Syllabus

MAT 4233 — Modern Abstract Algebra Fall 2026 · UT San Antonio

Texts and Materials

Primary text

- **LiZh** — Li & Zhao, *Introduction to Abstract Algebra*, Les Ulis: EDP Sciences, 2022. ISBN 978-2-7598-2915-6. DOI: 10.1051/978-2-7598-2916-3

Supplementary reading

- **Childs** — Childs, *A Concrete Introduction to Higher Algebra*, 3rd ed., Springer, 2009. ISBN 978-0-387-74527-5. DOI: 10.1007/978-0-387-74725-5
- **Rosebrock** — Rosebrock, *Visual Group Theory*, Springer, 2024. ISBN 978-3-662-69364-3. DOI: 10.1007/978-3-662-69365-0
- **Beardon** — Beardon, *Algebra and Geometry*, Cambridge University Press, 2005. ISBN 978-0-521-81362-4. DOI: 10.1017/CBO9780511800436

Course Information

Catalog Entry

MAT 4233 Modern Abstract Algebra

Basic properties and examples of semigroups, monoids, and groups, detailed study of permutation, dihedral, and congruence groups, cyclic groups, normal subgroups, quotient groups, homomorphism, isomorphism theorems, direct products of groups, rings and fields and their basic properties, ideals, polynomial rings.

Prerequisites

MAT 3233 Modern Algebra or equivalent

Credit Hours

3

Course Modality

Traditional in-person

Class Meetings

Duration	Wed 19 Aug – Thu 3 Dec
Campus	Main Campus
Location	MS 2.02.12
Time	Tue Thu 2:30 PM–3:45 PM

Learning Objectives

By the end of this course you should be able to:

- Define the notions of group, cyclic group, subgroup, normal subgroup, homomorphism, isomorphism.
- Define symmetric and permutation groups; determine the cycle decomposition and parity of finite permutations.
- Define the notions of ring, subring, domain, field, ideal, homomorphism, isomorphism.
- Define rings of polynomials over a field, the notion of degree, and irreducible factors.
- Explain the abstract algebraic properties of various rings and number systems including $\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$, $\mathbb{C}$, modular rings $\mathbb{Z}/n\mathbb{Z}$, finite fields $\mathbb{F}_p$ and polynomial rings $\mathbb{F}[x]$.
- Explain the common and specific aspects of the division and Euclidean algorithms in the rings $\mathbb{Z}$ of integers, $\mathbb{Z}[i]$ of Gaussian integers, and polynomial rings $\mathbb{F}[x]$.
- Show that every Euclidean domain is a Unique Factorization Domain.
- Communicate concepts in writing and debate technical arguments orally.

About the Instructor

Eduardo Dueñez, Associate Professor of Mathematics.

Department	Mathematics
Office	FLN 4.01.11
Student hours	Mon 5:30PM – 6:30PM & Tue 1:30PM – 2:30PM
Email	eduardo.duenez@utsa.edu
Homepage	https://supernumero.us/about

Email is the preferred method of communication.

Assessment and Grading

Weight of course activities

Component	Weight	
Q&A sessions	40%	4 sessions, 10% each; none dropped
Problem sets	15%	4 sets, 3.75% each; graded for completeness
Midterm Exam 1	20%	Thu 1 Oct in class
Midterm Exam 2	25%	Thu 3 Dec in class

Q&A sessions

Four class meetings throughout the semester (roughly every other Thursday except when adjacent to an exam) will be *Q&A sessions* in which each student will be asked to explain and defend their solution to a homework problem submitted as part of a written assignment. You will only be asked questions related to an assigned problem and about the solution you submitted.

Each Q&A session is scored 0–3:

- **3** Correct explanation to a correct solution, demonstrating full understanding of the concepts and all aspects of the solution submitted.

- **2** A completely correct solution submitted is explained to an incomplete degree; **Or**: an unfinished solution, with a thorough and articulate account of what you tried, explaining where and why you got stuck while demonstrating knowledge of the background and reading necessary to solve the problem.
- **1** Correct solution inadequately explained revealing little or no understanding; *or*: partial solution accompanied by an incomplete but partly correct oral explanation.
- **0** Nothing submitted; *or*: work submitted (even if fully correct) is backed by no cogent explanation nor knowledge of concepts involved.

A correct answer you cannot explain is worth less than an explainable honest failure.

Note: A low Q&A average caps the course grade, whatever the other components come to:

- a Q&A average **below 1.5** caps the course grade at **C**;
- a Q&A average **below 1.0** caps the course grade at **D**.

(An average below 1.0 is of course also below 1.5; in that case the 'D' cap is the one that applies.)

Problem sets

Four sets, each with five or six theoretical problems. **Maximum six pages.**

Computational (SageMath) material is supplementary and entirely optional: it is never part of a problem set or a Q&A session, and it is not graded.

Each item will be scored *only* based on the **degree of completion** (not on correctness): **2** for a nominally complete solution, **1** for a clearly partial one, **0** for nothing submitted or for obvious filler with no substance.

Note: Any submission containing non-human-readable content, stray characters, or artifacts revealing non-proofread AI output scores 0 for that item.

Use of Artificial Intelligence (AI)

AI assistance is allowed in preparing work for submission, as are any solution keys, collaboration, and internet sources. You are ultimately responsible for your submissions; any part of your work that has clearly not been proofread (e.g., includes non-human readable characters or LLM artifacts) automatically earns a zero grade. *Include one line noting what resources you used in your submission.*

This policy is by design, and it reflects how the course is graded: 85% of the grade comes from Q&A sessions and in-class exams where only what is truly understood and can be explained counts. Assignments submitted but not written/understood by you result in failing grades in Q&A sessions and exams. Use AI to learn faster —not to prepare and turn in papers you cannot defend, blocking you from passing exams as well.

All audiovisual (or audio only, or video only) recordings of lectures are explicitly forbidden; all uses of AI agents or apps to capture, process, or analyze any lecture contents are **strictly forbidden**. The only *limited* exceptions are *explicitly* allowed recordings per official memorandum of the office of Student Disability Services. Under no circumstances is any processing or analyzing of such recordings allowed. Any sharing of confidential course materials with individuals who are not enrolled students in the course is a violation of FERPA privacy laws.

Exams

Both exams are traditional in-class (written and closed book). Exams are based **primarily on the assigned problem sets** —expect some context and phrasing to differ from the homework, plus a minority of other unseen problems. Memorizing solutions will not result in good exam grades; preparing by understanding the assigned problems will make the exams straightforward and earn high Q&A grades as well.

Attendance and missed work

No extensions on problem sets. A *single* missed Q&A session in the semester may be made up during office hours within seven days (no documentation is required). *No Q&A scores are dropped.*

Final grade ranges

Grade	Range	Grade	Range
A	[90%, 100%]	A-	[85%, 90%)
B+	[80%, 85%)	B	[76%, 80%)
B-	[72%, 76%)	C+	[69%, 72%)
C	[65%, 69%)	C-	[60%, 65%)
D	[50%, 60%)	F	[0%, 50%)

Time Commitment Expectations

Expect an average of about **9 hours per week**, and no fewer than 7.

- Attend class meetings (**3 hours per week**)
- Reading the assigned textbook sections (**2–3 hours per week**)
- Problem sets (**2–3 hours per week**)
- Office hours and study group (**1 hours per week**)

A Writing-Intensive Course

This is a **writing-intensive course**. Standard professional standards for technical writing (mathematical writing) apply. The style is *mathematical prose* written for a human reader, An otherwise "correct" argument presented as a disorganized or unintelligible pile of symbols is not a solution will be returned without grading and earn *no* credit. For detailed requirements and required reading refer to the **Writing Mathematics** page.

Additional Course Information

Each student should be intimately familiar with the contents of any work submitted for grading. The instructor has the right to request adequate **verbal explanation** of methodology and content for any submitted work. Credit will not be awarded when such an explanation is requested but not satisfactorily provided.

Course Schedule

Date	Topic
Thu 20 Aug	Lecture — Course launch. The integers: division algorithm, gcd, Bezout
Tue 25 Aug	Lecture — Congruence and the ring Zn
Thu 27 Aug	Lecture — Binary operations; Cayley tables; isomorphic binary structures
Tue 1 Sep	Lecture — Plane isometries and finite symmetry groups: cyclic and dihedral
Thu 3 Sep	Lecture — Groups: axioms and first properties
Tue 8 Sep	**Q&A** (**Due**: Set 1)
Thu 10 Sep	Lecture — Subgroups; examples

Date	Topic
Tue 15 Sep	Lecture — Cyclic groups; the order of an element; generators
Thu 17 Sep	Lecture — Generating sets
Tue 22 Sep	Lecture — Permutation groups; cycle notation; Cayley's theorem
Thu 24 Sep	Lecture — Alternating groups; the sign of a permutation; A4 and the tetrahedron
Tue 29 Sep	**Q&A** (**Due**: Set 2)
Thu 1 Oct	**Exam** — Midterm Exam 1 — Sets 1 and 2
Tue 6 Oct	Lecture — Cosets; Lagrange's theorem; index
Thu 8 Oct	Lecture — Homomorphisms: kernel, image, and first properties
Thu 15 Oct	Lecture — Normal subgroups; quotient groups
Tue 20 Oct	Lecture — The fundamental homomorphism theorem; groups of small order
Thu 22 Oct	Lecture — Rings and subrings; units and zero divisors
Tue 27 Oct	**Q&A** (**Due**: Set 3)
Thu 29 Oct	Lecture — Integral domains and fields; Euler's and Fermat's theorems
Tue 3 Nov	Lecture — Ring homomorphisms, ideals and quotient rings; fundamental homomorphism theorem
Thu 5 Nov	Lecture — Ideal theory: principal, prime and maximal ideals
Tue 10 Nov	Lecture — Irreducibles and primes; unique factorization domains; principal ideal domains
Thu 12 Nov	Lecture — Euclidean domains; the Euclidean algorithm in Z and in k[x]
Tue 17 Nov	Lecture — Multiplicative norms; the Gaussian integers Z[i]; Fermat's Two Squares theorem
Thu 19 Nov	**Q&A** (**Due**: Set 4)
Tue 24 Nov	Lecture — Sums of three and four squares; Z[sqrt(-5)] and the failure of unique factorization
Tue 1 Dec	*Review* — Review — the exam pool
Thu 3 Dec	**Exam** — Midterm Exam 2 — Sets 3 and 4

Readings for each meeting are on the Weekly Schedule (also available as a printable PDF).

Department and University Policies

Ombudsperson

The ombudsperson is an advocate who investigates complaints about a specific section or instructor and attempts to resolve them through mediation. Comments or complaints sent to this person will be brought to the attention of department leadership, who will follow up. If you have questions about the logistics of your class, please contact the instructor.

Contact Ilse Rosales Martinez at ilse.rosalesmartinez@utsa.edu.

Video and Audio Recording

As the instructor of this course, I may record meetings and lessons. You are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Recordings may not be published, reproduced, or shared with those not in the class. If the instructor or a UTSA office plans any other uses for the recordings, consent of the students identifiable in the recordings is required before such use unless an exception is allowed by law.

Syllabus Changes

The syllabus is subject to change at the instructor's discretion. Any changes or corrections to the course materials, assignment dates, or other updates will be communicated to students ahead of time. You are responsible for checking Canvas for corrections or updates to the syllabus.

Essential Student Information

- **Important:** Bookmark and visit the Common Syllabus Information webpage for resources about counseling services, transitory/minor medical issues, supplemental instruction, tutoring services, academic success coaching, sexual harassment and sexual misconduct, campus safety and emergency preparedness, and the Roadrunner Creed.
- For technical requirements, support, and resources, visit Academic Innovation's Student Technical Support page.
- UT San Antonio provides reasonable accommodations to students via Student Disability Services, or call (210) 458-4157.
- Your well-being is important. Support, including 24/7 mental health services, can be accessed from the Well-being at UT San Antonio site.
- Student Assistance Services offers confidential support and personalized guidance.
- The Roadrunner Pantry provides free access to groceries, toiletries, and other essentials.
- Students are responsible for ensuring their work is consistent with UTSA's standards for academic integrity. Review Section 203 of the Student Code of Conduct.
- Visit UT San Antonio Libraries and Museums for journals, research tutorials, and your department's librarian.