MATH 113 Introduction to Abstract Algebra: Syllabus

Instructor:	Gabriel Dorfsman-Hopkins (gabrieldh@berkeley.edu)
Office Hours :	Mondays 2-3 and Wednesdays 12-1 and 2-3 in Evans 895 or by appointment
GSI:	Ben Castle (bcastle@berkeley.edu)
Homework Grader:	Lei Guo (lguo8@berkeley.edu)
Lecture:	MWF 1:00-1:59 Cory 247
Text:	Abstract Algebra, 3rd Edition, by Dummit and Foote [DF]
Secondary Text:	Paulin's Introduction to Abstract Algebra [P]: `https://math.berkeley.edu/~apaulin/AbstractAlgebra.pdf`
Course Website:	`http://www.gabrieldorfsmanhopkins.edu/m113sp20/index.html` Grades will be posted on bcourses.

Objectives

You are likely familiar with algebra as being a (perhaps tedious) exercise in solving equations. The structures of addition and multiplication, and the way they intertwine, allow us explicitly to extract information (solve) from relationships (equations).

Abstract algebra is the rigorous study binary operations, that is, functions which take to inputs and one output. You are already familiar with some binary operations (addition and multiplication of integers, for example), but it turns out there are many many more (addition and multiplication of matrices, composition of functions, mixing colors, applying symmetries, permutations and card shuffles, the list goes on). In studying the abstract properties of binary operations and their interactions, we will discover that they all share many very strong underlying structural properties, which allows us to extract information for given relationships (i.e., solve equations), in many different contexts. This leads to applications in cryptology, geometry, logic and even philosophy which we may glance at if time allows.

Along the way we will gain experience in proof writing and mathematical exposition and communication.

Structure

Mathematics is not a spectator sport, and watching someone do abstract algebra is much like reading the New York Times backwards. All the information may be there, but it will take some unscrambling to make sense of it. Therefore I plan to lecture enough to introduce the necessary concepts, but spend much of the time working through examples and exercises with your help. This will include time to work through examples and exercises in class. For this reason, it is a good idea to be a bit ahead in the reading, and ready to toy with some problems in class. There will also be many written exercises collected as homework assignments, as well as takehome and in class exams:

Homework

There will be written homework collected almost every week **on Fridays**. They will be assigned a week before they are due, and mostly be problems from the book, but keep in mind that some

of the problems may require material discussed on the Monday before they are due as well. These assignments will be proofs, as well as computations. It is preferable that they are typed up using LaTeX, or a similar mathematical typesetting language. Feel free to work in groups, but each student must write up their results separately.

Take Home Tests

There will be two take home tests. These will look similar to the homework assignments but differ in the following important ways. First, they will be assigned on Friday and due the following Monday. Second, you must work on them yourself. Third, they will consist primarily of proof writing. You may use the course texts ([DF] and [P]), as well as your course notes. You may *not* use the internet or your peers. They are in theory cumulative, but in practice will reflect material most recently covered.

Takehome Test 1: Assigned Friday 2/21 Due Monday 2/24
Takehome Test 2: Assigned Friday 4/24 Due Monday 4/27

In Class Exams

There will be one midterm and one final. The midterm will be the day before spring break, and the final during finals week. These will both be cumulative, and will include both computation and examples.

Midterm Exam: Friday 3/20 in class.
Final Exam: Tuesday 5/12, 8AM-11AM *location tbd*

Grading

Raw grades will be computed* as follows:

Category	Percentage
Homework	25%
Takehome (Lower Score)	15%
Takehome (Higher Score)	20%
Midterm	15%
Final	25%
Total:	100%

*After evaluating the performance of the class over the entire quarter, I will adjust the median grade accordingly.

Make-ups and Extensions

Exams (takehome and in class): in case of observance of religious holidays or participation in university sponsored activities, arrangements must be made **during the first 2 weeks of the semester**. If you miss an exam to *unavoidable, compelling, and well-documented reasons*, you will be given a make-up exam. If you do not have such a reason you will receive a 0 for that assignment.

Homework: I am a bit more flexible with homework. I grant extensions in reasonable circumstances, but you must talk to me as early as possible. The longer you wait, the less flexible I will be.

Disabled Students' Program (DSP)

The University of California is committed to providing access, equal opportunity and reasonable accommodation in its services, programs, activities, education and employment for individuals with disabilities. These resources include exam proctoring and accommodations in distraction free environments and with extra time as well as note taking. To request disability accommodation contact the DSP Office at least ten days in advance at (510) 642-0518(V), (510) 642-6376(TTY), (510) 643-9686(FAX), or dsp@berkeley.edu.

If you have a letter from the Disabled Students Program (DSP) indicating that you have a disability which requires academic accommodations, please present the letter to me **as soon as possible** so we can discuss the accommodations you need. If you don't do this before the day of the quiz/exam, I may not be able to accommodate you.

Course Schedule

On the next page is a (rough) schedule of the course, organized weekly.

Week 1 (1/20-1/24):	Introduction. Sets, function, proofs. [P] Chapter 1 and [DF] 0.1
Week 2 (1/27-1/31):	Properties of the integers. [P] Chapter 2, [DF] 0.2-0.3.
	Definition, examples, and early properties of groups. [DF] 1.1-1.5.
	Homework 1 due Friday.
Week 3 (2/3-2/7):	Group homomorphisms and group actions. [DF] 1.6-1.7
	Subgroups, properties, and examples. [DF] 2.1-2.3.
	Homework 2 due Friday.
Week 4 (2/10-2/14):	Subgroups and generators. [DF] 2.3-2.5.
	Homomorphisms and quotients of groups. [DF] 3.1-3.2.
	Homework 3 due Friday.
Week 5 (2/17-2/21):	*No Class Monday*
	The isomorphism theorems. [DF] 3.2-3.5.
	Homework 4 due Friday
	Takehome 1 assigned Friday
Week 6 (2/24-2/28):	Group Actions. [DF] 4.1-4.4.
	Takehome 1 due Monday
	Homework 5 due Friday
Week 7 (3/2-3/6):	Sylow theorems. [DF] 4.5-4.6.
	Direct products. [DF] 5.1-5.3.
	Homework 6 due Friday
Week 8 (3/9-3/13):	Semidirect products. [DF] 5.4-5.5.
	Extra topics in group theory. [DF] 6.1-6.2.
	Homework 7 due Friday.
Week 9 (3/16-3/20):	Free groups. [DF] 6.3.
	Midterm review.
	Homework not collected. Study problems available.
	In class midterm on Friday.
Week 10 (3/23-3/27):	*Spring Break*
Week 11 (3/30-4/3):	Rings, first properties, homomorphisms, ideals. [DF] 7.1-7.4.
	No homework collected. Start next week's early!
Week 12 (4/6-4/10):	Rings of fractions and the Chinese Remainder Theorem. [DF] 7.5-7.6.
	Hierarchy of particularly nice rings. [DF] 8.1-8.3.
	Homework 8 due Friday. This will likely be a longer one.
Week 13 (4/13-4/17):	Principle Ideal Domains. [DF] 8.3.
	Polynomial rings. [DF] 9.1-9.3.
	Homework 9 due Friday.
Week 14 (4/20-4/24):	More on polynomial rings. [DF] 9.4-9.5.
	Introducing fields. [DF] 13.1.
	Homeowrk 10 due Friday.
	Takehome 2 assigned Friday.
Week 15 (4/27-5/1):	Field extensions and algebraic closures. [DF] 13.1-13.2, 13.4.
	Takehome 2 due Monday
	Homework 11 due Friday
	Last day of formal instruction on Friday
Week 16 (5/4-5/8):	*Review Week*
	Homework 12 due Friday
Week 17 (5/11-5/15):	**Final Exam Tuesday, 8AM-11AM**.