

MATH 4800 - INTRODUCTION TO RESEARCH

Instructor: Adam Booher **Email:** boocher@math.utah.edu **Office:** JWB 315
Class: MW 1:25 - 2:45 AEB 306

Office Hours: Monday 2:45 - 3:45pm , Tuesday: 9:30-10:30am, Friday 1:30 - 2:30pm

Textbook: *Representations and Characters of Groups*, James and Liebeck. Additional course materials will be posted on the website. Grades will be reported using canvas.

Website: I'll post everything to Canvas.

Course Description: Roughly speaking, group theory is the mathematical study of symmetry. Shapes in the plane may have rotational or reflectional symmetry; a collection of n objects can be permuted in $n!$ different ways; a Rubik's cube can be configured in roughly 43 quintillion different ways. Symmetries can be composed and in general the order of composition matters. The resulting mathematical objects - groups - have a rich structure. Understanding this structure can be quite challenging. In this course we'll start with some down-to-earth examples of groups to build some intuition and the ability to do computations. Then we'll dive into the basics of Representation Theory - a field that studies how to represent abstract groups as a collection of square matrices. We'll see that the trace of these matrices is something very worthy of study - the character of the representation. Students should expect to work hard solving problems, doing computations, reading and presenting proofs in class. The course grade will be an equal combination of homework, class participation and an open-ended project.

A solid background in Linear Algebra is essential, as is some exposure to group theory. Depending on background, some self-study over the summer might be necessary. We will mostly follow the textbook *Representations and Characters of Groups* by James and Liebeck, though many topics will be supplemented with lecture notes, additional problems and other resources.

The course will meet Mondays and Wednesdays 1:25PM-2:45PM in AEB 306.

Course Objectives: At the end of this course, the students will:

- (1) Know how to carefully read an advanced undergraduate textbook and understand proofs;
- (2) Be able to present proofs to the class;
- (3) Know the basics of group theory, representations and characters;
- (4) Gain experience in what mathematical research is like through an open-ended project.

Homework and Attendance Policy There will be daily homework and attendance will be mandatory. Missing more than two classes during the semester can result result in a lower grade. This course will move quickly and classroom time is very important. Since space is limited in this course, I ask everyone to be committed to attending every class.

Strategies for Success: This class will be challenging - you will learn some abstract definitions and will be required to have a deep understanding. You'll be asked to solve problems and the solutions will require creativity. This course is very much a language course as much as anything else. Developing fluency requires practice.

I find that daily practice is the best pathway to success in a number of areas - consider music, meditation, yoga, etc. Consider making a commitment to think about mathematics on your own each day. Most days this will mean working on the homework, or participating in discussion. But if you find yourself busy with life's other demands, even five minutes of thinking "What was it we did in class the other day?" will do wonders.

There will be no extra credit in this course, but notice that participation is a component of your grade. Success is very strongly correlated with effort, and I can promise that if you are struggling in this course then attending office hours as well as volunteering in class will be very useful to your understanding in the course.

Academic Integrity: All University of Utah policies regarding ethics and honorable behavior apply to this course.

Resources for you:

1.) **ADA:** The University of Utah is fully committed to affirmative action and to its policies of nondiscrimination and equal opportunity in all programs, activities, services, and employment without regard to race, color, national origin, sex, age, disability, gender identity/expression, religion, sexual orientation, and status as a protected veteran. The University seeks to provide equal access to its programs, services, and activities for people with disabilities. Reasonable prior notice is needed to arrange accommodations. Evidence of practices not consistent with these policies should be reported to the University's Title IX/ADA/Section 504 Coordinator: Director, Office of Equal Opportunity and Affirmative Action, 201 S Presidents Cr., Rm 135, Salt Lake City, UT 84112. 801-581-8365 (V/TDD).

2.) **Wellness Center:** Are you concerned about stress, sleep difficulties, anxiety, depression, cultural differences, relationship difficulties, balancing work and school, or finances? Would you like to perform better in class, help a friend in distress, or learn more about physical activity or nutrition? Contact the Center for Student Wellness; wellness@sa.utah.edu; www.wellness.utah.edu; 801-581-7776.

3.) **Veterans:** If you are a student veteran, I want you to know that the U of Utah has a Veterans Support Center on campus. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu/>. Please also let me know if you need any additional support in this class for any reason.

4.) **LGBTQ:** If you are a member of the LGBTQ community, I want you to know that my classroom is a safe zone. Additionally, please know that the U of Utah has an LGBT Resource Center on campus. You can visit their website to find information about the support they can offer, a list of events through the center and links to additional resources: <http://lgbt.utah.edu/>. Please also let me know if you need any additional support in this class for any reason. My pronouns are (he/him/his) and please let me know if you have preferred pronouns.

5.) **Mathcenter:** There is free tutoring available at the Math Tutoring Center, located in room 155 of the T. Benny Rushing Mathematics Center (adjacent to the LCB and JWB). To let the tutors know that you need help, simply put up one of the flags. If you find that you'd prefer more personalized attention than our tutoring center can give, try the ASUU Tutoring Center (7 dollars an hour), 330 SSB, or pick up a private tutor list from the math department office (233 JWB). For more information look here: <http://www.math.utah.edu/ugrad/mathcenter.html>.