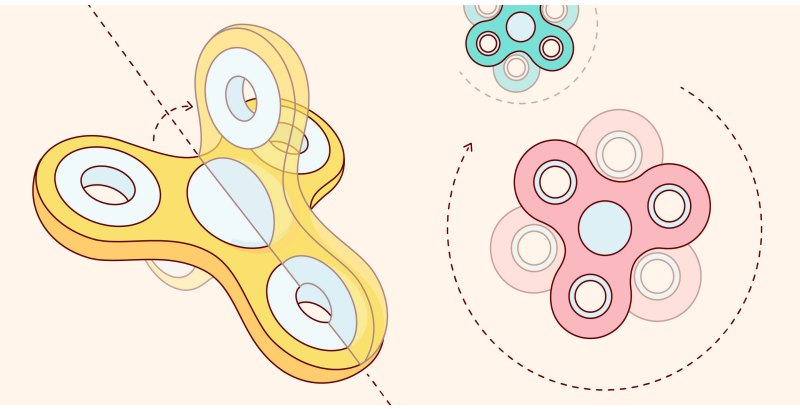
ma312: Abstract Algebra I - f24



Class Meetings

- Fall 2024 (Aug26 → Dec13)
- MWF 10:00-10:50AM
- JXJ 3103
- zoom link - passcode 685767

▼ Instructor

Daniel Rowe
darowe{at}nmu{dot}edu

I'm an associate professor of mathematics in the Mathematics and Computer Science Department at Northern Michgan University. I've been a professor at NMU for nine years, and I am very passionate about the praxis of doing mathematics and teaching it. I grew up on a fishing camp in Northwestern Ontario, Canada.

▼ Need Math Help?

- Office Hours
- W 1-2, R 10-11, F 11-12
- JXJ 2228
- zoom link - passcode 809390
- read the relevant section(s) of our materials
- study all posted solutions
- re-watch the recorded lectures
- math tutor lab

▼ Class Structure

- hybrid-flexible, in-person and over zoom
- recordings available 2-3 days after each class
- strive for in-person attendance
- avoid becoming reliant on zoom and recordings!
- use them for extenuating circumstances only
- engagement is vital to learning mathematics (or anything)

- (30%) Homework
- (10%) Collaborative In-Class Quizzes
- (30%) Traditional In-Class Midterm Exam
- (30%) Traditional In-Class Final Exam

▼ Grade Scale

A (92-100%)
A- (90-91%)
B+ (86-89%)
B (82-85%)
B- (80-81%)
C+ (76-79%)
C (72-75%)
C- (70-71%)
D+ (66-69%)
D (62-65%)
D- (60-61%)
F (⩽ 59%)

▼ Learning Outcomes

This course is an introduction to the vast area of mathematics referred to as *algebra*. This semester will focus on a small subset of topics from algebra, but will introduce students to the important themes of symmetry, transformation, and representation that underly the subject. At the end of the class, a student will be able to understand and apply:

- matrices and permutations

- groups, subgroups, order, generators and relations, homomorphisms
- particular finite groups: such as S_n, C_n, D_n, $Z/_n$, $(Z/_n)^x$.
- particular linear groups: such as GL_n, SL_n, O(n), SO(n)
- group actions, orbits, stabilizers, Frobenius' counting formula
- applications: elementary number theory, orbit counting problems, symmetries of objects.

▼ Success in College Courses

- the instructor's **job** is to ensure the course content is clear, organized, and interesting

- your **job** is to attend as many classes as you can, engage your mind, ask questions, read, and budget (at least) 1-2 focused hours every week to work on the course content

▼ Academic Honesty

In the spirit of academic honesty, credit for this section is due to Asher Auel, as this is an adapted form of their discussion of academic honesty in mathematics.

- Working with others on mathematics, and using electronic resources is both *highly encouraged* and *fun*. You may work with anyone (e.g. classmates, non-classmates, tutors, etc.) If this is done well, you'll learn more effectively and efficiently.

  Here's the fundamental rule:

  Work with anyone or anything to develop your own personal understanding of the ideas required to *solve* your homework problem, but always *write-up* the final draft by yourself and in your own words.

- Writing up the final draft is just as important as figuring out the problems on scratch paper with your friends, using the internet, ChatGPT, etc. If you work with people, or use electronic resources on a particular homework:

  You must list your collaborators and electronic sources at the top of the very first page. This makes the process completely transparent and honest.

▶ A Note About Copying Mathematics

▶ Punishments

▶ Accessibility

▼ Reading Materials

- here are my hand-written notes on abstract algebra
- the following is a good, free, open textbook on abstract algebra
- *Abstract Algebra: Theory and Applications*, Thomas W. Judson, 2020.
- how do I read the text to follow the flow of our class?
- 1.1 → 1.2 → 5.1 → 3.1 → 3.2 → 3.4 → 4.1 → 11.1 → 9.1 →
- here are some (ungraded) practice problems and their solutions

▼ Homework + Quizzes + Exams

- hw1 (due 9/8 @ 11:59PM)
- hw2
- hw3
- hw4
- hw5
- hw6

- quiz1
- quiz2
- quiz3

- practice_midterm
- midterm_exam

- practice_final
- final_exam

▶ Extra Credit Problems

▶ Submitting Your Work

Schedule + Recordings

> colored text = clickable links
> late homework may be submitted anytime during the semester
> before the solutions are posted (-0%), otherwise (-50%)

wk1: aug26 → aug30

□ study this webpage and all class information
□ study the lectures
□ start working on hw1

8/26
- introduction to abstract algebra
- geometric and inductive proofs

8/28
- proofs by induction
- geometric proofs
- the history of x in algebra
- balls colliding along a rod

8/30
- balls colliding along a rod
- matrices
- matrix inverses

wk2: sept2 → sept6

□ study the lectures
□ keep working on hw1

9/2
- Labor Day - no class

9/4
- help with hw1
- row operations
- elementary matrices

9/6
- column operations
- the matrix transpose
- determinants of nxn matrices
- properties of determinants
- nice video on determinants

wk3: sept9 → sept13

□ study the lectures
□ start working on hw2

9/9
- permutations of n objects

9/11
- disjoint cycle decomp.
- cycle type
- decomp. into transpositions
- decomp. into simple transpositions

9/13
- decomp. into simple transpositions
- permutation matrices
- the sign of a permutation

wk4: sept16 → sept20

□ study the lectures
□ keep working on hw2

9/16
- the sign of a permutation
- help with hw2

9/18
- help with hw2
- prison permuation problem!
- veritasium video that was mentioned

9/20
- help with hw2
- introduction to groups
- examples of groups
- futurama episode that was mentioned

wk5: sept23 → sept27

□ study the lectures
□ start working on hw3

9/23
- examples of groups
- examples of non-groups
- Abelian and non-Abelian groups

9/25
- examples of groups
- examples of non-groups
- group composition tables
- generators and relations

9/27
- group composition tables
- generators and relations

wk6: sept30 → oct4

□ study the lectures
□ keep working on hw3

9/30
- cyclic groups
- the order of an element

10/2
- help with hw3
- subgroups
- examples

10/4
- help with hw3
- matrices of finite order

wk7: oct7 → oct11

□ study the lectures
□ start working on hw4

10/7
- finding matrices of finite order
- subgroups of (Z,+)

10/9
- making new subgroups from old
- solving linear Diophantine equations

10/11
- the Euclidean algorithm
- solving linear Diophantine equations
- the relationship to hw4

wk8: oct14 → oct18

□ study the lectures
□ keep working on hw4
□ study for midterm exam next wed

10/14
- help with hw4

10/16
- help with hw4
- practice midterm

10/18
- help with hw4
- practice midterm
- diamond shreddies

wk9: oct21 → oct25

□ study the lectures
□ midterm exam on wednesday
□ start working on hw5

10/21
- practice midterm

10/23
- midterm exam

10/25
- group homomorphisms
- examples
- properties

wk10: oct28 → nov1

□ study the lectures
□ keep working on hw5

10/28
- group homomorphisms
- kernels and images
- examples

10/30
- group isomorphisms
- geometric groups G
- homomorphisms $G \to S_n$

11/1
- homomorphisms $S_k \to S_n$

wk11: nov4 → nov8

□ study the lectures
□ finish up hw5

11/4
- help with hw5

11/6
- help with hw5
- the tetrahedral group

11/8
- help with hw5

wk12: nov11 → nov15

□ study the lectures
□ start working on hw6

11/11
- the hexahedral group
- the octahedral group

11/13
- group actions, equivalence relations
- orbits
- examples

11/15
- stabilizers, fixed sets
- the Frobenius orbit-counting formula

wk13: nov18 → nov22

□ study the lectures
□ keep working on hw6

11/18
- more examples of the orbit-counting formula

11/20
- more examples of the orbit-counting formula
- the groups $(Z/nZ)^x$

11/22
- the groups $(Z/nZ)^x$
- the Euler-Phi function

wk14: dec2 → dec6

□ study the lectures
□ finish up hw6

12/2
- the Euler-Fermat theorem
- using the Euler-Fermat theorem
- Dihedral groups

12/4
- Dihedral groups
- plane symmetry groups
- wallpaper groups
- help with hw6

12/6
- help with hw6
- final exam review

wk15: dec9 → dec13 (FINAL EXAM WEEK)

- □ final exam date: TBA
- □ special office hour: TBA
- □ traditional in-person exam
- □ no electronic devices
- □ complete any late homework for 50%
- □ try an extra credit problem?

class evaluations

- please fill out the class evaluation
- I would REALLY appreciate it!
- the evaluation link is active: TBA