Math 351: Modern Algebra I (Section 02)

Spring 2021
Zoom, MWF 2:15–3:05

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Office Hours: TBD
Course Website: Canvas

1. Course Overview

Format. Online. Classes will be conducted synchronously on Zoom. Assignments will be submitted online through Canvas. Students are expected to participate during the class meeting.

Textbook. *Contemporary Abstract Algebra* by Joseph A. Gallian. Any edition after the 7th is acceptable. We will cover Chapters 1–11 and more, time permitting.

Course Description. Modern Algebra is an introduction to *mathematical structures*, in this case sets equipped with operations obeying certain rules. The motivating example is the set of all integers, together with the operation of addition; other examples include the set of invertible 2×2 matrices of complex numbers together with matrix multiplication, or the set of all bijective functions $f\colon \{1, 2, \ldots, n\} \to \{1, 2, \ldots, n\}$ together with function composition.

In this course, we will find an abstract description generalizing all of these examples, the mathematical structure of a *group*. Studying groups abstractly allows us to prove statements about all such structures — including these examples — simultaneously. In addition to being an essential building block of many mathematical disciplines (e.g. algebraic topology [my field of study], algebraic geometry, algebraic number theory), abstract algebra is also widely applicable in cryptography, coding theory, and physics.

In addition to learning topics in Modern Algebra, this course is specifically designed to develop your skills in:

- strategic self-questioning, revision, putting persistent effort towards difficult problems, learning to work through perceived (and productive) failures
- working collaboratively and productively with others
- investigating new definitions or theorems with examples or counterexamples
- reading and writing proofs; recognizing correct, incorrect, or incomplete proofs

Course Goals. There are two main goals of this course:

(1) Content: Mastering the concepts of abstract algebra
(2) Writing: Mastering the ability to produce and craft proofs.

I use the term "mastery" here not to mean that you have achieved perfection; I constantly am improving my ability to learn new topics and to write better proofs. However, I do mean that you have shown the ability to grasp the highest ideals of this field, and produce clear, concise, insightful, and beautiful proofs, demonstrating to your readers that you understand your arguments and their use masterfully.

To that end, this course is disigned to encourage of growth of these skills and learning outcomes.

Course Structure. Each day, you will be assigned reading from *Gallian*, often with an accompanying video. Class will be split between me providing an overview of some highlights from the reading, and group-work exercises where you get to actively work towards both of the course goals, by writing proofs and thinking collaboratively about the topics at hand with your peers.

2. Homework and Assessments

To assess your advancement towards the two course goals, the vast majority of your grade will be determined by proof writing. This will come in two forms:

Problem Sets. Each week you will be assigned a problem set, a collection of 8-10 problems, with both abstract concepts and concrete examples. Only *half* of these problems will be submitted to me (the rest are for your own development; solutions will be provided after they are due). These problems must be submitted as PDFs to Canvas. They can be written up however you like (e.g. handwritten on paper, using LaTeX).

After these problem sets have been submitted, Canvas will randomly assign each a *Peer Reviewer*. The Peer Reviewer will have two days to provide constructive but encouraging feedback (not corrections, but critical observation and guidance) by Friday evening. Students will then have an opportunity to resubmit their problem sets the following Wednesday, taking into considering the remarks from your fellow students.

Timeline:

- First submissions due by **Wednesday at 12 noon**
- Peer reviews due by **Friday at 11:59pm**
- Second submissions due by **the following Wednesday at 12 noon**

So most Wednesdays you will be submitting two documents: a first submission and a second submission.

Assessment:

- Your first submission will be graded solely on effort and completion by the deadline. This should be a serious attempt to complete the problems: you should treat this submission as if it were to be graded directly. Doing otherwise will adversely effect your grade on this part.
- Your peer review will be graded on effort and timeliness.
- Your second submission (changed or not) will be graded on both the content and writing goals of this course.

Resources:

- Peer Reviewer Guidelines
- Writing Goals and Proof Writing Resources

Proof Portfolios. There will not be traditional timed exams in this course. Instead, we will redouble our efforts on reflection and reconsideration of our proofs.

To that end, you will be asked to submit two Proof Portfolios, one in the middle of the semester, and one at the end. Each of these portfolios will consist of a number of proofs (6+ for the Midterm, 12+ for the Final) of **your choice** taken from questions on the Problem Sets. However, your curated collection will need to satisfy *Content Requirements* and *Skills Requirements*, ensuring that the proofs span the content of the course, and demonstrate particular proof/writing/reflection techniques. The specific details of these requirements will be provided closer to each deadline.

- Content and Skills Requirements — Example

As these collections consist of resubmissions, the expectation is that they will be of a significantly higher quality than your submissions for Problem Sets, and will be graded accordingly.

Grading. This course, and the assignments in it, will be marked according to the doctrine of **mastery-based** and **contract** grading. This means that you will not receive numerical scores (which, especially for proofs, seem rather arbitrary). Instead, you will receive a letter indicating how close to mastering each course objective you are.

The possible grades for each assessment are:

- N: "not yet"
- I: "in progress"
- A: "achieved"
- M: "mastered"

Your letter grade at the end of the semester is determined by how well you have mastered the course objectives. In particular, each letter grade requires the following minimum percentages:

	%	A	B	C	D
Participation	15	98%	85%	70%	50%
First Submissions	15	95%	85%	70%	50%
Second Submissions	20				
Content Goals:		90% **I**	80% **I**	70% **I**	60% **I**
Writing Goals:		80% **I**	70% **I**	60% **I**	50% **I**
Midterm Portfolio	20	80% **A**	70% **A**	60% **A**	50% **A**
Final Portfolio	30	90% **M**	90% **A**	70% **A**	60% **A**
			70% **M**	50% **M**	

3. Course Policies

This is a weird and difficult time for us all. I expect myself to work hard to make this class effective and flexible, and I expect you to do the same.

Math 35' students are expected to complete their assignments, come to class on time and ready to participate and engage with the material and their fellow classmates.

Additionally, you are responsible for announcements made in class, as well as any emails sent to your UK email account or announcements on the course website.

Attendance. Attendance is required. That being said, I expect there may be times where you are not able to make it to class, for a potential variety of health or personal reasons. If you must miss class, due to an illness or other pressing circumstance, please let me know as soon possible. I will not ask for medical documentation or a note from a Class Dean. Instead, I will trust your judgment and voice in these matters, and expect that you will take ownership of this trust and act responsibly.

As listed above, participation is **15 percent** of your grade this semester. That includes attendance and peer reviews, as well as in-class work and engagement.

While working in groups:

- *Share responsibility for making sure all voices are heard:* If you tend to have a lot to say, make sure you leave sufficient space to hear from others. If you tend to stay quiet in group discussions, challenge yourself to contribute so others can learn from you.
- *Understand that we are bound to make mistakes in this space:* Everybody (myself included!) does so when approaching complex tasks or learning new skills. In particular, you are invited to step outside your comfort zone!

Cameras. You may have considerations that will prevent you from keeping your camera on during our synchronous meetings, including internet speed or access issues, family responsibilities, or personal discomfort, so you may absolutely leave your camera off if you want or need to do so. To the extent that you are comfortable and able to turn your camera on, though, please feel free to do so (and be mindful of what's within your camera's view or which virtual background you're using!). This will help us to create a sense of connection and community in our class and encourage engagement with and trust in one another.

Please try, however, to mute your microphone unless you are actively speaking or would like to offer a thought or question. This is to ensure that we give due focus to whoever is speaking and to avoid being distracted by unintended background noise.

Tokens. Each student will have two "tokens". These can be used to grant a "no reason" 2-day extension on either submission of a Problem Set or a missed class. However, if a toekn is used to extend a first submission homework deadline, you are not guaranteed that the homework iwll be peer-reviewed.

Academic Integrity. The Department of Mathematics and Computer Science has drafted a Policy on Academic Integrity. Please read this policy in full. By taking this class, you assume responsibility towards following this policy.

If you cheat in this class, you risk failing the course. Using Internet resources or printed solutions of **any kind**, except the ones I distribute in class, constitutes cheating, and will be penalized.

It is far more important to learn from your mistakes on the problems sets than to get a "high score". Perfect is not expected: e.g. to achieve an "A" on your problem sets, you do not need to have yet mastered the material.

Collaboration. Mathematics is an inherently collaborative and social activity. You are encouraged to work together on your problem sets. However, the solutions you submit for credit must be written up **by you in your own words**. This does not just mean you have made a few minor changes of word choice, but that you have understood the ideas and presented them in terms natural to you, personally.

In particular, you may not exchange written work with your classmates; doing so constitutes dishonest collaboration.

There is also be a peer-review component of this course. It is unrealistic to expect that reading another person's proof would not affect your next draft. However, you should prioritize editing your own ideas rather than adapting another person's. If you think that you adapted another student's ideas significantly after reading their work, you should try to avoid including that problem in your proof portfolio.

The proof portfolio should be **assembled individually**. You are allowed to discuss which problems you are including, you are allowed to solicit feedback from me on its assembly and from your peers on individual components (for example, if you want a classmate to look over a proof outside of instructor-organized peer-review, this is fine, as long as any **changes** you make are **yours**, not theirs).

Accommodations. It is my job to provide all students with an accessible and inclusive learning environment. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Office of Accessibility Services to determine appropriate accommodations. Any information you provide is private and confidential, and will be treated as such.

Advice.

- Work with others!
- Attend class, participate, and ask questions.
- Office hours are a great place to ask questions, go over material, and work through problems.
- Learning is not fast, don't try to rush it. Be patient with yourself.
- Just because the first approach at a problem does not work, does not mean that the second or third will not. Sometimes the first thing you (or I) try doesn't work, but this does not necessarily mean that you do not understand the tools required to solve the problem.
- Start your problem sets early! You should try to make progress over the weekend so that you can ask questions in class and/or office hours.

Important Dates.

- Easter Break: Thursday April 1 – Tuesday April 6
- Last day to withdraw with a W: Friday April 23
- Academic Conference Day: Wednesday April 28
- Last day of Classes: Friday May 7
- Finals: Wednesday May 12 – Tuesday May 18
- Commencement: Friday May 28