MATH 441/561: Abstract Algebra I

Salisbury University · Fall 2026 · Section 001

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Course information

Instructor

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Office

Henson Hall 116

Office phone

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Office hours

2:00–3:30 p.m. Monday, Tuesday, Wednesday, Friday; and by appointment.

Class meetings

9:00–9:50 a.m. Monday, Tuesday, Wednesday, Friday

Room

Henson Hall 111

Credits

4 credit hours. Meets four hours per week. Meets General Education IVB or IVC.

Prerequisites

C or better in MATH 210 or MATH 306. Both are recommended before enrolling.

Cross-listing

This section is cross-listed as MATH 441, for undergraduates, and MATH 561, for graduate students. Graduate students are assigned separate homework problems, quiz or exam problems, or projects, at my discretion, noted in class and in MyClasses as they arise.

If you have already received credit, including transfer credit, for a course whose material is equivalent to MATH 441, or that serves as a prerequisite for it, you may not also receive credit for MATH 441. Talk to me or to your advisor if you are unsure whether this applies to you.

Course description and purpose

Abstract Algebra I is an introduction to the theory of groups, rings, integral domains, and fields, including the basic properties of polynomials. The course covers:

- basic notions: sets, functions, binary operations, and modular arithmetic;
- rings, subrings, integral domains, fields, and division rings, including zero divisors, characteristic, and the interconnections among these structures;
- polynomial arithmetic, the division algorithm, factorization, units, associates, and unique factorization domains;
- ring homomorphisms, ideals, quotient rings, and the homomorphism theorem for rings;
- the definition and elementary properties of groups, including cancellation, uniqueness of the identity and of inverses, subgroups, orders of elements, and cyclic and abelian groups, with permutation and dihedral groups treated as running examples.

> **What this course is for:**
>
> MATH 441 develops the foundations of modern algebra. The primary focus is on constructing proofs and on writing mathematics clearly, not on memorizing a list of theorems. You will spend the semester learning to state a claim precisely, decide whether it is true, and then prove it using only the definitions and results you have already established.
>
> This particular offering runs through Section 7.3 of the text, the definition of groups, their basic properties, and subgroups. Permutation groups and dihedral groups appear throughout as concrete examples, not as a separate unit. Isomorphisms of groups and a deeper study of the symmetric and alternating groups are left for a second semester of abstract algebra.

Required textbook

- Hungerford, T. W. (2014). *Abstract Algebra: An Introduction* (3rd ed.). Brooks/Cole, Cengage Learning. ISBN-13: 978-1-111-56962-4.

Bring the text to every class session. Homework exercises are assigned by section and problem number throughout the semester, in the course schedule below, and lecture follows the text closely enough that you will want it open during class.

This course draws entirely from Part 1 of the text, the Core Course, Chapters 1 through 7. We cover Chapter 1 through Section 7.3.

Grading

Grade weighting

Component	Weight
Quizzes	40%
Midterm Exams (Exam I, II, and III)	40%
Final exam	20%

Component	Weight
Total	**100%**

The Department of Mathematical Sciences specifies a grading range for MATH 441 of 30 to 40 percent exams, 30 to 40 percent homework, and 20 to 30 percent final exam. This section does not collect or grade separate homework assignments; there are no homework due dates. Instead, weekly quizzes directly assess your preparation on the assigned Q exercises, and the three midterm exams assess the assigned E exercises, as described below. The Quizzes row above fills the role the department calls Homework, within its specified range.

Letter grades. A: 90–100. B: 80–89.9. C: 70–79.9. D: 60–69.9. F: Below 60.

Homework and the Q, E, *, and # system

Homework in this course is not collected and does not carry its own grade. There are no due dates for it. Instead, every class day in the course schedule below lists specific exercises from Hungerford, each labeled with one of four codes:

- **Q** marks exercises that may potentially appear, in some form, on the quiz covering that section.
- **E** marks exercises that may potentially appear, in some form, on the respective exam covering that section.
- An asterisk (*****) after a problem number marks that problem as potential extra credit on the respective quiz or exam.
- **#** marks exercises assigned for enrichment only. They do not appear, in any form, on a quiz or an exam.

> Work every Q and E exercise assigned for a section before the quiz or exam that covers it. The exercises are your actual preparation for those assessments, not an optional suggestion. A quiz or exam with no matching homework behind it is simply a quiz or exam you have not studied for.

You are encouraged to work Q, E, and # exercises with classmates. Talking through a stuck proof with someone else is one of the most reliable ways to actually learn it. See Academic integrity and

collaboration below for how this differs from quiz and exam conditions.

Weekly quizzes

A short written quiz is given during most Monday class meetings, after the first week of the semester. When a holiday falls on a Monday, that week's quiz moves to the next class day; see the course schedule below for the exact date and coverage of every quiz. Each quiz is modeled directly on the Q exercises assigned for the sections it covers.

No calculator, computer, cell phone, or other electronic device, including any AI tool, is permitted during a quiz. All quiz work must be handwritten, using only techniques presented in class, with full supporting work shown.

Midterm exams and the final exam

Three midterm exams, Exam I, Exam II, and Exam III, are given during the semester on the dates in the course schedule below. Each exam is modeled directly on the E exercises assigned for the sections it covers, and each is given during the regular class period.

The final exam is comprehensive, covering material from the entire semester, and is given during the University's final assessment period.

Midterm exams and the final exam follow the same rules as quizzes. No calculator, computer, cell phone, or other electronic device, including any AI tool, is permitted. Your answers must be fully written out by hand, using only techniques learned in this course, with all supporting work shown, as an original solution written by you and not acquired from an electronic source, including AI and search engines.

Policy on artificial intelligence

You may use AI to help you understand a concept while you work through the Q, E, and # exercises. AI is not permitted on quizzes, exams, or the final exam, under any circumstances.

> *"Using AI to do homework would be like having the Teacher's Solutions Manual, looking up the answers to assigned homework questions, writing those answers down, and then turning them in. I wouldn't have to learn anything."*
>
> — Jeanne Y. Clark, January 14, 2026

Ms. Clark's observation applies directly to this course. Letting AI produce your work on the Q and E exercises removes the exercises' entire purpose: the learning, understanding, and creativity they are there to build in you, not in a model. Using AI this way is the least effective way to prepare for a quiz, an exam, or the final exam, all of which you must complete without it.

For more on this topic, see this NPR piece.

Plagiarism

Any unauthorized use of AI, or of any other electronic aid, during a quiz, an exam, or the final exam constitutes cheating and plagiarism. A student found to have used an unauthorized aid on an assessment may fail that assessment, the course, or both.

Any use of AI or another electronic aid during a quiz, an exam, or the final exam is unauthorized, unless I state otherwise in advance, in writing, for that specific assessment. This restriction includes accessing AI or an internet search engine from a phone, a tablet, a computer, or any other electronic device.

Work submitted for a quiz, an exam, or the final exam may be screened for matches with published sources or with AI-generated text.

Attendance and classroom conduct

Plan to attend every class meeting. For every hour of class time, expect to spend at least three hours studying the text and working the assigned exercises outside of class. That works out to roughly 12 to 15 hours per week outside class for this course; build that time into your schedule from the start of the semester, not the week before Exam I.

Do not give up on an exercise the moment it gets difficult. Bring a stuck problem to office hours, work through the closest worked example in the text, or ask for help at the Math Emporium. All three exist for exactly this purpose.

Cell phone usage

Do not ever have your mobile phone out during class. This applies to lecture, quizzes, and exams alike, with no exceptions for a quick check.

If you need a phone or other device out for a documented medical or accessibility reason, contact me directly and we will arrange it. You do not need to explain the underlying condition to me.

Laptops and other devices

This course has no computing component. A laptop or tablet is not needed in class, and should stay closed and put away during lecture, quizzes, and exams, unless I specifically ask you to use one for a particular activity.

Academic integrity and collaboration

Homework (Q, E, and # exercises). You may work with classmates. Write your own final version of every proof or solution, in your own words.

Quizzes, midterm exams, and the final exam. Individual work. Do not collaborate. No external resources, be they human, electronic, cell phone, or other, may be used on any assessment in this course.

Course materials. Course notes and materials are for the use of students enrolled in this section. Ask me before sharing them with anyone outside the course; sharing them without permission also violates copyright law.

The Salisbury University Academic Misconduct Policy is available from the Office of the Provost.

Writing across the curriculum

You are expected to communicate mathematics and mathematical ideas effectively, in speech and in writing. Clear descriptions of your thought process, evidence of critical thinking, and effective communication must be demonstrated in your written proofs. At the University Writing Center, trained consultants are ready to help at any stage of the writing process. In addition to the writing instruction that occurs in the classroom and during office hours, the Center offers another site for learning about writing. All students are encouraged to make use of these services.

Course schedule

The schedule is tentative and subject to change. Changes are announced in class and posted in MyClasses as early as possible. Calendar dates below (semester start, holidays, and the final exam) are confirmed against the department's Fall 2026 course schedule.

Exercises in the Homework column are listed by problem number from Hungerford, using the Q, E, *, and # system described above. The Quiz / Exam coverage column names the sections each quiz or exam draws on; it is blank on days with no quiz or exam.

Key dates

- Semester begins: Monday, August 31, 2026
- Labor Day, no class: Monday, September 7, 2026
- Exam I: Monday, September 28, 2026
- Fall Break, no class: Monday–Tuesday, October 19–20, 2026
- Exam II: Monday, November 2, 2026
- Thanksgiving recess, no class: Wednesday–Friday, November 25–27, 2026
- Exam III: Friday, December 4, 2026
- Last day of classes: Friday, December 11, 2026
- MATH 441/561 Final Exam: Thursday, December 17, 2026, 8:00–10:00 a.m.

Daily schedule, Fall 2026

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exam coverage
Week 1: Aug 31–Sep 4				
Mon 8/31	1.1	The Division Algorithm	1.1 Q: none assigned	—
Tue 9/1	1.1	The Division Algorithm	1.1 E: none assigned	—
Wed 9/2	1.2	Divisibility	1.2 Q: 1, 2, 3, 4a, 6, 7, 10, 12, 13, 15, 16	—

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exa coverage
Fri 9/4	1.2	Divisibility	1.2 E: 4b, 5, 8, 9, 11, 14, 17–22, 25–28, 31*, 32*, 33*	—
Week 2: Sep 7–11				
Mon 9/7	—	**No class: Labor Day.**	—	—
Tue 9/8	1.3	Primes and Unique Factorization	1.3 Q: 1ab, 2, 3, 4, 8, 9, 11, 13, 16, 18, 21, 22, 27, 33*, 35a*	1.1, 1.2
Wed 9/9	1.3	Primes and Unique Factorization	1.3 E: 5, 6, 7, 10, 14, 15, 17, 19, 20, 23, 24, 25, 26, 32, 34*, 36*	—
Fri 9/11	1.3	Wrap-up and questions	—	—
Week 3: Sep 14–18				
Mon 9/14	2.1	Congruence and Congruence Classes	2.1 Q: 1, 2b, 5, 9, 10, 12, 13, 15, 17, 21*	1.3
Tue 9/15	2.1	Congruence and Congruence Classes	2.1 E: 2a, 6, 7, 8, 11, 14, 16, 19, 20, 22*. 2.1 #: 3, 4, 18	—
Wed 9/16	2.2	Modular Arithmetic	2.2 Q: 1ab, 3, 4, 7, 9, 11ab, 13, 14ab, 15ab, 16a	—
Fri 9/18	2.2	Modular Arithmetic	2.2 E: 1c, 2, 5, 6, 8, 10, 11c, 12, 14c, 15cd, 16bcd. 2.2 #: 1d	—
Week 4: Sep 21–25				
Mon 9/21	2.3	The Structure of Z_p (p Prime) and Z_n	2.3 Q: 1ab, 2ab, 3, 4ab, 5, 7, 9, 11, 13, 15, 17. 2.3 #: 18	2.1, 2.2
Tue 9/22	2.3/3.1	Wrap up 2.3 The Structure of Z_p (p Prime) and Z_n; begin	2.3 E: 1bc, 2cd, 4cd, 6, 8, 10, 12, 14, 16	—

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exa coverage
		3.1 Definition and Examples of Rings		
Wed 9/23	3.1	Definition and Examples of Rings	3.1 Q: 1, 3, 5abc, 7, 9, 11, 13, 15ab, 17, 19, 21, 23, 27, 29, 31, 35*, 37*, 43*	—
Fri 9/25	3.1	Review session	3.1 E: 2, 4, 5def, 6, 8, 10, 12, 14, 16, 18, 20, 22, 28, 32, 34*, 36*, 38*, 42*	—
Week 5: Sep 28–Oct 2				
Mon 9/28	Exam I	**Exam I (in class, closed book, handwritten).**	—	Ch. 1, Ch. 2
Tue 9/29	3.1	Definition and Examples of Rings	3.1 #: 24, 25, 26, 30, 33, 39, 40, 41, 44	—
Wed 9/30	3.2	Basic Properties of Rings	3.2 Q: 1–43 odd, 44*	—
Fri 10/2	3.2	Basic Properties of Rings	3.2 E: 2–42 even, 45*, 46*	—
Week 6: Oct 5–9				
Mon 10/5	3.3	Isomorphisms and Homomorphisms (Rings)	3.3 Q: 1–37 odd, 39*, 41*	3.1, 3.2
Tue 10/6	3.3	Isomorphisms and Homomorphisms (Rings)	3.3 E: 2–38 even, 40*, 42*	—
Wed 10/7	4.1	Polynomial Arithmetic and the Division Algorithm	4.1 Q: 1–19 odd, 21*	—

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exa coverage
Fri 10/9	4.1	Polynomial Arithmetic and the Division Algorithm	4.1 E: 2–20 even, 22*	—
Week 7: Oct 12–16				
Mon 10/12	4.1/4.2	Wrap up 4.1 Polynomial Arithmetic and the Division Algorithm; begin 4.2 Divisibility in F[x]	4.2 Q: 1–15 odd	3.3, 4.1
Tue 10/13	4.2	Divisibility in F[x]	4.2 E: 2–16 even	—
Wed 10/14	4.2/4.3	Wrap up 4.2 Divisibility in F[x]; begin 4.3 Irreducibles and Unique Factorization	4.3 Q: 1–23 odd, 25*	—
Fri 10/16	4.3	Irreducibles and Unique Factorization	4.3 E: 1–22 even, 24*	—
Week 8: Oct 19–23				
Mon 10/19	—	**No class: Fall Break.**	—	—
Tue 10/20	—	**No class: Fall Break.**	—	—
Wed 10/21	4.3/4.4	Wrap up 4.3 Irreducibles and Unique Factorization; begin 4.4 Polynomial Functions, Roots, and Reducibility	4.4 Q: 1–27 odd, 29*, 31*	4.2, 4.3

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exa coverage
Fri 10/23	4.4	Polynomial Functions, Roots, and Reducibility	4.4 E: 2–28 even, 30*, 32*. 4.4 #: 29	—
Week 9: Oct 26–30				
Mon 10/26	4.5	Irreducibility in Q[x]	4.5 Q: 1–19 odd	—
Tue 10/27	4.5/4.6	Wrap up 4.5 Irreducibility in Q[x]; begin 4.6 Irreducibility in R[x] and C[x]	4.5 E: 1–20 even. 4.5 #: 21	4.4, 4.5
Wed 10/28	4.6	Irreducibility in R[x] and C[x]	4.6 E: 1–7, 8*	—
Fri 10/30	4.6	Review session	—	—
Week 10: Nov 2–6				
Mon 11/2	Exam II	**Exam II (in class, closed book, handwritten).**	—	3.2, 3.3, Ch.
Tue 11/3	5.1	Congruence in F[x] and Congruence Classes	5.1 Q: 1–11 odd	—
Wed 11/4	5.1	Congruence in F[x] and Congruence Classes	5.1 E: 2–12 even, 13*	—
Fri 11/6	5.2	Congruence-Class Arithmetic	5.2 Q: 1–13 odd, 15*	—
Week 11: Nov 9–13				

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exa coverage
Mon 11/9	5.2	Congruence-Class Arithmetic	5.2 E: 2–14 even, 16*	5.1
Tue 11/10	5.3	The Structure of F[x]/(p(x)) When p(x) Is Irreducible	5.3 Q: 1–11 odd	—
Wed 11/11	5.3	The Structure of F[x]/(p(x)) When p(x) Is Irreducible	5.3 E: 2–12 even, 13*	—
Fri 11/13	6.1	Ideals and Congruence	6.1 Q: 1–41 odd, 43*, 45*	—
Week 12: Nov 16–20				
Mon 11/16	6.1	Ideals and Congruence	6.1 E: 2–40 even, 42*, 44*. 6.1 #: 46, 47	5.2, 5.3
Tue 11/17	6.2	Quotient Rings and Homomorphisms	6.2 Q: 1–27 odd, 29*, 31*	—
Wed 11/18	6.2	Quotient Rings and Homomorphisms	6.2 E: 2–28 even, 30*, 32*	—
Fri 11/20	6.3	The Structure of R/I When I Is Prime or Maximal	6.3 Q: 1–17 odd, 19*, 21*	—
Week 13: Nov 23–27				
Mon 11/23	6.3	The Structure of R/I When I Is Prime or Maximal	6.3 E: 2–18 even, 20*, 22*. 6.3 #: 23–25	6.1, 6.2
Tue 11/24	6.3	Wrap-up and questions	—	—

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exa coverage
Wed 11/25	—	**No class: Thanksgiving recess.**	—	—
Fri 11/27	—	**No class: Thanksgiving recess.**	—	—
Week 14: Nov 30–Dec 4				
Mon 11/30	6.3, 7.1	Wrap up 6.3 The Structure of R/I When I Is Prime or Maximal; begin 7.1 Definition and Examples of Groups	7.1 Q: 1–29 odd, 31*, 33*, 35*	—
Tue 12/1	7.1	Definition and Examples of Groups	7.1 E: 2–24 even, 30, 32*, 34*, 36*	—
Wed 12/2	7.2	Basic Properties of Groups	7.2 Q: 1–29 odd, 31*, 33*, 35*, 37*, 39*	—
Fri 12/4	Exam III	**Exam III (in class, closed book, handwritten).**	—	Ch. 5, Ch. 6
Week 15: Dec 7–11				
Mon 12/7	7.2	Basic Properties of Groups	7.2 E: 1–30 even, 32*, 34*, 36*, 38*	—
Tue 12/8	7.3	Subgroups	7.3 Q: 1–33 odd, 35*	—
Wed 12/9	7.3	Subgroups	7.3 E: 1–32 even, 34*, 36*	—
Fri 12/11	7.3	Wrap-up and grade projections	—	—
Final Exam				

Date	Section	Lecture topic	Homework (Q / E / * / #)	Quiz / Exa coverage
Thu 12/17	—	**MATH 441/561 Final Exam, 8:00–10:00 a.m.**	—	Compreher (cumulative entire semester)

Accessibility and accommodations

Any student registered with the Office of Access & Accommodations (OAA) who would like to use approved accommodations in this course should contact me as soon as possible to arrange a meeting to coordinate them.

Students with disabilities can request reasonable accommodations, auxiliary aids and services, and modifications to University policies through the OAA by following the OAA's procedures for Requesting Accommodations, Modifications, Aids, and Services.

For more information, see the Office of Access & Accommodations page, email accommodations@salisbury.edu, or visit the office at Guerrieri Student Union, Room 229.

If any course material is inaccessible to you, tell me and I will fix it. Examples include a handout that does not work with your screen reader or a figure without a usable description. You do not need to be registered with the OAA to raise this.

Student support resources

Communication. MyClasses and email are used extensively for announcements and course material. Check your SU email at least once a day.

Office hours. Office hours exist for your benefit. Students who attend office hours regularly tend to do noticeably better in mathematics and science courses. You do not need a specific question prepared; come by.

Math Emporium. Visit the Math Emporium frequently for help. No appointment is necessary, and it is free.

Writing support. The University Writing Center works with students at any stage of a draft, including a written proof. Bringing a homework write-up there is a good use of your time.

Basic needs. If you have difficulty affording food or lack a stable place to live, SU has resources that can help. Contact the Dean of Students, or talk to me and I will help you find them.

Learning outcomes

Course Learning Outcomes (CLO)

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

1. Construct clear, rigorous mathematical proofs using the definitions and theorems of ring theory and group theory.
2. Determine whether a given set and operation define a ring, an integral domain, a field, or a group, and justify that determination in writing.
3. Analyze the structure of ideals, quotient rings, and subgroups, and apply the relevant homomorphism theorems.
4. Apply the division algorithm and unique factorization to problems in the integers and in polynomial rings over a field.
5. Communicate mathematical reasoning effectively in written proofs, following the conventions of mathematical writing.

MATH 441/561, Section 001, Fall 2026. Salisbury University. This syllabus is subject to change; changes will be announced in class and posted in MyClasses.