Math 4120/6120: Modern Algebra

Fall 2017

Martin Hall, Room M-307, TR 9:30–10:45

Instructor

Dr. Matt Macauley (macaule@clemson.edu)
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Phone: (864) 656–1838 (no voicemail!)
Office Hours: (subject to change!) MWF 2:15–3:15pm, or by appointment
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Textbook

Choice of either *Visual Group Theory*, by Nathan Carter (currently out-of-print; there should be a 2nd printing soon), or the e-book *An Inquiry-Based Approach to Abstract Algebra*, by Dana C. Ernst. The latter is available at

http://danaernst.com/teaching/mat411f16/materials/

in pdf form, both the entire book and individual chapters.

Prerequisites

Math 3110 (Linear Algebra) and Math 3190 (Intro to proofs).

Overview

Group theory is the study of symmetry, and it 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. This course will cover the basic concepts of group theory, with a special effort made to emphasize the intuition behind the concepts and motivate the subject matter. After group theory, we will study field theory and ring theory, which involves more advanced algebraic objects.

Many pictures and diagrams will be provided. In class, we will play with the Rubik's cube. We will analyze art freises, chemical molecules, and contra dances. At the end of the semester, you will truly understand groups, subgroups, cosets, products and quotients, homomorphisms, group actions, conjugacy classes, centralizers, normalizers, semidirect products, theorems by Lagrange, Cayley, Cauchy, and Sylow, and what Évariste Galois stayed up until dawn writing the night before his untimely death in a duel at age 20, that remains one of the most celebrated achievements in all of mathematics, and which provided the framework necessary to elegantly solve several classic mathematical mysteries of the ancient Greeks.

In the end, you will leave with a new appreciation of the beauty, and difficulty, of an area of mathematics you never dreamt existed.

Learning Outcomes

By the end of the semester, students will be able to:

- Demonstrate a solid understanding of abstract algebra at the undergradate 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 brances of mathematics.
- Use visual diagrams and pictures to demonstrate the important definitions and concepts of group and ring theory (of course, in addition to being able to define them rigorously).

- Learn to understand, read, write, and critique rigorous mathematical proofs on abstract algebra.
- Develop good mathematical writing skills. Important aspects of this are *accuracy*, *clarity*, and *conciseness*.

Homework Homework assignments will be due roughly once a week. *Please start them early!* Homework must be handed in *in person*. Late homework will *not* be accepted.

I will post the homework assignments on my website, as I like to make all materials freely available to everybody (Warning: Websites such as *Course Hero* that sell downloaded free materials are a SCAM; spread the word!). You may collaborate on homework problems, but you *must* write up and submit your assignments separately as well as document your collaborators. You are encouraged to typeset your homework assignments with LaTeX, and you will get an extra 24-hour extension if you do. You should keep all the graded homeworks in case of missing grades due to missing name or typo errors.

Grading The final grade will be calculated as follows:

Homework:	25%
Quizzes	15%
Midterm 1:	20%
Midterm 2:	20%
Final exam:	40%

I will drop either your lowest midterm grade, OR half of the weight of the final exam; whichever is lowest. Also, if you get at least an A or B on the final exam, then you will get at least that grade in the course, *assuming you attend class very regularly and have a passing grade on the homework*.

Policies

- All of the course materials will be freely avaiable on the course website.
- All use of cell phones, laptops, and tablets are prohibited during lecture and exams.
- I will NOT post homework solutions. However, I will gladly help you with any of the problems during office hours or whenever I'm around, which is quite frequently.
- 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, anyone with a final grade of 85% will be solidly in the A range.

Key Dates

Aug 23 (Wed)	Classes begin; late enrollment fee applies
Aug 29 (Tue)	Last day to register or add a class
Sep 5 (Tue)	Last day to drop a class or withdraw from the University without a W grade
Oct 16-17 (M-Tu)	Fall break
Oct 31 (Tue)	Last day to drop a class or withdraw from the University without final grades
Nov 22-24 (W-Fr)	Thanksgiving break
Dec 8 (Fri)	Last day of class
Dec 13 (Wed)	Final Exam, 8:00–10:30am.
Dec 21 (Thu)	Graduation

The official statement on 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.

When in the opinion of a faculty member, there is evidence that a student has committed an act of academic dishonesty, the faculty member shall make a formal written charge of academic dishonesty including a description of the misconduct, to the Dean of the Graduate School. At the same time, the faculty member may, but is not required to, inform each involved student privately of the nature of the alleged charge.