

School of Mathematical and Statistical Sciences
College of Science
Clemson University

MATH 4120-001, Algebra I
Fall 2026 MW 4:00–5:15pm
Martin M-103

Instructor: Matthew Macauley, Martin Hall O-325, macaule@clemson.edu, 656-1838 (no voicemail)

Course website: We will rarely use Canvas, except to host the textbook. Most of the course materials will be made freely available on the course website:

http://www.math.clemson.edu/~macaule/classes/f26_math4120/

Course Description: Group theory is the study of symmetry, and is one of the most beautiful areas in all of mathematics. It arises in puzzles, visual arts, music, nature, the physical and life sciences, computer science, cryptography, and of course, all throughout mathematics. The majority of this course will cover group theory, with a special effort made to emphasize the intuition behind the concepts and motivate the subject matter. The last part of the course will be devoted to ring theory.

In this class, we will discover abstract algebra through beautiful visuals, rigorous mathematics, and concrete examples, such as the Rubik's cube, frieze and wallpaper patterns, roots of unity, matrices, permutations, polytopes, and chemical molecules. The two main visual themes running throughout the course will be *Cayley graphs* and *subgroup lattices*. Guided by these pictures and examples, we will develop the structure and theory of groups: subgroups and cosets, products and quotients, homomorphisms and isomorphisms, group actions, conjugacy, automorphisms, semidirect products, and the celebrated theorems of Lagrange, Cayley, Cauchy, and Sylow. We will then turn to rings and fields, studying ideals, quotient rings, ring homomorphisms, maximal ideals, and finite fields. By the end of the semester, you will leave with a new appreciation for the beauty, power, and difficulty of an area of mathematics that, just a few years ago, you may never have imagined existed.

Prerequisite: Math 3110 (Linear Algebra) and Math 3190 (Introduction to Proofs).

Textbooks: There does not yet exist a textbook that covers the material in this course how I will teach it. I recently finished writing such a book, which was inspired by the delightfully wonderful 2009 book *Visual Group Theory*, by Nathan Carter. However, that was written for a more general audience, and so it is not rigorous enough for advanced math majors. As of the beginning of the class, I have finalized four of the nine chapters (#1, 2, 3, 9), and will post pdfs of all of them on Canvas.

Exams: There will be 2 in-class midterm exams, and one final exam. I will drop either your lowest midterm or one-half the final exam's weight. All exams will be closed notes and closed book.

Quizzes: I will give (almost) daily quizzes. They will be *very* short, and should take less than 1 minute. I expect that most people will miss a few days due to illnesses, etc. Rather than give make-ups, I will drop a number of your scores—at *least* everybody's lowest quarter.

Homework: There will be 14 weekly homework assignments, usually consisting of 4–5 problems. Though it can be a difficult habit to form, *I strongly encourage students try to complete one problem per day, rather than save them all for the last 24–48 hours.*

Working together is encouraged, but everyone must do their own work, and *collaborators must be cited*. Outside sources, such as webpages, must also be cited as well, if they were instrumental to a solution. Citations should be done on a problem-by-problem basis.

Homework assignments are due at 11:59pm EST, and will be submitted through Gradescope. Assignments can be submitted multiple times; only the last submission will be graded. There is a 3-hour grace period for deadlines, meaning that there is no penalty for assignments submitted within 3 hours of the deadline.

Assignments submitted after this period will not be accepted, but I will drop everybody's lowest score. This policy is intended to be an alternative to giving extensions due to unexpected circumstances such as an illness.

Any assignment that is typeset using L^AT_EX will get an automatic 24-hour extension.

Grading: Your final grade will be computed as follows:

Homework	12%
Quizzes	22%
Midterm 1	22%
Midterm 2	22%
Cumulative Final Exam	44%

I will drop either your lowest midterm grade, OR half the weight of your final exam; whichever is lowest. I also have the following “final exam policies,” though *they only apply if you have a passing grade on the quizzes*: If you get an unambiguous **A** on the final exam, then you will get an **A** in the course. If you get an unambiguous **B** or better on the final exam, then you will get (at least) a **B** in the course.

I do not impose arbitrary numeric cutoff lines for final grades, e.g., A=90+, B=80–89, etc. Rather, I grade by natural “clusters.” I tend to give difficult assignments and exams, and so the letter grades end up corresponding to lower numeric averages than they do in most classes. For example, in Spring 2022, the “**A** range” was from 72–93, and the “**B** range” was from 54–67.

Anyone whose final grade is below 25% will get an automatic **F** in the course. This does *not* mean that anything above 25% is necessarily a passing grade.

Communication Strategy: I prefer to communicate via emails rather than Canvas messages.

All of my email addresses (e.g., macaule@clemson.edu) go to the my mattmacauley@gmail.com gmail inbox, which I check multiple times a day. Though I have the gmail iPhone app, I don't get email push notifications. Also, I usually don't check email on Saturdays. I have had a few people tell me that occasionally, an email to my Clemson address bounces, and no one has really figured out why. I recommend using my gmail address.

I will typically be in my office every day, from roughly 8:15am–5:00pm, except when teaching (MW 2:30–5:15pm). If you need to reach me immediately during the week, feel free to call my office phone, at (864) 656-1838. If I'm not there, please send an email rather than leaving a voicemail.

If you send me an email and do not get a reply by the time you go to bed, please re-send it, as that is my mistake. Or perhaps, I'm up later than you (likely!), and this will bump it to the top of my inbox. Just click “Reply” and “Send”; no need to explain.

Office Hours: It has been my experience that evening Zoom office hours are much more frequently attended than (pre-COVID) on-campus office hours ever were. As such, I will hold Zoom office hours two days a week at 7pm (days TBD). I'll stick around to answer questions as long as there are some. However, except on days when HW is due, *I will only show up if at least one person RSVPs, either in class or by sending me an email before 4pm, saying they will attend.* If no one is there by 7:05pm, I will log off.

I am also available to meet by appointment, if desired, either over Zoom or in person. To make an appointment, email me and include block(s) of time in which you are available. Please let me know in advance if you want any Zoom meeting to be private, like if you want to discuss your grade. In that case, I will use a different Zoom meeting or a breakout room.

Finally, I'm usually in my office all day, every day. Feel free to drop by anytime; just knock if my door is closed.

Attendance: Please make an effort to attend all classes, and to be on time. I will try to show up at least 10 minutes early to all classes. In the unlikely scenario that I am absent 5 minutes after class has started, check your email. If you have not heard from me 10 minutes after class has begun, you may assume that class has been canceled.

If you cannot make class, due to illness, trip, or some other reason, please let me know as a courtesy. I will mark it as an excused absense, for the sake of quiz grading (see above).

Useful websites:

Course webpage: http://www.math.clemson.edu/~macaule/classes/f26_math4120/ (all relevant links posted here)

Canvas: <https://www.clemson.edu/canvas/> (will be used very sparingly, if at all)

Gradescope: <https://www.gradescope.com/> (click "Log in", then "School Credentials")

Key Dates

Aug 19 (Wed)	Classes begin
Aug 25 (Tue)	Last day to register or add a class
Sept 2 (Wed)	Last day to drop a class or withdraw from the University w/o a W grade
Sep 7 (Mon)	Labor Day
Oct 12–13 (M–Tu)	Fall break
Oct 27 (Tue)	Last day to drop a class or withdraw from the University w/o final grades
Nov 25–27 (W–F)	Thanksgiving break
Dec 2 (Wed)	Last day of class
Dec 8 (Tue)	Final Exam, 7–9:30pm

Modality: This is an in-person class, but we all must be prepared to shift to an online modality with little notice, and I will email a Zoom link that will be used if this happens. There is a strong chance that on at least one day, I will be sick (nearly impossible to avoid with two young kids at home), traveling due to a conference, or we will have a weather event like a tornado or snowstorm. If this happens, we will have class online (could be either synchronous or asynchronous), rather than it being canceled or taught by a substitute, and I will provide details ahead of time.

Technology in class: One particular study on multitasking showed that students on laptops score 11% lower than those not on laptops. Moreover, students who were not on laptops but had a laptop in their “line of sight” scored *17% lower!* Therefore, the use of laptops and cell phone in class will not be allowed. Tablets may be used *only* for taking notes.

Make-Up Policy: No make-up exams will be given. I will drop your lowest midterm, which means that if you miss a midterm, then your final exam grade will replace it. The homework deadlines will not be extended for individual students, and assigned homework must be turned in by the deadline.

Student Learning Outcomes: Upon successful completion of the course, students will be able to

Demonstrate a solid understanding of modern algebra (group theory and ring theory) at the undergraduate level.

Explain to a friend or family member who knows nothing about mathematics what group theory is, how it arises, and why it’s beautiful.

Explain how group theory can be thought of as the study of symmetry, and how it arises in puzzles, visual arts, the sciences, and other branches of mathematics.

Use visual diagrams and pictures to demonstrate the important definitions and concepts of group theory (of course, in addition to being able to define them rigorously).

Learn to understand, read, and write rigorous mathematical arguments on topics in algebra.

Develop good mathematical writing skills. Important aspects of this are *accuracy*, *clarity*, and *conciseness*.

“No exceptions”: In any class syllabus, no matter how they are worded, policies and phrases like “no exceptions”, “no make-ups”, etc. are *never* actually what they sound, and this is especially true this semester. Things happen, from natural disasters (hurricanes, tornados), to human disasters (9/11, school shootings), to personal and family tragedies, to health emergencies (COVID, auto accidents, hospitalizations). This does not mean that any exception or extension will be granted, but I will do my best to be reasonable, fair, and accommodating.

Make-Up Policy: I will drop your lowest midterm, which means that if you miss a midterm, then your final exam grade will replace it. The homework deadlines will not be extended for individual students, and assigned homework must be turned in by the deadline. **PLAN AHEAD:** If you submit assignments minutes before the deadline, you take the risk of bad luck, e.g., a power outage, computer freeze or crash, personal emergency, zombie attack, etc., that could make you miss the deadline.

By default, any exam that was scheduled at the time of a class cancellation due to power outage / inclement weather will be given at the next class meeting. Any extension or postponement of assignments or exams must be granted by me via email or Canvas within 24 hours of the weather-related cancellation.

Mental health: Your mental health is important to me, and I am always available to talk. Please don’t hesitate to reach out. We’re in this together, and all of us are struggling in some regards, myself included.

Social media: If you want to connect with me on Social Media, then use LinkedIn or Bluesky. I don’t really use the first one, though I have an account. I use the second one to promote my mathematical materials and current book project. I will not accept friend requests on Facebook, there is just too much potential for risk and liability.

Academic Integrity: “As members of the Clemson University community, we have inherited Thomas Green Clemson’s vision of this institution as a ‘high seminary of learning’. Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.”

Special Accommodations: Students with disabilities who need accommodations should make an appointment with Dr. Arlene Stewart, Director of Disability Services, to discuss specific needs within the first week of classes. Students should present a Faculty Accommodation Letter from Student Disability Services when they meet with instructors. Student Disability Services is located in Suite 239 Academic Success Building (656-6848; sds-1@clemson.edu). Please be aware that accommodations are not retroactive and new Faculty Accommodation Letters must be presented each semester.

Title IX Policy: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran’s status, genetic information or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

The University is committed to combatting sexual discrimination including sexual harassment and sexual violence. As a result, you should know that University faculty and staff members who work directly with students are required to report any instances of sexual harassment and sexual violence, to the University’s Title IX Coordinator. What this means is that as your professor, I am required to report any incidents of sexual harassment, sexual violence or misconduct, stalking, domestic and/or relationship violence that are directly reported to me, or of which I am somehow made aware.

There are two important exceptions to this requirement about which you should be aware:

Confidential Resources and facilitators of sexual awareness programs such as “Take Back the Night and Aspire to be Well” when acting in those capacities, are not required to report incidents of sexual discrimination.

Another important exception to the reporting requirement exists for academic work. Disclosures about sexual harassment, sexual violence, stalking, domestic and/or relationship violence that are shared as part of an academic project, a research project, classroom discussion, or course assignment, are not required to be disclosed to the University’s Title IX Coordinator.

This policy is at <http://www.clemson.edu/campus-life/campus-services/access/title-ix/>. Alesia Smith is the Executive Director for Equity Compliance and the Title IX Coordinator. Her office is at 223 Holtzendorff Hall, phone number is 864.656.3181, and email address is alesias@clemson.edu.

Copyright Statement: Some of the materials in this course are possibly copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Refer to the Use of Copyrighted Materials and “Fair Use Guidelines” policy on the Clemson University website for additional information: <http://clemson.libguides.com/copyright>.