
Instructor:	Prof. Sarah Frei	Class Time:	MWF 10:00-10:50AM
Office:	426 Herman Brown	Classroom:	ABL 131
Email:	sarah.frei@rice.edu	Student Office Hours:	Wed 11:30am-12:30pm, Thurs 3-4pm, or by appointment

Class Webpage: Look for Math 356 001 F21 on Canvas

TAs: Harshit Yadav (hy39@rice.edu) will hold a weekly office hour on Mondays 5-6pm in HBH 423. Fernando Liu Lopez (fc12@rice.edu) will hold a weekly office hour on Tuesdays 5-6pm over Zoom; the Zoom link for the office hour can be found on Canvas.

Prerequisites: (MATH 354 or MATH 355) AND (MATH 302 or MATH 354 or MATH 220 or MATH 221)

Class Meetings: This class will meet **in-person**, and per university requirements, **all students must wear a mask in the classroom**. Since some students may have made arrangements to not arrive on campus until Sept. 4, you will be allowed to attend **synchronously via Zoom** until that date. The Zoom link will be posted on Canvas.

Beyond that, if you are unable to get to campus before the start of the semester due to travel or visa restrictions, the course lectures will be recorded and made available to you. If this pertains to you, please notify me **immediately**.

Textbook: The main textbook is *Abstract Algebra: Theory and Applications*, Thomas W. Judson. This book can be *freely and legally* downloaded at <http://abstract.ups.edu/download.html>. You can also purchase a hardcopy, which is linked from the same site; the book is sold at cost. We will cover, approximately, Chapters 3-6, 9-11, 13-16, and 18.

We will also use some material from *Algebra: Abstract and Concrete*, Frederick M. Goodman. This book can also be *freely and legally* downloaded at <http://homepage.divms.uiowa.edu/~goodman/algebrabook.dir/download.htm>.

Learning Outcomes: A successful student in this course should:

- Understand and be comfortable working with definitions and concepts in group theory, including: subgroups; cyclic, dihedral, and symmetric groups; cosets and Lagrange's Theorem; homomorphisms; quotient groups and Isomorphism Theorems; direct products; The Fundamental Theorem of Finite Abelian Groups; group actions; and Sylow's Theorems.
- Understand definitions and concepts in ring theory, including: subrings; ideals; ring homomorphisms; quotient rings and Isomorphism Theorems; maximal ideals; and integral domains, Euclidean domains, PIDs and UFDs.
- Be able to state, understand, and apply structural theorems from the theory of groups and rings to solve theoretical problems.
- Be able to clearly communicate mathematical ideas related to abstract algebra.

Weekly homework problems, quiz questions, and problems on the midterm and final exam will provide students with opportunities to demonstrate the level of their abilities relative to the above learning outcomes.

More generally, mathematics courses should be viewed as an opportunity to develop and strengthen your problem-solving skills; you will be given numerous opportunities to grapple with complex problems and strategize solutions. These are skills you will certainly need to employ throughout as well as after

your time at Rice.

Ardila's Axioms¹: I believe in the axioms laid out by SFSU Professor Federico Ardila², and I will use them to guide my instruction of this course.

1. Mathematical potential is distributed equally among different groups, irrespective of geographic, demographic, and economic boundaries.
2. Everyone can have joyful, meaningful, and empowering mathematical experiences.
3. Mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs.
4. Every student deserves to be treated with dignity and respect.

Homework: You will have weekly written homework assignments. Every week I will assign 5-7 problems whose solutions you can either type up using LaTeX or write up by hand, and then scan and upload to **GradeScope**. You will receive an email invitation to register. Written assignments will be due by **11:59pm on Wednesdays**. The first assignment will be due on **Sept 1st**. To scan your solutions to problems, I recommend the App **Genius Scan**, though you are welcome to use whatever works for you.

Homework is a very important component of the course. This class has a heavy workload, and you should expect to spend a lot of time doing homework. An abstract mathematics class is in many ways similar to a language course: you must get lots of hands-on practice to internalize the definitions. Moreover, the homework is a chance for you to develop your mathematical communication skills. To this end, homework will be graded on correctness as well as clarity and exposition. The lowest homework score will be dropped at the end of the semester.

Not all problems on these assignments will be graded every week. They will typically be graded and returned to you a week after you hand them in.

A note about LaTeX: LaTeX is a very useful program for typesetting mathematics nicely. If you haven't used LaTeX before and would like to learn, a good place to start is <https://www.overleaf.com/>, which is free and provides templates. I am also happy to help you get started with this during office hours.

A note about accommodations: The global COVID-19 pandemic has not ended, and we are all living in a time of unprecedented circumstances. I recognize that this means you may experience hardships out of the ordinary throughout this semester.

To this end, you may have a 24-hour extension on every homework assignment, without having to notify me. If you believe you need a more significant extension, please **email me at least 12 hours before the deadline** with your proposed new deadline and a specific plan for how you will complete the assignment while staying current in this class. I will generally approve these requests, unless I notice a pattern of late work, in which case we'll need to have a conversation about necessary adjustments in order to stay better on-top of the material.

Quizzes and Exams: There will be approximately one quiz every other week (excluding exam weeks), during class on Fridays. Each quiz will cover the material discussed in lectures and on homework since the previous quiz. The lowest quiz score will be dropped at the end of the semester.

¹Mathematically, an *axiom* is a statement accepted as truth, on which all other work is built.

²<https://www.ams.org/publications/journals/notices/201610/rnoti-p1164.pdf>

There will be **one midterm exam** during the semester, administered in class. This is tentatively scheduled for **Wednesday, October 20th (week 9)**.

Final exam: The date for the final exam is not available at this time. It is the policy of the Mathematics Department that no final may be given early to accommodate student travel plans. If you make travel plans that later turn out to conflict with the scheduled exam, then it is your responsibility to either reschedule your travel plans or take a zero in the final.

Exams are pledged. Books, notes, phones, online resources and calculators will **not** be allowed on exams. Make-up exams will be allowed only in the case of a documented medical emergency. If an exam conflicts with a holiday you observe, please let me know before the end of the second week of classes.

Grading: Course grades are weighted according to the following:

Homework	40%
Quizzes	15%
Midterm Exam	20%
Final Exam	25%

Student Office Hours: These are times I have set aside specifically for you. Please come to office hours for any of the following reasons:

- To ask a question you have about homework or any other upcoming assessment.
- To ask a question about something that was said or done in class that you didn't understand.
- To listen and learn from other people's questions.
- To ask a question about why you received the grade you did on an assessment.
- To discuss how you're doing overall in the class.
- To tell me more about yourself, why you're taking this class, and what you hope to get out of your time at Rice.
- To tell me about some other math that you recently learned, thought was cool, and want to share.
- Ask me about what it's like to do math research, take more advanced math classes, etc.
- To discuss dogs, cycling, hiking, food, Houston,...

You are also welcome to schedule an appointment if you would like to meet outside of the above scheduled times (send an email to sarah.frei@rice.edu).

Honor Code: Homework is not pledged. You can collaborate with other students in the class. In fact, **you are very much encouraged to collaborate!** However, you should write up your solutions individually, and **you are not allowed to look up solutions in any written form.** In particular, you are not allowed to look up solutions online. Doing so will be considered an honor code violation.

All exams are pledged. You are not allowed to use calculators, notes, or resources to seek or look up solutions to exam problems, including but not limited to: electronic devices, Chegg, course hero, photo math, wolfram alpha, MathWay, etc, etc, etc. Using any such device or app will be considered a serious honor code violation and will be summarily and mercilessly reported to the Honor Council.

Attendance: Attendance is not required. However, lecture recordings (if they exist) will only be made available to students who are unable to get to campus before the start of the semester due to travel or visa restrictions, or those needing to quarantine due to exposure to covid-19. You are responsible

for all the material and announcements covered in class. While Canvas is a valuable resource, not all announcements will be posted there. You are responsible for reading any emails/announcements I send to the class through Canvas or email.

Statement of Conduct: The Department of Mathematics supports an inclusive learning environment where diversity and individual differences are understood, respected, and recognized as a source of strength. Racism, discrimination, harassment, and bullying will not be tolerated. We expect all participants in mathematics courses (students and faculty alike) to treat each other with courtesy and respect, and to adhere to the mathematics department standards of collegiality, respect, and sensitivity:

`mathweb.rice.edu/departement-statement-collegiality-respect-and-sensitivity`

as well as the Rice Student Code of Conduct. If you think you have experienced or witnessed unprofessional or antagonistic behavior, then the matter should be brought to the attention of the instructor and/or department chair. The Ombudsperson is also available as an intermediate, informal option, and contacting them will not necessarily trigger a formal inquiry. See the above website for details on how to contact the Ombudsperson.

Title IX Statement: Rice University cares about your wellbeing and safety. Rice encourages any student who has experienced an incident of harassment, pregnancy discrimination or gender discrimination or relationship, sexual, or other forms interpersonal violence to seek support through The SAFE Office. Students should be aware when seeking support on campus that most employees, including myself, as the instructor, are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. For more information, please visit `safe.rice.edu` or email `titleixsupport@rice.edu`.

Disability Support: If you have a documented disability that may affect academic performance, you should: (1) make sure this documentation is on file with Disability Resource Center (Allen Center, Room 111 / `adarice@rice.edu` / x5841) to determine the accommodations you need; and (2) get in touch with me during the first two weeks of class to discuss your accommodation needs. All such discussions will remain as confidential as possible.

Tentative Weekly Schedule: The following schedule of sections to be covered is approximate, and subject to change. Attend class regularly to stay up-to-date with what sections will be covered on homework and quizzes/exams each week. Note that this schedule does **not** include the homework assignments.

J=Judson, **G**=Goodman.

Week	Assessment	Sections	Notes
1		G 1.1–1.4	
2		G 1.5, 1.7, 1.10	
3	Quiz 1	J 3.2–3.3	No class Mon 9/6 (Labor Day)
4		J 4.1, 5.1–5.2	
5	Quiz 2	J 6.1–6.2, 10.1	
6		J 11.1–11.2	
7	Quiz 3	J 9.2, 13.1	
8		J 13.1	No class Mon 10/11 (Midterm Recess)
9	Midterm	Review, J 14.1	
10		J 14.1–14.2, 15.1	
11	Quiz 4	J 15.1–15.2, 16.1	
12		J 16.3	
13	Quiz 5	J 16.3–16.5	
14		J 18.1	No class Wed 11/24–Fri 11/26 (Thanksgiving)
15	Quiz 6	J 18.1–18.2, Review	
16/17	Final Exam		Finals, no classes