

Math 4813, Groups and Representations

Course Information

Spring 2018

Professor: Dr. Lisa Mantini, 410 Math Sciences

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- ▷ Office hours: MW 1:30-2:20 PM and 3:30-3:50 PM, and by appointment.

Course Times: MWF 2:30 – 3:20 PM in 509 MSCS.

Course Objectives: The aim of this course is to introduce you to my favorite topic in abstract algebra, the theory of groups and their *representations*, or actions as symmetry groups of objects like geometric figures, molecules, or data sets. Our objective is to know and be able to use basic topics in group theory (subgroups, cosets, conjugacy classes, quotient groups, etc.), then group actions both in the abstract and as linear transformations inside a vector space. Then we will study representation theory and character theory. We will finish with what I like to call the *numerology* of finite groups, some amazing facts seen in simple numerical relationships that have profound implications for the underlying groups. Our approach will be to blend theorems and proofs with calculation of enough examples to help the core ideas of the course make sense. We will also be both pure and applied mathematicians this term – I hope to end with an application of group theory to chemistry, computing the modes of vibration of a molecule using the character table of its symmetry group. Pretty cool stuff.

Prerequisites: The prerequisites are linear algebra (Math 3013 with grade of “C” or better) and an introductory experience in mathematical proof and basic abstract algebra (Math 3613 with grade of “C” or better), or consent of the instructor. Some knowledge of differential equations may be used towards the end – folks who have not studied Math 2233 may need a little tutorial at the time. You’ll find that I may review specific facts when needed, or else feel free to ask for a reminder.

Texts: There is no purchased text for this course. I will pass out notes as we go along. Your old textbooks from Introduction to Modern Algebra (particularly the chapter on elementary group theory) and Linear Algebra (particularly eigenvectors and eigenvalues, diagonalization, and change of basis) will sometimes be useful. The text *Representations and Characters of Groups*, second edition, by Gordon James and Martin Liebeck, is a useful reference (but it is much more detailed than we need and it is English, so all matrices act on the wrong side).

Course Requirements: Students enrolled in this course will complete the following:

ITEM	DUE DATE	POINTS	WEIGHT
Exam 1	Monday 26 February	150 pts	25%
Exam 2	Monday 16 April	150 pts	25%
Assignments	various	200 pts	33%
Final Project	May 2, 4, or 7	100 pts	17%
TOTAL		600 pts	100%

Graduate Credit: Graduate students wishing to earn graduate credit will complete all assignments individually, including the final project and any group work assigned, and they may have an occasional extra problem on an assignment. Any curve applied to the undergraduate and/or graduate sections will be determined independently.

Grading: The points assigned during the semester add up to a total of 600 points for the course. Preliminary cutoffs for the final course grade are as follows:

- ▷ 540 points (90%) guarantees an A in the course;
- ▷ 480 points (80%) guarantees a B;
- ▷ 420 points (70%) guarantees a C;
- ▷ 360 points (60%) guarantees a D.

Homework: Homework will be collected about once every week for most weeks. I expect about 8–10 assignments, worth about 20–25 points each. Homework is typically due by midnight on the days it is due, but submitting assignments in class is preferred, unless we decide to may use the Dropbox function in Brightspace if that is agreeable. Late homework is very rarely acceptable and only if approved by me **in advance**. Please prepare your homework on 8.5” by 11” paper, stapled, with no ragged edges. In order to receive full credit your work must be clear and legible, you must show all work, and explanations must be written out in correct English sentences. If scanning an assignment to upload, use a scanning app to create a single pdf and make sure you can read it clearly. Label the file with the course number, assignment number, then your last name.

Final Project: The final written project will be your opportunity to investigate in depth something related to a topic we have covered in this course. You will prepare a written paper on your topic (approximately 5 pages in length) and will present your topic to the class either during Pre-Finals week or during our scheduled final exam period on Monday, May 7 at 2:00 PM (note different start time). I will discuss possible topics with the class at a later date.

Drop Policy and Special Dates: Please note the following dates for Spring 2018:

- ▷ Last drop day without charge: Tuesday, January 23;
- ▷ Last drop day with 50% refund: Friday, January 26;
- ▷ Spring Break: March 19–23;
- ▷ W withdrawal deadline: Friday, April 13;
- ▷ Scheduled final exam period: Monday, May 7, 2:00–3:50 PM.

Attendance Policy: Attendance is a part of your course grade only during the student presentations at the end of the semester, but it is very highly recommended at all times. You are responsible for all material covered in class and all assignments. I would prefer you notify me in advance of absences.

Academic Dishonesty: Oklahoma State University is committed to the maintenance of the highest standards of integrity and ethical conduct of its members. This level of ethical behavior and integrity will be maintained in this course. Participating in a behavior that violates academic integrity (e.g., unauthorized collaboration, plagiarism, cheating on examinations, helping another person cheat, and so on) will result in your being sanctioned. Violations may subject you to disciplinary action including the following: receiving a failing grade on an assignment, examination or course, receiving a notation of a violation of academic integrity on your transcript (F!), and being suspended from the University. Carefully read the OSU policy at academicintegrity.okstate.edu.

Specifically, for this course, any group assignments and routine homework may be discussed with other students but all written work should be your own unless an assignment is specifically identified as a group assignment. You should not show your written work on an individual assignment to other students and should not read the written individual work of another student before you submit your own work. **No collaboration or discussion of problems from a take-home quiz or exam is permitted unless those discussions take place with your instructor.**