

Math 6310-001 Abstract Algebra I

Fall Semester 2025

Course Description

In this course, we will learn about Rings and Modules including an introduction to Commutative Algebra and to Homological Algebra.

- **Time:** Monday, Wednesday, Friday 12:55PM – 1:45PM
- **Location:** LCB 215
- **Instructor:** Karl Schwede
- **Contact information:**
 - email: schwede@math.utah.edu
 - office: JWB 315
 - website: <https://www.math.utah.edu/~schwede/math6310/>
- **Office hours:**
 - *TBD*
- **Textbooks:**

There are multiple good options for textbooks. I will try to mostly follow

 - “Algebra: Chapter 0”, *Paolo Aluffi* (Chapters, 1,3,5,6,8,9)

Other good options include:

 - “Abstract Algebra”, *Davis S. Dummit and Richard M. Foote*
 - “Basic Algebra I, II”, *Nathan Jacobson*
 - “Algebra”, *Serge Lang*

Course Outcomes and Objectives

By the end of this course, you will be able to precisely work with the topics covered above in the course. The specific topics are:

Rings: ideals, quotient rings, group rings, matrix rings, division rings, commutative rings, prime and maximal ideals, group of units, principal ideal domains, unique factorization domains, structure theorem for modules over a principal ideal domain and its applications to Abelian groups and to linear algebra, rational and Jordan forms, eigenvectors, eigenvalues, minimal and characteristic polynomials, Cayley-Hamilton Theorem.

Module theory: free modules, submodules, quotient modules, tensor, symmetric and exterior products of modules, projective and injective modules, exact sequences, complexes, homology, connecting homomorphisms, Tor and Ext functors.

Commutative ring theory: polynomial rings, Gauss' Lemma, Eisenstein's criterion, localization, Noetherian rings, Hilbert's Basis Theorem, integral extensions, algebraic sets, Hilbert's Nullstellensatz.

Prerequisites

Students should have had an introductory proof-based course on groups and rings. We will mostly focus on rings.

Course Requirements

Your grade will be determined by the following formula

- 40% - Homework and in-class worksheets (due every week or so, not every problem will be graded)
- 25% - Midterm, Tentatively Friday October 24th
- 35% - Final Exam. Scheduled as University guidelines.

<https://registrar.utah.edu/academic-calendars/final-exams-fall.php>

Currently - Friday, December 12, 2025. 1pm - 3pm

Grading Scale

A 93+ will be an A, 90-93 an A-, 87-90 a B+, 83-87 a B, 80-83 a B-, 77-80 a C+, 73-77 a C, 70-73 a C-, 67-70 a D+, 63-67 a D, and below will be an E.

The final grading scheme may be more generous than this one.

The midterm and final will have problems similar to qualifying exam problems.

https://math.utah.edu/graduate/qualifying_exams/index.php

The final will be cumulative.

Gradescope

All assignments will be turned in and graded on gradescope.

Group work

Students are allowed and even encouraged to work together when solving homework problems (although each student is responsible for their own write-up). Do not use artificial intelligence tools to solve homework problems without authorization. The point of doing the exercises is to come to your own understanding. Using AI (or getting the answers written up for you by a friend) will likely mean you won't learn the material well enough to succeed on the midterm and final. This does mean that starting the assignments early is important. We will have some activities where we explore what artificial intelligence can do though hopefully.

University Policies

Updated mandatory syllabus policies regarding the ADA Act, Safety at the U, Addressing Sexual Misconduct, and Academic Misconduct can be viewed at:

<https://cte.utah.edu/instructor-education/syllabus/institutional-policies.php>

Americans With Disabilities Act (ADA)

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. All written information in this course can be made available in an alternative format with prior notification to the [Center for Disability & Access](#) (CDA). CDA will work with you and the instructor to make arrangements for accommodations. Prior notice is appreciated. To read the full accommodations policy for the University of Utah, please see Section Q of the [Instruction & Evaluation regulations](#). In compliance with ADA requirements, some students may need to record course content. Any recordings of course content are for personal use only, should not be shared, and should never be made publicly available. In addition, recordings must be destroyed at the conclusion of the course.

If you will need accommodations in this class, or for more information about what support they provide, contact:

Center for Disability & Access

801-581-5020

disability.utah.edu

Third Floor, Room 350

Student Services Building

201 S 1460 E

Salt Lake City, UT 84112

Safety at the U

The University of Utah values the safety of all campus community members. You will receive important emergency alerts and safety messages regarding campus safety via text message. For more safety information and to view available training resources, including helpful videos, visit safeu.utah.edu.

To report suspicious activity or to request a courtesy escort, contact:

Campus Police & Department of Public Safety

801-585-COPS (801-585-2677)

dps.utah.edu

1735 E. S. Campus Dr.

Salt Lake City, UT 84112

Addressing Sexual Misconduct

Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status, or genetic information.

If you or someone you know has been harassed or assaulted, you are encouraged to report it to university officials:

Title IX Coordinator & Office of Equal Opportunity and Affirmative Action

801-581-8365

oeo.utah.edu

135 Park Building

201 Presidents' Cir.

Salt Lake City, UT 84112

Office of the Dean of Students

801-581-7066

deanofstudents.utah.edu

270 Union Building

200 S. Central Campus Dr.

Salt Lake City, UT 84112

To file a police report, contact:

Campus Police & Department of Public Safety

801-585-COPS (801-585-2677)

dps.utah.edu

1735 E. S. Campus Dr.

Salt Lake City, UT 84112

If you do not feel comfortable reporting to authorities, the U's Victim-Survivor Advocates provide free, confidential, and trauma-informed support services to students, faculty, and staff who have experienced interpersonal violence.

To privately explore options and resources available to you with an advocate, contact:

Center for Campus Wellness

801-581-7776

wellness.utah.edu

350 Student Services Building

201 S. 1460 E.

Salt Lake City, UT 84112

Academic Misconduct

It is expected that students comply with University of Utah policies regarding academic honesty, including but not limited to refraining from cheating, plagiarizing, misrepresenting one's work, and/or inappropriately collaborating. This includes the use of generative artificial intelligence (AI) tools without citation, documentation, or authorization. Students are expected to adhere to the prescribed professional and ethical standards of the profession/discipline for which they are preparing. Any student who engages in academic dishonesty or who violates the professional and ethical standards for their

profession/discipline may be subject to academic sanctions as per the University of Utah's Student Code: [Policy 6-410: Student Academic Performance, Academic Conduct, and Professional and Ethical Conduct](#).

Plagiarism and cheating are serious offenses and may be punished by failure on an individual assignment, and/or failure in the course. Academic misconduct, according to the University of Utah Student Code:

"...Includes, but is not limited to, cheating, misrepresenting one's work, inappropriately collaborating, plagiarism, and fabrication or falsification of information...It also includes facilitating academic misconduct by intentionally helping or attempting to help another to commit an act of academic misconduct."

For details on plagiarism and other important course conduct issues, see the U's [Code of Student Rights and Responsibilities](#).