

MATH 427 F FA21: Honors Abstract Algebra (Rui Loja Fernandes)

Course Information

Algebra is the study of operations, rules and procedures to solve equations. The origin of the term 'Algebra' seems to go back to a IX Century treaty by an Arab mathematician with the title 'The Compendious Book on Calculation by al-jabr and al-muqabala'. The term *al-jabr* is used in this book to denote two procedures: (i) the sum of two positive quantities to both sides of an equation, in order to cancel negative terms and (ii) the multiplication of both sides of an equation by a positive number to cancel fractions. With the passage of time, the term *al-jabr* or *algebra* became synonymous of the general study of equations and operations on them.

Algebra is one of the pillars of Mathematics and this course gives an introduction to the basics of Algebra, including conceptual proofs of all the main results.

Course Overview

- **Basic Algebraic Structures.** Groups, Rings, Integral Domains and Fields. Homomorphisms and Isomorphisms. Permutations and symmetries. Quaternions.
- **The ring of integers.** Axiomatic definitions of the integers. Induction. Factorization. Ideals and Euclides Algorithm. Congruences, equivalence relations. Prime factorization and cryptography.
- **Other Rings.** Integers mod m . Rings of fractions and rational numbers. Polynomials and power series. Division of polynomials. The ideals of $K[x]$. Prime factorization of polynomials.
- **Quotients and Isomorphisms.** Groups and equivalence relations. Quotient groups and rings. Real and complex numbers. Isomorphism theorems. Free groups and generators.

Course Location: 3217 Everitt Laboratory

Discussion Sessions: I will held discussion sessions in class from time to time. **These will be announced in advance.**

[Office hours](#) will be held in person on WF at 11 am, in the lecturer's office (Altgeld Hall 366). To arrange for a help session at other times, contact the lecturer via [e-mail](#).

Course Goals

The main goals of this course are:

- Understand the most important basic algebraic structures;
- Learn specific examples of algebraic structures and how to work with them to deduce results relevant for applications to other branches of mathematics;

Recommended Textbooks

Written versions of the lecture notes will be posted on-line. The recommend textbook is:

- Matej Bresar, [Undergraduate Algebra](#), Springer Undergraduate Mathematics Series. Springer-Verlag, 2019.

Other texts that are highly recommended are:

- Michael Artin, *Algebra*, (2nd edition) Prentice Hall, 1991
- Garrett Birkhoff and Saunders MacLane, *A survey of modern algebra*, (4th Edition), Macmillan, 1977.

Policies

Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students should contact both the instructor and the Disability Resources and Educational Services (DRES) as soon as possible. You can contact DRES at 1207 S. Oak Street, Champaign, (217) 333-1970, or via e-mail at disability@illinois.edu.

Lectures and Discussion Sessions

The lectures and discussion sessions for this course are all in-person.

Lectures: MWF 2:00PM - 2:50PM

Location: 3217 Everitt Laboratory

Office Hours: WF 11:00 am

Homework Assignments

Each unit (week) contains a homework assignment consisting of several exercises. **Homework assignments are due by midnight (Central time) on the dates specified in the weekly overviews unless otherwise noted.** The homework grade will be the average of the 10 best homework grades.

If you need an extension on an assignment because of medical reasons or personal emergencies, you must address the issue with the course instructor. Such accommodations will be made on a case-by-case basis.

Homework assignments will be reviewed and graded by the course TA within 1 week. The midterms and final exam will be graded by the course instructor within 5 business days. If your instructor is unable to meet this timeline, students will be notified.

Grades

The final grade will be based on the homework assignments grade (25%), the midterm grades (20% each) and the final exam grade (35%). The homework assignments grade will be the average of the 10 best grades of the weekly homework assignments.

Midterms and Final Exam

The **two midterms** will be held in class on the following dates:

- October 8
- November 19

Requests for a make-up exam require a serious documentation and are almost never granted.

According to the non-combined final examination schedule, the **final exam** will be held on:

- Monday Dec. 13, 7:00pm-10:00pm.

Homework problems are to be assigned once a week. They are due the following week **in class** not by email. *No late homework will be accepted.*