

Math 578, Spring 2021

Algebraic Structures

Credit hours: 3

Department: Mathematics

Time/location: TuTh 9:30am–10:45am in Zoom 951 0381 4267

Instructor: David Rose

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Target audience: Advanced undergraduates interested in a thorough treatment of abstract algebra as preparation for graduate study in mathematics or a related field. The pace of the course and the level of exposition will assume this target audience. Those interested in a more leisurely and less demanding (but less comprehensive) treatment of abstract algebra might consider the alternative Math 534.

Course prerequisites: Both hands-on and theoretical understanding of linear algebra, including matrices, vector spaces, linear transformations, and (ideally) quotient spaces and the rank-nullity theorem.

Course goals and learning objectives: To develop a working knowledge of groups, rings, and fields.

Course requirements To demonstrate knowledge of the above, via homework assignments and examinations.

Zoom lectures/etiquette: Due to the COVID-19 pandemic, this course will be taught virtually via zoom. The lectures will be given synchronously, and you are expected to attend. (Prof. Rose will record/distribute lectures, but you will get much more out of this course if you attend the lectures live and participate.)

Please keep your camera on (whenever possible) and your microphone muted during lecture. Feel free to unmute if you'd like to ask a question, or answer one posed by Prof. Rose. Lastly, the zoom "lecture room" is password protected, for our security; please do not distribute the password.

Textbook: We are using the **7th edition** of *A First Course in Abstract Algebra* by Fraleigh. Although the content is similar to other editions, the homework problems will be assigned from the 7th edition, so if you have a different version be sure to look at a friend's/classmate's 7th edition when working on problems.

Course communication via Piazza Unfortunately, the following holds for this course:

$$\# \text{ of students} > \# \text{ of TAs} = \# \text{ of Prof. Roses.}$$

To ensure that questions are addresses in a prompt and organized manner, we will utilize Piazza, an online Q&A forum for our course, where students can post questions, and have them answered by fellow students, TAs, or Prof. Rose. Please sign up here:

<https://piazza.com/unc/spring2021/math578>

if you haven't already been enrolled.

All questions that are appropriate for public discussion (i.e. concerning mathematical content, general course logistics, etc.) should be asked via a **public** Piazza post. Private Piazza communication should be reserved for questions of a personal nature, or those containing sensitive information.

In order to encourage Piazza use, direct email communication to Prof. Rose or Andrew should only be used in exceptional circumstances, and will typically only be addressed in such cases.

Course content: Here is a preliminary schedule, with corresponding sections from the book:

| | Dates | Topics |
|------------|------------------|--|
| Week 1 | 1/19, 1/21 | Groups and subgroups (§4,5) |
| Week 2 | 1/26, 1/28 | Cyclic groups and generators (§6,7) |
| Week 3 | 2/2, 2/4 | Permutations and the symmetric group (§8,9) |
| Week 4 | 2/9, 2/11 | Theorem of Lagrange and homomorphisms (§10,20,13) |
| Week 5 | 2/16, 2/18 | Quotient groups and the isomorphism theorems (§14,34) |
| Week 6 | 2/23, 2/25 | Classification of (f.g. abelian) groups, products (§15,11) |
| Week 7 | 3/2, 3/4 | Additional material on groups (§16,17?) |
| Week 8 | 3/9, 3/11 | Midterm |
| Week 9 | 3/16, 3/18 | Rings, fields, and integral domains (§18,19,20) |
| Week 10 | 3/23, 3/25 | Field of fractions; ideals and quotients (§21,26) |
| Week 11 | 3/30, 4/1 | Prime/maximal ideals; introduction to factorization (§27) |
| Week 12 | 4/6, 4/8 | UFDs, PIDs, and Euclidean domains (§45,46) |
| Week 13 | 4/13, 4/15 | Polynomials rings (§22,23) |
| Week 14 | 4/20, 4/22 | Field extensions (§29,30) |
| Week 15 | 4/27, 4/29 | Algebraic extensions and geometric constructions (§31,32) |
| Week 16 | 5/4 | Finite fields (§33) |
| Final Exam | 5/11 at 8am | |

Professor Rose reserves the right to deviate from the posted schedule as needed.

Grades: Your grade will be based on the following:

- Homework (30%)
- Mid-term examination (30%) on **March 9th**.
- Cumulative final examination (40%) on **May 11th** at **8am**.

Although not a formal component of the grading scheme, students are expected to regularly attend and actively participate in lectures.

Raw final course grades will be curved (typically with the average score set no lower than a B-), and the curve will be no harsher than the standard 10-point UNC grading system. An approximate curve for the midterm will be announced when the exams are returned.

Exam protocol: Exams will be administered online via Gradescope, and monitored in real time via Zoom. During the exam, you are required to show your face as well as your work area and immediate surroundings at all times. At the end of the exam time, you will be required to submit through Gradescope within 15 minutes of the end of the exam period. If you are not able to accomplish this because of technological or personal reasons, please work with Prof. Rose to develop an alternate testing approach.

Missed midterm exams will be treated on a case-by-case basis. If the absence is excused, the final exam grade will be substituted in place of the missed midterm. **No** make-up midterm will be given.

Homework: In order to properly learn the course material, it is crucial to develop the necessary problem-solving skills. As such, homework will be assigned weekly (typically on Friday, to be collected the following Friday). Students are allowed to work on homework collaboratively, but everyone should write up their own solutions. I encourage people to start working on the homework over the weekend, and to come to office hours with questions. I'm also happy to discuss quick questions immediately before/after lecture.

Submission will be via Gradescope:

<https://www.gradescope.com/courses/230787>

and you will need the passcode: N8P62K to get things up and running. As is the case with many standard textbooks, you may be tempted to search for homework solutions online; I urge you **not** to do so, since 1) you will learn best by struggling with the problems, and eventually fighting through your confusion (which won't happen if you look up solutions), and 2) it is a violation of the UNC Honor Code.

Academic integrity: Don't cheat. Don't act dishonestly. During my 4.5 years at UNC I've caught 7 cheaters, and the consequences for these students were much, much worse than the (low-ish) grades they would have received. It's not worth it.

Syllabus changes: Professor Rose reserves the right to make changes to the syllabus, including test dates, should any unforeseen circumstances occur. These changes will be announced as early as possible so that students can adjust their schedules.