

Clemson University
School of Mathematical & Statistical Sciences

MATH 4120-141 / 4190-141, Modern Algebra
Summer Session I, 2020

Instructor: Dr. Matthew Macauley

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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. This course will cover the basic concepts of group theory, with a special effort will be made to emphasize the intuition behind the concepts and motivate the subject matter. It will also cover basic Galois theory and ring theory, which are more advanced topics.

Many pictures and diagrams will be provided. We will analyze art freises, chemical molecules, and braids. At the end of the semester, you will truly understand groups, rings, subgroups, cosets, ideals, 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.

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

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

Communication Strategy: Email is the best way to reach me. I will check it *at least* every few hours during the hours of 8am–9pm, seven days a week.

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. Just click “Reply” and “Send”; no need to explain.

Students are responsible for checking their Clemson email regularly, as that address will be the one subscribed to the class email list. I am not responsible if you miss important messages because you use a different email account.

Office Hours: I will be available for Office Hours every day on Zoom, and I can connect my iPad to use as a virtual whiteboard. The URL will be the same for all meetings, and will be emailed to the class list. There will be two types of office hour meetings:

1. I will log onto Zoom every weekday at 9am, and will stick around to answer questions as long as there are some. If it's 9:15am and nobody is there, I will log off.
2. If you want to meet at a different time, email me and we can make an appointment. In that case, include block(s) of time in which you are available.

Please let me know in advance if you want any meeting to be private, like if you want to discuss your grade. In that case, I will use a different Zoom meeting.

Useful websites:

Course webpage: http://www.math.clemson.edu/~macaule/classes/m20_math4120/ (all relevant links posted here)

Canvas: <https://www.clemson.edu/canvas/> (will be used minimally)

Texts:

Visual Group Theory, by Nathan Carter (recommended)

Abstract Algebra: Theory and Applications, by Tom Judson (required; a free textbook)

An Inquiry-Based Approach to Abstract Algebra, by Dana Ernst (required; a free textbook)

Required technology:

A computer on which you can watch the YouTube lecture videos and view pdf files.

A reliable internet connection.

A free Zoom account, and a video camera that allows you to be recorded over Zoom (for exam proctoring).

A smartphone scanning app. There are many free apps, such as CamScanner or Adobe Scan. If you do not have a smartphone, a traditional scanner will suffice, but a smartphone app is preferred.

Calculators/Other Technology: A calculator is not required, but it may be useful when we cover cryptography. You will be allowed to use a traditional calculator on the exams (i.e., *not* a smartphone app, or computer, etc.).

Schedule: This course is being offered in an entirely ONLINE and ASYNCHRONOUS format through the course website and Canvas (only for submitting HW). The course calendar can be found on the course website.

Lectures: There will be 49 lectures, ranging in length from 11 to 48 minutes, that are be available on YouTube. Students will be required to watch approximately 2 lectures each day. The lecture schedule is listed on the course calendar.

Homework: Homework assignments are posted on the course webpage. Students will be required to upload and submit each assignment on Canvas as a single pdf file with multiple pages (*not* one document per page). Students can either hand-write and scan their assignment, or typeset them using \LaTeX . Homework assignments must be submitted by 11:59pm on the day they are due. Late assignments will NOT be accepted.

Course Format: This course is being offered in one summer semester so EVERYTHING GOES QUICKLY. I have taught this class during a regular semester and I plan to cover the same amount of material and assign the same amount of homework, but over 5 weeks instead of 15.

You should expect to spend *at least* 3 hours per day on this course:

Watching 1–2 online lectures.

Working homework problems.

You will prepare for two Midterms and a cumulative Final Exam.

Because this is an online course, our chief means of communication is through e-mail. It is important that you check your Clemson e-mail on a regular basis - at least once a day.

Exams: There will be two 90-minute midterm exams during the semester and a cumulative 3-hour final exam: Midterm 1 on Wed. May 27, Midterm 2 on Wed. June 11, and the Final Exam on Thu. June 18. I will proctor all exams over Zoom during a common time that we decide upon in advance. You must provide consent to having the meeting recorded.

Exam checklist (things to bring):

- Plenty of blank scratch paper and pens or pencils.
- One 5×7 handwritten notecard; double-sided is okay.
- Calculator.
- Smartphone (for scanning your exam when you finish).

Exam rules:

- Before beginning the exam, you must do a “room scan” with your camera, and also verify that all of the paper you brought is indeed blank.
- You must share your video for the entire duration of the exam.
- The camera must be far enough away so I can see your hands and paper at all times. That is, I must be able to verify that you are not using a phone or computer.
- When you are finished, send me a private Zoom Chat to let me know, and then scan and email your exam to me while still on camera. It must be scanned in one multi-page pdf document, and *not* multiple individual one-page documents.

It is strongly recommended that you practice with your smartphone scanning app before the exam.

Grading: Your final grade will be computed as follows:

Homework	25%
Midterm 1	25%
Midterm 2	25%
Cumulative Final Exam	50%

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 get at least that grade in the course, *assuming you have a passing grade (60%) on the homework*.

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. **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.

Student Learning Outcomes: Upon successful completion of MATH 4120, students will be able to

Demonstrate a solid understanding of modern algebra (group theory, ring theory, and Galois 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 proofs on topics in algebra.

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

Key Dates

May 12 (Tue)	Classes begin; late enrollment fee applies
May 13 (Wed)	Last day to register or add a class
May 18 (Mon)	Last day to drop a class or withdraw from the University without a W grade
May 25 (Mon)	Memorial Day holiday
May 27 (Wed)	Midterm 1
June 5 (Thu)	Last day to drop a class or withdraw from the University without final grades
June 10 (Wed)	Midterm 2
June 16 (Tue)	Last day of class
June 18 (Thu)	Final Exam
June 24 (Wed)	Deadline to submit grades

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.

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>

Statement Included for Certification Purposes: In this online course, you will interact with the content, instructor and classmates on at least a weekly basis through course assignments, asynchronous discussions and/or synchronous sessions as indicated in this syllabus.