204

Welcome to Groups, Rings, and Fields!

In this class we will begin the study of *Abstract Algebra*, which focuses on mathematical objects (groups, rings and fields) equipped with algebraic structures (operations) satisfying a set of axioms. Together we will learn deep ideas about algebra, formally and precisely prove results based on these ideas, and build a framework for ourselves connecting these ideas together.

Our course will focus on groups, which appear naturally in other fields, such as physics, chemistry and even art! For instance, groups help to model the idea of *symmetry* in physics, whereas rings and fields generalize the properties that we observe in certain classes of numbers, such as the rational numbers. You already have seen some of these objects (without giving it that name) in linear algebra. In this course we will study the axioms that rule groups, rings and fields, as well as their key properties using mathematical rigor (proofs).

What you'll learn along the way

Everyone in this class has different (and sometimes overlapping) goals for themselves, which might include:

- Learning some cool math
- Getting a good grade
- Challenging yourself
- Fulfilling a prerequisite for a class you want to take
- Fulfilling a major requirement
- Preparing for more advanced math
- Preparing to take the honors qualifying exam
- Finally understanding what is going on with modular arithmetic
- Making more advanced mathematical memes
- Taking the advice of someone important
- Building a mathematical foundation for non-math topics you like

and many others! That said, there are also goals that I as the instructor and the math department as a whole has for you, such as the following:

- Demonstrate fluency with the precise formal definitions of fundamental objects in the study of groups, rings, and fields as well as related definitions and theorem statements,
- Recognize patterns, formulate conjectures about those patterns, and prove or disprove said conjectures,
- Write clear and cogent proofs of the statements, propositions, and theorems contained in this course,
- Apply various notions and constructions of abstract algebra to different scenarios, and
- Build and solidify mathematical intuition, reasoning and the ability to connect different areas of mathematics.

How are we going to do that?

Learning new mathematics is a difficult thing to do, and takes a lot of work and time! That said, you are *completely capable of mastering this material if you are willing to put in the time, attention, and strategic effort into it*. For learning to happen, both of us (you and me as the instructor) will have to work hard!

Moreover, as you are engaging in a liberal arts education here at Amherst College, we will also explore the meaning of what we're learning. This will include questions like "what is the point of learning this topic?" and "how does this idea fit into my current goals and what I want for my future?" Ultimately, I can only teach you the mathematics. You get to decide and develop what that mathematics means to you!

It is very easy to familiarize yourself with a topic, particularly now since it is so easy to use a search engine or generative AI model to summarize the topic for you and use the correct words. Learning is much deeper; it is difficult both to create and measure.

In the “components of the course and their purpose” section of this syllabus, you will see the concrete aspects of the course designed to support your learning. The big picture of this course structure works like this:

1. Your introduction to each new math topic will happen as a combination of our work together in class and you reading the textbook outside of class. Because math is a physical skill that requires focused practice over time to improve, you should work problems *along with me* in class. This is a difficult course, and will take lots of work!
2. The first check in about how you’re understanding the current topic happens in real time, in class. I’ll *ask you to work a problem with your neighbors or on your own* and I’ll give you a hint or two once you’ve tried the problem for a bit. Then, I’ll ask for your ideas about the problem! Finally, we’ll finish the problem together in class.
3. The next check in about the topic happens on *homework*. The homework is your first chance to get feedback on your written work about the topic, and you have all of the resources of me, your book, your math fellows, and many other resources available to you. The graders will give you feedback, guided by me, that you can use to continue to develop your understanding and skills.
4. Now that you’ve had more experience with the topic, you’ll sometimes take a short *quiz* in class asking straightforward questions with only a page of notes as a resource. Your work on this quiz will give both of us information on your growing independence and fluency, and my feedback on the quiz will help point you to areas that need more attention. Since you are taking an advanced math class, I expect you to keep up with the material regularly without needing a weekly quiz. You should expect there to be some kind of in class assessment every two weeks (either a quiz or exam).
5. Finally, after all of this work, you will have hopefully learned enough to be fluent in the topic! To demonstrate that, you will study for and take a timed *exam* that is both closed book and closed note. The exam feedback and grade will be a very important data point for both of us on how your mastery of the topic is coming along.

Please remember that every professor at Amherst College is different, and every course is different. This is a feature of the academic freedom we enjoy at this wonderful liberal arts college, not a bug! Even distinct sections of the same course may have very different course structure, rhythms, and even topic orders. Know that the math department professors talk to each other regularly and have agreed on common material and skills for all of the core classes of the department; though we all have our own styles, we all get you to the same final goal!

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Mutual Expectations

Some of the things you can expect from me:

- The most important thing to me is that you learn something in this class, and that will require work from both of us!
- I am committed to creating a learning environment in which all of my students feel safe and included. Our classroom is a living community that will change and grow based on our participation and interaction in it, and as its facilitator I will constantly work to help it be a place of trust, curiosity, and mutual respect where learners with many different communication styles, needs, and goals can participate meaningfully. I hope you will, too!
- I have been teaching and tutoring for quite some time (since 2009). Students from a huge range of backgrounds and with many different kinds of preparation for college math have succeeded both in my classes and others I have helped them with. This means when I make choices in the classroom or suggest something for you to try, it’s because I have seen it work many times before, and think it might help you, too!
- I will always assume you are acting in good faith and with good intentions, and I hope you will assume that of me and your fellow classmates as well!
- I will respond to your emails within two business days (meaning Monday through Friday, excluding holidays), during normal business hours (9am–5pm) unless it is an emergency, in which case I will do my best to respond sooner. You can always email me questions at any time, including about specific problems!
- I will do my best to clearly communicate expectations and standards in this class, and will regularly solicit feedback from you on how it’s going,

Some of the things I will expect from you:

- Approach this course with curiosity and commitment: some struggle is expected and is necessary for learning mathematics! I will *never ask you to do something I don't believe you are capable of doing*, and sometimes we learn and grow the most by trying things that feel difficult.
- Trust yourself that you are capable of meeting the expectations I have for you in this course. Mistakes are good: they help you clarify how you are understanding the material and where you have more room to grow!
- Use our class time effectively and treat your fellow class members with respect and care. This can include asking questions, even if they feel silly, because if you have a question there are usually multiple other students with the same question who aren't speaking up! Participating in class in a respectful way also includes listening to your classmates, stepping up to take space when appropriate, and stepping back to allow other class members to take up space when appropriate.
- Assume good intentions from other students and myself, but please acknowledge in a timely fashion if you are feeling hurt by information in the class and/or the way it is shared.
- Try not to make assumptions! Please ask questions to learn more about other perspectives and strategies from your peers and me, especially those that are different from your own.
- If something is going on with you that affects your participation in this class, please tell me as early as possible!
- Read the entire syllabus carefully, familiarize yourself with the entire course Moodle page, and check your email every day, even if you take a business day or two to respond to non-urgent emails.
- If what you've done so far in the course isn't giving you the results you want, please be open to changing how you are studying, doing homework, participating in class, or participating in office hours (among other things) and please come to office hours or schedule a meeting with me to chat about it!
- If you have a concern about a grade you've earned on an assignment, reach out to me AS SOON AS POSSIBLE. I won't be able to address regrade requests or concerns about a grade if I get them more than *one week* after you have received the grade.
- Keep track of deadlines and assignments, turn things in on time, and take in-class assessments on time.
- Follow assignment instructions carefully.
- Carefully justify all of your work with clear, organized solutions that can be understood easily by your peers in class, and by future you trying to study for the final exam!

Illness Policy

If you are showing symptoms of a contagious illness and/or testing positive for COVID-19 on a regular class day, please follow the Amherst College illness protocols at <https://www.amherst.edu/campuslife/health-safety-wellness/covid-19> and do not come to class. If you still want to attend class virtually while ill (though there is no pressure to do so!) please ask me about options over email.

If it is an exam day, please email me immediately to schedule a makeup exam. I (and some of your classmates) are high risk, so if you are sick please rest and protect yourself and our community!

Abstract Math and Proofs

For most of you, Groups, Rings, and Fields will be one of the more abstract math courses you will take at Amherst College. But although it might sound scary at first, abstraction is just a way to cover many similar situations with the same framework! And we will see lots of examples to illustrate abstract concepts.

A bit of advice for the homework in this class:

Individual homework problems, whether computational or theoretical, will require more strategizing and scratchwork than in non proof-based courses. As a rule of thumb, try to write your work so that someone in the class who is sort of following along, but is confused about a lot of things, can understand your answer without having to look at the textbook or lecture notes. Just like in your humanities classes, think about how to make your thoughts clear to a reader on first reading.

- *Computations*: Please show every step and justify all your work, *using words* along the way. There are graded examples on Moodle.
- *Proofs*: I'll model lots of proofs in class. So, please follow my models if you want to know what I and your professors in other math classes will expect you to do! There are also graded examples on Moodle and a generic rubric you should use as a guideline for what I expect.
- *All problems*: Please use complete sentences and well-written paragraphs.

Of course, equations will usually appear, too, and you can certainly use abbreviations and standard mathematical shorthand. But fundamentally, solving any mathematics problem, whether computational or theoretical, is about making an argument using *words*.

Start on Scratch Paper: Please take pride in handing in neat and organized written work in math courses. In particular, unless a given problem is a *totally* straightforward computation, *don't start working on a problem on the same piece of paper that you will hand in.*

Instead, start the problem on scratch paper, to figure things out *before* you write anything about that problem on the piece of paper that you will hand in.

The components of this course and their purpose

In-class work, discussion, and lecture

During our lecture time we will have many conversations about what we are learning, so come to class expecting that you will be both contributing to the discussion and taking away something interesting to think about. We are creating this class together. The in-class portion of this course is time to engage with material together, ask questions, and do practice problems and proofs with immediate feedback from me. Our class time is also your opportunity to think out loud, make mistakes, and ask questions!

I encourage you to stop me during the lectures and ask questions. If you are feeling lost, it is extremely likely there is someone else sharing the same feeling. Asking your question ensures the whole class gets to benefit from the answer!

I like to stop from time to time and ask around questions about the material, please do not feel intimidated! It is a way to encourage thinking through things in a different way, and for me to check in with how you all are connecting with the material in real time.

Cold Calling

I will ask you lots of questions during class, just like I expect you to ask me lots of questions! I will call on specific students to answer, with the goal of every student speaking at least once per week (which I will keep track of as part of your effort grade).

When I call on you, you always have the option of saying "pass" with no questions asked! While I would love to hear your ideas, I know it can be scary to speak in public. Just remember that thinking through things is an important part of learning. If you ever worry about making a mistake in public, know that I am a "think out loud" kind of person and will make more public mistakes and typos this semester than you could possibly make :)

Group Work Tips

There will be many times in class that I'll ask you to work with your neighbors and report back to me what you figured out. Please be generous with both your own ideas and your listening ear; everyone thinks about math a little differently, and talking through math together in pairs or small groups can teach you a lot!

Studying and learning outside of class

We only spend 3 hours in class each week together, and according to the Federal Credit Hour standard that means you should expect to spend at least 2 hours outside of class per week for each credit hour of class. Therefore the time you spend outside of class on this material is the single biggest component of the course! To help support you with this work outside of class, I will occasionally post videos of extra problems and proofs and will post selected homework solutions.

The time outside of class you spend learning and studying is how you develop your own perspective on the course material, deepen your understanding, and strengthen your skills. It is also important that you check in with yourself regularly on how the class is going, and part of your Effort grade will involve occasional reflection assignments.

Homework

Learning math (or any other skill, like playing music or sports, learning a new language, or writing poetry) would be *so much easier* if we could watch someone do it and then automatically reproduce it. Unfortunately for most of us (myself included), we have to actually *practice* new skills in order to be able to do them easily and quickly. This is what homework is: practicing the new things you've learned, and applying them to new situations to strengthen your knowledge and creativity! This means that homework is a stepping stone on your journey to learning this mathematics, it is *not your final product*. Therefore, you should treat it as you do any other thing you practice doing!

There will be one homework assignment per week, due on *Wednesdays by 11:59pm* through Gradescope. Homework will generally be posted one week before it is due.

You will get the most out of homework and will probably find doing it less stressful if you *start working on each problem set the same day it is assigned*. If you wait until the last minute to do it, you will get less benefit from the practice, just like you

can't cram all your instrument practice for the week into the night before a concert and expect to sound as good as if you had practiced every day!

I will not accept homework in person, you must scan it and turn it in online. Homework turned in after the due date will not be accepted (see the special arrangement section of the syllabus for extension policies). In order to make sure your work is organized well, please make sure you write legibly and label the problems in the same order as listed in the assignment. I will drop your lowest homework grade.

Your homework consists both of reading the relevant sections of the book and of doing the assigned problems. (Only the written work counts directly in your grade, but I expect you to do both.)

Homework grading will involve more general feedback than feedback on quizzes and exams; this is intentional to help you feel more comfortable trying out the material for the first time. Please make sure you check the rubric on the right side of your returned assignments on gradescope as well as comments made directly on your submission in text boxes. The homework graders and I leave many notes on your work, please let me know if you're having trouble seeing them.

On quizzes and exams, you have had more time and practice with the material. After each homework assignment, I will post solutions to selected problems or point you towards solutions in the book. I will mainly post selected solutions to the more difficult problems. *Once the solutions have been posted, I will not accept that homework assignment late, even if you haven't used up your two allowed extensions.*

Working in groups and talking through your ideas is a great thing to do, and a skill that will be invaluable throughout your mathematical journey. However, the homework you turn in must be written *by you*. Copying or paraphrasing the work of others is plagiarism and is *a violation of the honor code*. This includes using ChatGPT, Chegg, CourseHero, Wolfram Alpha, and similar websites and programs. If you happened to work on an assignment with other people and you all came up with the same solution, please write the name(s) of the other students involved.

The software system LaTeX is the international standard for typesetting mathematics and scientific documents in many other disciplines. Once you get the hang of it, it will become much easier for you to type professional-looking mathematical documents, presentations, and posters. In order to give you an opportunity to practice, each homework assignment that you fully typeset in LaTeX will earn 2% extra credit on the whole assignment. Note that this cannot bring your homework grade over 100%!

I don't expect you to have ever used LaTeX before (or to have any experience with coding or typesetting), so to get started here is a short 30 minute LaTeX tutorial. I strongly recommend using Overleaf to typeset your work; there are editors you can install on your computer, but they can sometimes be tricky to set up. There is also a homework LaTeX template on Moodle you can start with; the best way to learn LaTeX is to get in and start trying it!

Biweekly quizzes

Starting the second week of class, there will be a quiz roughly every other week on Friday during weeks we don't have an exam. These quizzes are to provide a regular check in for both of us on how the material in the class is going for you. Since a semester has many twists and turns for everyone, I will drop your lowest *two* quiz grades.

You will be allowed one 8.5' x 11" page of notes (you can use the front and back of the paper) which you must turn in with your quiz. I strongly suggest making your own page of notes rather than sharing with another student, as making your own note sheet will help you organize your thoughts in the best way for you and usually helps you study.

If your total quiz average is higher than your lowest midterm grade at the end of the semester, I will replace that midterm grade with your quiz grade. However, you cannot replace your quiz average with an exam average.

Exams

There will be 2 midterm exams in class and one comprehensive final exam during final exam week.

Midterm Exam 1	Friday, October 9
Midterm Exam 2	Friday, November 13
Final Exam	TBA

An important part of learning the material in this course is gaining fluency in the concepts, computations, and proofs we are learning together. Being able to succeed on an exam in a timely fashion is part of being able to demonstrate that fluency. For example, if you wanted to become fluent in a new language, one of your goals would probably be to be able to have a conversation without having to refer to a dictionary for most of the words and grammatical structures during the conversation (this is one of the skills distinguishing different levels of fluency in a language by the ACTFL and CTFR scales). For this reason,

the exams for this class will be closed book and closed note. Calculators, cell phones, laptops, ipads, etc. are not permitted in exams.

Additionally, the kind of deep studying required for an exam allows you to engage in the material in a different way and learn the material more thoroughly. Think about it this way: would you study harder for a class with no exams or a class with exams?

Finally, exams provide valuable feedback for both of us on specific things you are understanding and not understanding in this course, and can help both of us make an informed decision about how the class is going.

Final Exam

The final exam period this semester is December 14-18, and the final exam date and time will not be announced until well into the semester. *Do not make any travel plans for the end of the semester until after final exam dates are announced.* Final exams cannot be taken as makeup exams or rescheduled due to travel by policy of the Class Deans, and I do not have the power to make exceptions for this.

Office hours and Math Fellow Hours

Office hours with myself, the Math Fellows, and the Q Center are your time to have smaller group interaction and feedback with us to clarify concepts, ask questions, and get help if you are stuck on a problem. They will be most effective if you prepare for them by attempting the homework first, reviewing both your class notes and mine, and reading the textbook.

You can think about going to office hours like meeting with a coach or a trainer: we can demonstrate lifting a weight for you, but ultimately, if you don't also actually lift the weight yourself you won't get the benefits from lifting weights! Office hours are for helping you navigate problem solving and learning the material in the course, which is not the same thing as simply telling you the solutions to homework problems. Office hours and math fellow hours supplement the rest of the components of this course, but they *cannot replace any other component of the course*.

Some of the things you can expect from the Math Fellows and QCenter Fellows

- Treating you with dignity and respect,
- Holding regular office hours,
- Supporting your problem solving and learning in this course with a student-centered approach,
- Asking you questions to pinpoint exactly where you need more support in this class, and providing that support based on their significant experience and expertise (this might not include giving you the final answer!)
- Their support will likely be a mix of helping with specific problems and more broad, structural advice about studying and engaging with the course; both will help support your success!
- They will be patient with you and respect the learning process.

Some of the things the Fellows will expect from you

- Treating them with dignity and respect,
- Trusting their experience and expertise and that you will try out the things they suggest you try,
- Assume they are acting with good intentions and in good faith and have been chosen as Fellows because they know what they are doing!
- You will be patient with them and respect the learning process.

My Office Hours

Drop in hours (all in SMUD 303):

Monday: 11:30-12pm, 3:30-5pm

Wednesday: 2-3pm

Thursday: 1-2pm (starting September 17)

Friday: 11:30-12pm

Appointment booking link is [here](#). Appointment slots will generally be Tuesdays from 3-4:30pm and Wednesday from 11:30am-12pm.

You can book 15 minute slots at a time and are allowed to book multiple slots in a row. You can book appointments up to 24 hours in advance, and are welcome to email me for a last minute appointment if my schedule hasn't filled up already. Please indicate if you would like to meet in person in my office or on zoom.

Appointment office hours are for when you would prefer to talk to me in a smaller setting or if the drop-in office hours don't work for your schedule. You are welcome to bring friends with you if you would like but please do not interrupt someone else's appointment office hour time without their consent!

Tenure track and tenured professors at Amherst College both teach math and do research in math, so our time is split between these two tasks. If you're curious about my research, check out [this link](#).

Hours with Math Associate Allison Tanguay at the QCenter

Drop in hours (all in SMUD 208):

Monday: 9am-12pm

Tuesday: 12-2:30pm

Wednesday: 9am-12pm

Thursday: 12-2:30pm

Friday: 9am-12pm

You can also make an appointment by clicking [this link](#).

Math Fellows:

Fellow Office Hours

Math Fellow Office Hours:

Drop in hours (all in SMUD 208a):

Monday: 6-7:30pm Sam Johar

Tuesday: 9-10:30pm Sam Johar

Wednesday: 6-7:30pm Erika Salvador

Thursday: 7:30-9pm Erika Salvador

Required Text

For Amherst college students only, all required textbooks at Amherst are now provided by the college! You will receive an email from customerservice@efollett.com notifying you that course materials are ready for pickup.

Unfortunately this program does not apply to 5 college students; if you have issues getting the textbook, please come chat with me.

Please bring your Student ID to the textbook distribution center at the Alumni House to collect your course materials. If you drop the course on or before the last day of the add/drop period, you must return the print materials to the same Alumni House location.

Distribution Dates: August 17 - September 11

Location: Alumni House

Hours Monday - Saturday, from 9 a.m. - 5 p.m. (Open on Labor Day)

Saturday - Sunday from 10 a.m. - 3 p.m..

Required text

Concrete Abstract Algebra: From Numbers to Gröbner Bases by Niels Lauritzen.

Add/Drop and Attendance Policy

It is very difficult to catch up in a math class if you miss classes, even the first couple of days of the semester. We will start out the semester with some tricky, abstract ideas and trying to catch up if you miss the topics the first time in class is unnecessarily difficult. If you're interested in adding this class, you should attend every class the first week.

Our time together in class is very important and there is quite a lot of data that attending class regularly strongly correlates with success in the course (see Credé, Roch, and Kieszczyńska 2010).

As a result, I will take attendance in this class. If you have at least four unexcused absences (which is over 10% of our class meetings for the semester) you must schedule an individual meeting with me to discuss your absences. This may or may not be paired with a grade penalty.

If you come to class more than 15 minutes late without an excused reason, that will count as an unexcused absence.

The Amherst College Honor Code

The Amherst College Honor Code applies to this course. It is your responsibility and mine to be familiar with and uphold *all aspects* of this code, including the Statement of Intellectual Responsibility, the Statement of Respect for Persons, the Statement of Freedom of Expression and Dissent, and the Statement of Student Rights.

Generative AI Policies and Philosophy

Generative AI will not be allowed on any in-class assignment and if used will be considered a violation of the honor code.

Using generative AI (artificial intelligence or machine learning tools such as Gemini, ChatGPT or Dall-E 2) has become very common. While some students use it to completely generate assignments, it is even more common for students to use it in other ways.

For example, students are using it to:

- Generate practice problems
- Generate study schedules
- Generate outlines for proofs or solutions
- Replace office hours
- Talk through ideas
- Replace a tutor
- Ask guiding questions

While it is true that many companies now expect their employees to use generative AI tools to increase efficiency, it is also true that generative AI is most effective when used by *experts* in the area it is being used in. Right now, you are not an expert in MATH 350. If you were, you would be better served by taking a different math class! Since you are not an expert, it is actually very difficult to tell if the information generative AI is giving you is accurate or helpful, and generative AI is very good at presenting information that looks accurate and helpful at first glance.

For example, think about the posters and advertisements you have seen around Amherst or your hometown that were obviously created using AI. You likely ignore them; in fact, there is emerging research that AI-generated advertisements have up to 70% less engagement than traditionally created marketing. However, those posters and advertisements exist because someone decided they were “good enough” for their purposes. You are an expert in being marketed to, and this is why many of you might find this kind of advertisement alienating instead of attractive.

A liberal arts education is about thinking deeply, not about producing output that is “good enough.” Therefore, I encourage you to think about whether you would trust your math education to a computational tool that is extremely convincing and reassuring, but might be giving you AI slop instead of what you actually want from it. Without expertise, it’s very difficult to tell the difference. This is particularly true in a proof-based class like MATH 350; AI generated proofs are usually very confident and polished-looking, and often have major errors that are difficult for a non-expert to detect.

How to earn a specific grade in this class

Your final grade in the class will be computed by:

Effort	3%
Biweekly Quizzes	15%
Highest Midterm Exam	25%
Lowest Midterm Exam	20%
Final Exam	30%
Homework	7%

“Effort” is a combination of class attendance, class participation, and handing in problem sets. Final grades will be determined based on a holistic evaluation of your performance throughout the course. This may include, but is not limited to, mastery of both the proof-writing and computational components of the course, participation, improvement over time, and engagement with course materials. At the end of the semester, I as the instructor reserve the right to make adjustments to the final grade to reflect overall effort and learning in the course. Final course grades will be curved.

Any student who skips an exam for an unexcused reason or fails to hand in at least 50 homework problems *on time* over the course of the semester *automatically* gets an F in the class.

Special arrangements

Extensions and Make-Ups

If for some reason you cannot hand in your homework in time or take a quiz on time, you can request up to TWO extensions during the term with no questions asked. You must contact me no later than the day before the due date to let me know. If you have a religious holiday on the same date as an exam in this course, let me know within the *first two weeks of the semester*.

Accommodations

I strive to support all students so please come meet with me if you have any questions or concerns about your engagement and success in this course. Students seeking general disability services and/or accommodations should contact Accessibility Services. You can reach them via email at accessibility@amherst.edu, or via phone at 413-542-2337. Once you have your accommodations in place, I will be glad to meet with you privately during my office hours or at another agreed upon time to discuss the best implementation of your accommodations. For more information, please visit the Accessibility Services website.

Electronics Policy

Please silence your phone and put it away during class. As many students find laptops distracting, if you plan to use a laptop during class please sit in the back row.

What we'll be learning about

The following schedule is tentative and may shift slightly as the semester develops. Nothing will be made due earlier than indicated but some things may be pushed back or eliminated altogether, depending on time. All changes will be announced in class and posted on Moodle.

Week	Topics we'll explore
Week 1	• Appendix A: Mathematical Foundations • Relations and orders
Week 2	• Division and congruence • The Euclidean Algorithm
Week 3	• Division and congruence • The Euclidean Algorithm • Binary Operations • Definition of a group
Week 4	• Abelian groups • The group $\mathbb{Z}/n\mathbb{Z}$ • Composition tables/Cayley tables • Subgroups • Cosets

Week 5

- Normal subgroups
- Normal subgroups
- Center of a group, products of subgroups

Week 6

- Group homomorphisms
- Kernel and image
- Quotient groups
- The isomorphism theorem
- Midterm Exam 1

Week 7

- Generators of a group
- Cyclic groups
- Applications of group theory to number theory
- Finitely generated abelian groups
- Group actions (If time permits)

Week 8

- Symmetric groups
- Theorems about permutations
- Transpositions
- Alternating groups
- Dihedral groups
- Orbits (If time permits)
- Stabilizers (If time permits)

Week 9

- Burnside's lemma (If time permits)
- Sylow theorems (If time permits)
- Definition of a ring
- Units and zero divisors
- Definition of an integral domain

Week 10

- Definition of a field
- Subfields and extension fields
- Ideals
- Quotient rings
- Principal, prime, and maximal ideals

Week 11

- Ring homomorphisms
 - Characteristic of a field
 - Field of fractions
 - Unique factorization domains
 - Midterm Exam 2
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Week 12

- Prime and irreducible elements in a ring
- Euclidean domains
- Gaussian integers
- Polynomial rings

THANKSGIVING BREAK

Week 13

- Roots of polynomials over a ring

Week 14

- Finite fields (Time permitting)
- Roots of unity (Time permitting)
- Wrap up

FINAL EXAM WEEK

Important Dates

September 1	First Day of Classes
September 10	Last Day of Add/Drop
October 12-13	Mid-Semester Break
November 2-6	Advising Week for Spring 2026
November 23-27	Thanksgiving Break
December 9	Last Day of Classes
December 14-18	Final Exams

This syllabus provides a general plan for the course; deviations may be necessary. You are responsible for all of the information in this syllabus, so please read it carefully and refer back to it regularly.