MATH 4113 Abstract Algebra II (Spring 2023)

Professor John Bergdall
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MWF 12:55 - 1:45 PM
Classroom: SCEN 405

Overview

This is a second course in abstract algebra. We explore the connection between algebraic numbers and symmetric structures alongside developing the fundamental laws that govern algebraic equations in a single variable.

Learning goals

Develop polynomial algebra.

Construct algebraic fields.

Universally solve equations.

Expose symmetry in roots.

Practice mathematical discourse.

Page background: handwritten page of manuscript by Évariste Galois, 1832. (Public domain.)

Materials

Textbook	Course materials	Office hours (SCEN 220)
Abstract Algebra (3rd/4th ed.) by Beachy and Blair (Rent/buy: $37/$63*)	On Blackboard; assignments and quizzes on Gradescope (Free)	Monday 9:00-10:00 Tuesday 3:30-4:30 Friday 2:00-3:00

*Used costs. If costs cause hardship or would limit your course access, email me for support.

Tasks and grades

Course tasks are broken into: *supporting tasks, performance tasks, and major works*. Your work on these tasks will determine your final grade. **Assignment details are on page 3. Grade details on page 4.**

Supporting Tasks	Performance Tasks	Major Works
Quizzes, in-class presentations, and peer review.	Evidence of understanding building upon basic knowledge.	Investigate theoretical aspects more deeply.

Turn-in

During the week you will do readings and participate in class. A quiz is due on **Friday afternoons**. Performance tasks are due **Wednesday afternoons**. Major works will be due on **Monday afternoons**, when applicable (four times).

Revisions

You may revise your work, repeatedly in the case of Performance Tasks and Major Works.

- Revisions for quizzes (a Supporting Task) are due **the following Wednesday** (five days later).
- Revisions for presentations (a Supporting Task) are due **as soon as feasible**.
- Revisions of Performance Tasks or Major Works are due no more than one week after its assessment. You will be able to simply resubmit your work and request a re-grade.

Late work

We allow late work, except on quizzes. When you turn something in late, notify me.

Supporting Tasks

Supporting Tasks test your knowledge and move the course forward. They include: **quizzes** on reading and class discussion, in-class **presentations**, and **peer reviews**.

Quizzes
Timed on Gradescope (due *Fridays*).

Presentations
Problems and theorems live.

Peer review*
Feedback on peer work.

Initial attempt: auto-graded.
Revisions: upload work (based on solutions!) *by Wednesday.*

Initial attempt: live, with Q & A.
Revisions: upload a written version to a wiki on Blackboard.

Initial attempt: online submission.
Revisions: re-submit if the instructor suggest improvements.

Performance tasks

Performance tasks are exercises to apply your knowledge, connect core ideas, and broaden your perspective. Due *Wednesdays.*

Peer review*: As the semester progresses, you will sometimes review each others's Performance Tasks.
Submission: Your work is uploaded and assessed on Gradescope (via Blackboard).

Major works

Major works let you piece together parts of the theory and develop a narrative explaining a single piece of mathematics.

Final essay: Your final exam (*May 8*) is a two-hour essay on one theoretical development in our course.

In-term essays: You will also write four essays, each on a fundamental law. Prompts will be provided during the semester, with roughly two weeks for each essay.

Fundamental laws of polynomial algebra over a field™

Polynomial equations have no more roots than their degree.

Due Feb 6

An algebraic number's degree determines the dimension of the field it generates

Due Mar 6

"Splitting fields"
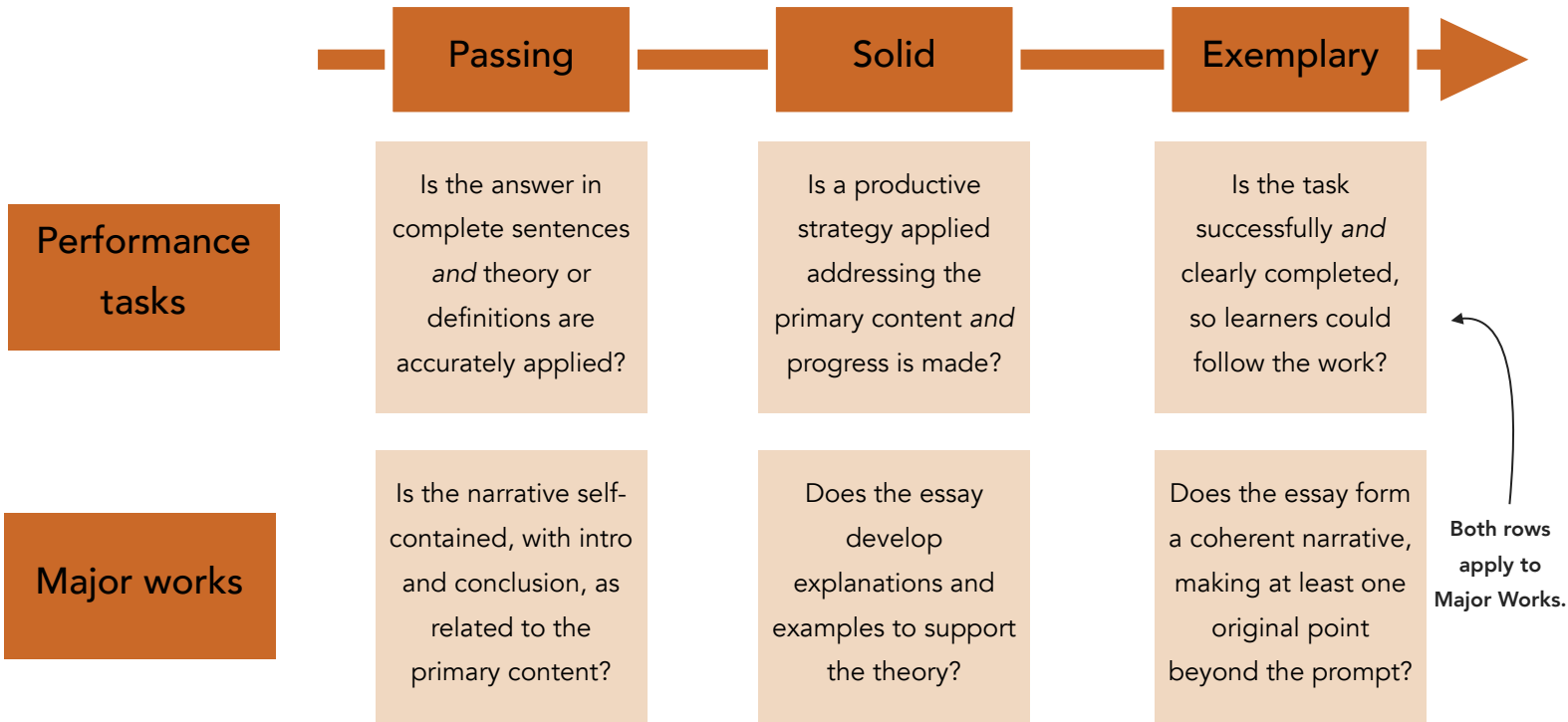Every polynomial equation has a *universal* smallest field containing its roots.

Due Mar 27

"Galois theory"
The algebraic structure of a splitting field is faithfully reproduced in the symmetry group of its field structure.

Due Apr 17

Grading

Our grading quickly gives feedback and promotes growth. You may revise work repeatedly and without penalty, except for the final exam.

- Supporting Tasks are *exemplary* if they are **correct** (quizzes, presentations) or **thoughtful** (peer review). This includes work, if something has undergone a revision.
- For Performance Tasks/Major Works, there is a more involved rubric of *passing, solid,* or *exemplary*. The Major Work includes as well the Performance Task rubric.

	Passing	Solid	Exemplary
Performance tasks	Is the answer in complete sentences *and* theory or definitions are accurately applied?	Is a productive strategy applied addressing the primary content *and* progress is made?	Is the task successfully *and* clearly completed, so learners could follow the work?
Major works	Is the narrative self-contained, with intro and conclusion, as related to the primary content?	Does the essay develop explanations and examples to support the theory?	Does the essay form a coherent narrative, making at least one original point beyond the prompt?

Both rows apply to Major Works.

Final grade

Your final grade is determined by your performance on each of the three course components. I reserve the right to *lower* these thresholds.

|	To earn a C…	To earn a B…	To earn an A…
Supporting Tasks	at least 80% exemplary	at least 90% exemplary	at least 95% exemplary
Performance Tasks	at least 90% passing	at least 90% solid	at least 90% exemplary
Major Works	100% passing	at least 80% solid 100% passing	at least 80% exemplary 100% solid

Tips for success

Read!
Before class.

Post!
To Blackboard.

Collaborate!
In class. With peers.

Hey!
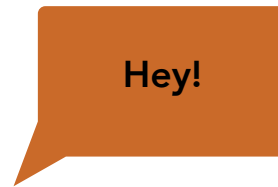
Conference!
With me.

Practice!
Repetition is key.

Budget!
Give yourself time.

More tips: We all get stuck and frustrated.
- Take a break.
- Explain to someone why you are stuck.
- Check hypotheses or assumptions.
- Work out a single example.
- Keep going!

Schedule

The course is broken into five units covering most of Chapters 4-6 and 8. Major Work essays are due for each of Units 1-4 (see page 3).

Unit 1 / 3 weeks	January 18 - February 3* Ch. 4, Appendix A.5	Polynomial algebra.
Unit 2 / 3 weeks	February 6 - February 24 Sec. 5.1-2, 6.1-3	Rings and algebraic field extensions.
Unit 3 / 3 weeks	February 27 - March 17* Sec. 5.3, 6.4-6.6	Splitting fields and finite fields.

Spring break (March 20 - 24)

Unit 4 / 3 weeks	March 27 - April 14 Sec. 8.1-8.3, 8.5, Ch. 3	Galois theory (and review of groups).
Unit 5 / 3 weeks	April 17 - May 3 Sec. 7.6, 8.4, 8.6	Applications of Galois theory.

Final exam (May 8, 12:45 - 2:45 PM)

*Substitute instruction will be provided January 18 - 20 and March 6-17 (research travel).

Further Resources

Email
Your questions are important. Email me or post to Blackboard. (I may ask you to do this anyways.) Responses may take 24 hours, but send a reminder if I do not reply.

Office hours
Ask anything you like in office hour! You can come for help on the material, but I will also lend an empathetic ear when you want to discuss your life or future outlook. Appointments may be set up via email.

Access
I want you to pass this class with success. If you find resources not being provided, tell me and I will work to fix the issue. Request student accommodations from the Center for Educational Access (cea.uark.edu), early in the semester. Meet with me to discuss further.

Academic integrity
I trust students to follow the University of Arkansas Academic Integrity Policy (https://honesty.uark.edu/policy) and explicit assignment rules. Your work *must reflect your own personal understanding*. For questions, ask me rather than assuming an answer.

Class formation
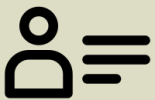
Names and pronouns
You deserve to be called how you want. Let me know your preferred name and pronouns any time. When meeting one another, re-introduce yourself *frequently*. Everyone's names, pronouns, etc. should be properly used.

Diversity
I welcome all forms of participation. I pledge attention for your identity and experience, regardless of your age, background, beliefs, ethnicity, gender identity and expression, national origin, racial identity, religious beliefs, sexual orientation, and any other visible or non-visible categories. Please acknowledge the same for your peers.

Health
If you face debilitating circumstances or have overwhelming concerns of wellness, you should contact me along with a trusted mentor, U of A Cares (uofacares.uark.edu), or the Wellness Center (health.uark.edu).