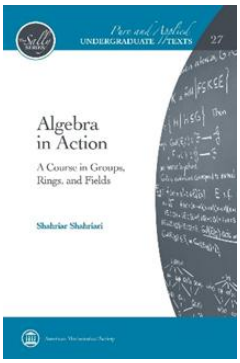
POLICIES/SYLLABUS

Instructor: Eric Moorhouse, Ross Hall $6^3 = 216$, https://ericmoorhouse.org, email moorhous@uwyo.edu.

Class Meeting: MWF 9:00–9:50 am in AG4021. I try to record classes and post pdf slides and audio/video recordings of classes on the course website (see below) for your future reference as an aid to reviewing and studying. However, this is *not* an invitation to skip class. Moreover, sometimes the technology fails to record properly, or I forget to hit the 'record' button. You are expected to attend class regularly. *Students who consistently attend class perform on average a full letter grade better than students who do not*. Classroom behavior is relaxed: use your laptops and devices as needed, as long as you are not disturbing me or others. If you arrive late or leave early, or need to excuse yourself during class, I will assume you have a good reason for doing so and this should not bother me. We will only revisit this policy if the need arises.

Prerequisite: Grade of C or better in Math 3500 (Algebra I: Group Theory). Successful completion of Math 4510 (Algebra II: Ring Theory) is an asset, but not essential. However, *familiarity with linear algebra (at the Math 2250 level) will be expected*; please let me know if this is a problem.



Textbook: S. Shahriari, *Algebra in Action: A Course in Groups, Rings, and Fields*, American Mathematical Society, 2017. You are required to prepare by reading relevant sections of the textbook before coming to class. Occasional printed handouts may be prepared and distributed as the course progresses. These (and any other assigned readings, including notes from class lectures) you will be expected to read and absorb, asking questions if anything is unclear. In addition to the textbook, some course content will be presented as printed handouts and instructional videos, and these will also be linked on the course website (see below). You will be expected to read/watch these on your own time.
you will watch on your own time; and you should watch these videos as well because much of this content will not be repeated during class time.

Grading Scheme:

I will assign grades (A, B, C, D, F, W) *at the end of the semester* according to the scale: A=exceptional, B=very good, C=adequate, D=poor, F=fail, W=withdrawal.

I always encourage students to consult me at any time during the semester with questions, including (but not restricted to) questions about your progress in the course. You may ask questions by email, at your own risk (remember that email is not secure); but questions asked in person typically receive more prompt and complete answers. Raw numerical grades for the test and homework may be checked on WyoCourses, but *WyoCourses does not supply letter grades for the course.* For further information regarding assignment of letter grades, refer to the FAQ (see below) and consult with the instructor.

50%	**Written Homework**
20%	**Midterm Test**
30%	**Final Exam**
100%	**Total Grade**

Office Hours: MWF 10:00–10:50am; T 2:30–3:50pm in my office RH 216. In addition to my regularly scheduled office hours, please feel free to see me at other times, either by appointment or at other times if I am not busy. Office hours are subject to change with or without notice, so you are advised to check my current schedule and availability posted at https://ericmoorhouse.org/schedule.html.

Homework:

Homework is a vital part of this course. Mathematics, more than most subjects, is one which you learn not by listening and absorbing, but by trying out yourself. The learning of mathematics is also more sequential than that of other subjects … so all the more need to be regular in doing problems yourself! Homework assignments will be assigned approximately once per week, and will be submitted to me through WyoCourses by specified due date (usually after 2–3 classes) by 5:00pm. The following expectations apply to submitted homework:

- Write clearly. Part of the grade reflects organization and clarity of presentation.
- Most solutions require sentence answers. Correct use of vocabulary, spelling, grammar, and punctuation is expected for full credit.
- There is no need to re-write questions.

It is fine for you to discuss the homework with other students. However, please do not copy anyone else's work directly, whether or not they are in the class. Copying may adversely affect your grade; but more importantly, of course, you won't be adequately preparing yourself for the tests in this way. **Do not use Chegg, ChatGPT or other AI**. *If I suspect you are using such aids then you will receive a zero on the question or entire assignment, according to the extent you have used these external sources*. If you wish to contest receiving a zero in such a situation, you will have one week to meet with me to contest my reaction and have your work re-graded; and you will need to convince me in person that you sufficiently understand the work you have written. I cannot give you credit for work that is not your own. For further information, consult the FAQ (see below).

Tests

We will have one mid-term test during class time, and one final exam. Both are 'closed book'; however, you will be permitted to use a handheld calculator and one 'cheat sheet' (one 8½×11 inch sheet with information written on one side in your own handwriting). Sharing of calculators or other aids during the test and the exam is not permitted. No other devices are permitted. Cell phones must be switched off (and in particular cannot be used as calculators). The test will cover a specified unit of material only, but the final exam will be comprehensive. The final exam is scheduled for 8:00–10:00 am on Wednesday, December 10, in our usual lecture room (AG 4021).

Make-up tests for those who miss tests, will only be granted in cases of verifiable illness or the most extreme circumstances (at my discretion). Please contact me in advance of such a situation if possible. Even in legitimate cases, the make-up test will be harder than the original test.

MATH 4520 Course Website:

Course-related announcements, links, handouts, homework solutions, etc. will be posted at the course website https://ericmoorhouse.org/courses/4520/ (not to be confused with WyoCourses). The WyoCourse site will be reserved for materials deemed private or sensitive (including Zoom links, course grades, and any documents we don't want to spread beyond our class). The course website however will provide much more capacity for posting homework, instructional videos and documents, while also demanding much less time for me to regularly update than WyoCourses which is designed with security in mind.

Submitting Homework on WyoCourses: Electronic homework submissions on WyoCourses are due on specified days by 5:00pm. Submit your work on time; no work can be accepted after the solutions have been posted. Please submit your work in pdf format (not of excessive file size). You are responsible for making sure your document uploads correctly. Popular options for generating your pdf are

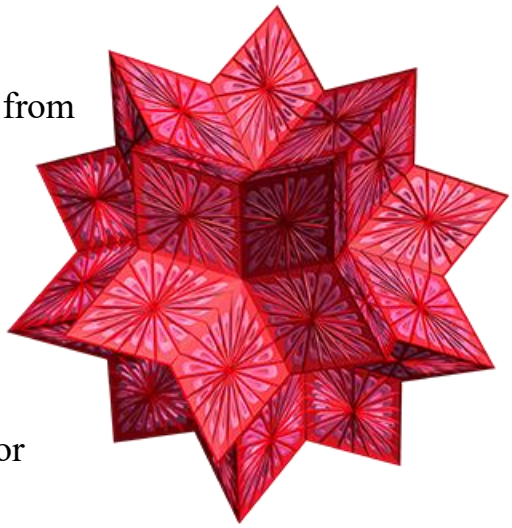
- Write on blank paper and scan it using a mobile device or flatbed scanner, then export save as pdf. *Do not use your camera app*; rather, use a dedicated scanner app which crops your document and avoids glare, shadows, etc., optimizing the images as documents (unlike the camera app which optimizes for faces etc.)
- Avoiding paper, use a tablet and stylus with a good note-taking app (Notability is a popular and highly recommended choice). Write either on a blank new page, or in our case, annotating the pdf copy of the worksheet from our course website. Export as pdf.
- Some assignments may be typed on your laptop (e.g. in MS Word) and then exported as pdf.

Frequently Asked Questions: For more detail on policies of course administration, learning progress, etc. please refer to https://ericmoorhouse.org/courses/FAQ.html. Most questions students ask me are already answered in this document.

The Algebra Depth Sequence (Math 3500/4510/4520):

The Algebra Depth Sequence at the University of Wyoming consists of three courses: Math 3500 (*Algebra I: Group Theory*), Math 4510 (*Algebra II: Ring Theory*), and Math 4520 (*Algebra III: Topics in Abstract Algebra*). These courses cover (roughly) the theory of groups, rings and fields, respectively—three of the four classes of algebraic structures which form the cornerstone of modern algebra. We strive to accommodate students who take Algebra III before Algebra II; but you might let me know if you are taking the depth sequence in the order I-III-II. Also please let me know if you have not yet taken Group Theory (this may be the case with any students who took Algebra I more than a year ago, when we followed a different textbook covering Ring Theory before Group Theory). The fourth such class of structures (vector spaces) is the subject matter of Math 2250 (*Elementary Linear Algebra*). The student is assumed to arrive at this point (the third course in the depth sequence) with a ready foundation in formal mathematical thinking and communication, including the reading and writing of proofs, as well as a strong foundation in the theory of rings, and vector spaces.

Wolfram Mathematica



As a UW student, you have access to the Wolfram Mathematica software, either from campus computers, or from anywhere while logged in remotely from a personal computer using your UW credentials. It is recommended (although not strictly necessary) that you install Mathematica on a personal computer for use throughout this course as we will frequently demonstrate number-theoretic computations in class using Mathematica, and the software will often be useful in homework, if only for checking your work. See the link on the course website for details on installing Mathematica.

SageMath provides a free open source alternative to Mathematica, but this alternative requires a level of technical expertise that I am not going to assume every student has; so if you use SageMath, you may be on your own. Please let me know if you intend to use SageMath. I know that many students will have experience with Matlab, but this simply *will not suffice* for most of the computations we require. In previous years we have used Maple, but UW no longer maintains a Maple license. Your hand-held calculator will suffice for some, but not all, computations we encounter throughout the semester. Most modern applications of number theory (in particular, applications to public key cryptography) require computations involving integers of hundreds of digits; and for

practical reasons, many textbooks are limited in scope to computations involving integers with at most 8 digits. We feel that this limitation does not allow students to reasonably appreciate the subject. Our department's Learning Goals and Objectives (www.uwyo.edu/mathstats/current), Objective 3, prescribes that "[Students shall] use appropriate computational tools, such as dynamic mathematics software, [or] programming languages … in mathematical work."

Course Content: The course will cover the basic theory of fields, found in Part 3 (Chapters 21-28) of the textbook. Since fields are logically special cases of rings, some topics from the earlier must also be recalled (notably Chapter 17). These sections of the textbook will be supplemented with related course handouts and videos. Highlights include

- The most important examples ($\mathbb{R}, \mathbb{C}, \mathbb{Q}, \mathbb{F}_q, \mathbb{Q}_p, F(\!(x)\!)$, algebraic number fields, the hyperreals, etc.) and the most basic properties of each.
- Basic theory, beginning from the axioms of field theory: field extensions, characteristic; algebraic and transcendental elements; splitting fields; field automorphisms; algebraic closures.
- The impossibility of trisecting an arbitrary angle in the Euclidean plane using straightedge and compass.
- The rudiments of Galois theory, including Abel's Theorem: the impossibility of expressing roots of a general quintic polynomial $f(x) \in \mathbb{Q}[x]$ as algebraic expressions (including radicals) of the coefficients of $f(x)$. (Only general results will be presented, not complete proofs.)

Students with Disabilities: If you have a physical, learning or psychological disability and require accommodations, please let me know as soon as possible. You will need to register with, and provide documentation of your disability, to the University Disability Support Services (UDSS) in SEO, Knight Hall.

Academic Freedom and Institutional Discrimination: UW Regulation 2-15 on Academic Freedom states, "Academic freedom in teaching protects the rights of Academic Personnel to teach according to their expertise. Academic Personnel are entitled to freedom in discussing their subject. Academic Personnel have a responsibility to ensure that their teaching is effective and consistent with the standards of the discipline, understanding that disciplines may have diverse points of view on any given subject. Teaching may involve controversial material; however, with academic freedom in the classroom, Academic Personnel also have the responsibility to respect others' freedom to express disagreement and alternative opinions." Additionally, "Academic freedom does not negate the rights of students and the public to disagree with Academic Personnel's work, although students are expected to learn material with which they may disagree." Also adopted by UW in its Academic Freedom policy, "Students should be free to take

reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled."

Green Dot Program at UW: Here at The University of Wyoming, we are committed to reducing and preventing power-based personal violence such as sexual assault, relationship violence, and stalking. Green Dot is a bystander intervention program to reduce these forms of violence with one thought: If everyone does one thing, no one will have to do everything. A Green Dot is your choice at any moment to make campus safer by promoting safety for everyone and letting others know that you will not tolerate violence. A Green Dot is any behavior, choice, word or attitude that sends a clear message that (1) Violence is not okay with you; and (2) Everyone is expected to do their part. Additional information on Green DOT training and resources are available at https://www.uwyo.edu/greendot/

Duty to Report: UW faculty are committed to supporting students and upholding the University's non-discrimination policy. Under Title IX, discrimination based upon sex and gender is prohibited. If you experience an incident of sex- or gender-based discrimination, we encourage you to report it. While you may talk to a faculty member, understand that as a "Responsible Employee" of the University, the faculty member MUST report information you share about the incident to the university's Title IX Coordinator (you may choose whether you or anyone involved is identified by name). If you would like to speak with someone who may be able to offer privacy or confidentiality, there are people who can meet with you. Faculty can help direct you or you may find info about UW policy and resources at https://www.uwyo.edu/reportit

Academic Honesty: Academic dishonesty will not be tolerated in this class. Cases of academic dishonesty will be treated in accordance with UW Regulation 2-114. The penalties for academic dishonesty can include, at my discretion, an "F" on an exam, an "F" on the class component exercise, and/or an "F" in the entire course. Academic dishonesty means anything that represents someone else's ideas as your own without attribution. It is intellectual theft (stealing) and includes (but is not limited to) unapproved assistance on examinations, plagiarism (use of any amount of another person's writings, blog posts, publications, and other materials without attributing that material to that person with citations), or fabrication of referenced information. Facilitation of another person's academic dishonesty is also considered academic dishonesty and will be treated identically.

Syllabus Changes: This syllabus is subject to change. Updates to this syllabus will appear electronically on the course website, and you will be alerted by email.