

## SYLLABUS: MATH 417 ABSTRACT ALGEBRA SPRING 2022

**Instructor:** Professor R. Kedem [rinat@illinois.edu](mailto:rinat@illinois.edu)

**Office hours:** By appointment.

**Course website:** is on [learn.illinois.edu](http://learn.illinois.edu)

**Official text:** Fraleigh, *First Course in Abstract Algebra* There are additional free textbooks provided online.

### 1. COURSE CONTENTS

In this course, we concentrate on structures, rather than specific problems. We start with sets (for example, integers), impose a structure on the sets (for example, addition), and study maps between sets which preserve their structure. Examples of structures in this course include **groups, rings and fields**. These structures are new, but you are already familiar with specific examples.

A primary source of examples for the structures we study comes from linear algebra, integer arithmetic, modular arithmetic, symmetries of geometric objects and polynomials.

Our goal is to learn a new way of reasoning, analyzing and thinking about mathematical structures, then seeing what we can construct using this reasoning. The material of this course forms the foundation of all the rest of mathematics.

The contents of this course have applications in many other fields, such as cryptography, coding theory, quantum information theory, and designing wall paper patterns.

This course sets up a lot of **language**. We require a lot of precision in mathematics, and this course is where you will learn a lot of the necessary language. There are many **definitions** as well as **notation**: Make yourself a dictionary for each as you take notes. Being able to recall the precise definition of each term will get you most of the way through the course.

In the textbook (Fraleigh) we will cover Sections I–VI, with some additions to Section 0.

### 2. COURSE FORMAT

As much as possible, we will incorporate collaborative **problem sessions** during class time. I will provide you with a set of short problems to work through in small groups. The idea is to give you practice in working with the material, and also in talking math with your classmates and explaining your thinking to others.

There will be a lot of material available online each week: Readings, links, short lecture clips and instant feedback **quizzes**. You will get much more out of the class if you read the material and do quiz problems before coming to class.

**Note:** Each quiz has a strict deadline, and Moodle settings are such that if you don't attempt the quiz, it becomes invisible to you, and therefore not available for review purposes. There is nothing I can do about this Moodle setting, so please attempt it at least once before the deadline – you don't lose any points by doing this!

### 2.1. Online materials.

- **Reading assignment:** Relevant text sections will be listed for each topic. Alternative text sections will be listed also. Take notes while reading and do as many of the exercises as possible in each section. It is just as important to understand the proof of each theorem as the statement, so try to do the proofs yourself. In order to really understand what's going on, reading math should be an active process.
- **Quizzes:** These will appear on the course website, try them at least once before they are due, after reading the assigned material. These will help you with the subsequent in-class problem sessions. The quizzes include **lecture clips**. To help you take notes on the lecture clips, there are some **fill-in notes** online as well.
- **Practice problems:** There will be practice problems posted, which will include the **homework assignments** to be turned in. The homework should be turned in online: Scan your solutions into a single pdf file to upload. Because of grader time constraints, no late homework will be accepted, but your 3 lowest scores will be dropped.

Language counts. Be extremely careful how you state things, and make sure to explain all the steps in the proofs. Be kind to the grader: Only turn in legible copies of homework. It helps to copy out your work once you are satisfied that you know how to solve each problem.

**2.2. Class participation.** Participation in lectures and discussions is strongly encouraged. This is the lowest potential barrier chance to learn the material. It is an opportunity to practice the material, ask questions, and help you go over the reading, with some extra information.

If you choose to participate, active participation is required. The first level of interaction during Zoom sessions is to have your video on. In person, properly fitted N95 or equivalent masks **must be properly worn**, over nose and mouth. No food or drink are allowed in class at any time.

If you test positive for Covid or are feeling unwell, notify me via email, so that you can be kept up to date with the class.

## 3. HOW TO STUDY FOR THIS COURSE

We learn math the way we learn to play the piano or to speak French: By practicing it, rather than by listening to concerts or watching movies. In this context, the equivalent of concert-going is listening to lectures and reading about a subject. The equivalent of practice is problem-solving, which in this course includes proving theorems and working out examples. The purpose of this course is to provide you with opportunities to practice, on your own as well as in groups.

Do the readings prior to class time, try the practice problems, text problems and the online quiz questions. Take notes during lecture and reading. Try to come up with three questions on the material before class time each day.

The average student can expect to spend about 9 hours outside of class per week on this course.

## 4. GRADE COMPONENTS

4.1. **Written homework.** The weekly written homework should be uploaded by the due date. Clarity of writing reflects clarity of thinking, and the homework will be graded with good presentation in mind. Copy your rough draft cleanly and explain your thinking as follows:

- (1) What is the problem you are attempting to solve?
- (2) What is the method of solution?
- (3) What are the steps you are following?

Math is beautiful, if you can see the beauty of the solution to each problem, and explain this in writing, it will make you and the grader happy.

Upload your solutions as a single pdf file. The homework will count for 20% of your grade, with the 3 lowest scores dropped (including missed deadlines).

4.2. **Quizzes.** There will be basic comprehension quiz questions on Moodle to provide instant feedback and give you an idea of what will go on in the discussion. These count for 10% of the total grade. Even if you don't have time to finish it, **start the quiz before the due date**, in order to have access to review materials.

4.3. **Midterms.** There will be two midterms. Campus policies apply to missed exams.

- (1) Exam 1: Feb 23
- (2) Exam 2: April 6

These will be closed-book exams. Each midterm counts for 20% of the grade.

4.4. **Final exam.** The final exam will be 3 hours long and will be a combined exam at 8am on May 6. Apart from the length, this will follow the same format as the midterms, and counts for 30% of the final grade.

4.5. **Grade calculation.** The total grade is computed as follows:

- Midterms: 40% (20% + 20%)
- Final: 30%
- Homework 20% (3 lowest scores dropped)
- Quizzes 10%