Math 329 - Algebra II: Rings and Fields

Course Information

Instructor and Course Meeting Information

Instructor: Lola Thompson
E-mail: lola.thompson@oberlin.edu
MWF 1:30-2:20 PM
Location: King 239
Office: King 200
Office Hours:
M 5 - 6
R 8 - 9 PM (Math 329 Group Office Hours)
F 2:30 - 3:30
*And by appointment.

Course Objectives

In this course, we will study algebraic structures known as "rings" and "fields," which generalize number systems with two operations. We will build up the basic theory of rings and fields, examining many interesting examples along the way. By the end of the semester, we will be able to answer several classical questions in mathematics:

- Can an angle be trisected, a cube duplicated, or a circle squared (using only a compass and straightedge)?
- Is there a general procedure for solving polynomial equations of any degree?

We will see that the answers to these questions are connected with deep ideas from Galois Theory(!).

Pre-requisites

A solid understanding of the content from Math 220 (Discrete Mathematics), Math 232 (Linear Algebra), and Math 327 (Abstract Algebra I: Group Theory) will be assumed. If you have not taken all of these courses at Oberlin, please contact the instructor ASAP to discuss whether Math 329 is appropriate for you.

Textbook

Abstract Algebra by David S. Dummit and Richard M. Foote (Third Edition)

Grades

The grades in this course will be calculated as follows:

	Weight
Peer Grading	10%
Homework Problems	20%
Midterm Exam #1	20%
Midterm Exam #2	20%
Final Exam	30%

Peer Grading

One of the primary objectives of this course is to help you hone your mathematical writing skills. There is no better way to improve your own proofs than to read those of your classmates! To that end, homework will be *peer-graded* by groups of 2-3 students each week. Together with the instructor, students will be responsible for grading the assignments and offering **useful** and **respectful** feedback. Afterwards, students will be required to submit a feedback report which comments on one specific problem that you encountered while grading. Feedback reports will be made available to the entire class on the Blackboard site.

Each student will be required to attend **three** peer grading sessions over the course of the semester. Students will have the opportunity to sign up for peer grading sessions at the beginning of the semester. If plans change and you can no longer attend a peer grading session that you have signed up for, you must find another student who is willing to switch with you and then e-mail the instructor (and CC the other student) to inform her about the change.

Each peer grading session is worth approximately 3% of your final grade. In order to receive credit for peer grading, you must: (1) attend your assigned sessions and participate fully; and (2) submit a feedback report within 1 week of when the peer grading took place. I reserve the right to remove any students from the peer grading session who are behaving in a disrespectful or distracting manner.

During the weeks when you are serving as a peer grader, you will automatically receive a grade of 100% on the homework assignment. That way, you will not be able/forced to evaluate your own work.

Homework Assignments

Problem sets will be due on Mondays at the beginning of class. Solutions MUST be written in LaTeX, and they must be stapled to a cover sheet. It is very important that your name not appear on any pages other than the cover sheet. That way, we can preserve anonymity in the peer grading sessions.

You are welcome (and encouraged!) to work closely with your classmates, provided that each student writes up their own set of solutions in their own words. I understand that life happens and unforeseen circumstances can occasionally get in the way of homework preparation. For that reason, I will drop your two lowest homework scores at the end of the semester. **Due to the peer grading structure, late homework cannot be accepted.**

Exams

There will be two midterm exams. The midterm exams will have two components: an in-class portion and a take-home portion. The in-class portion will test your ability to solve routine problems and write some basic proofs. The take-home portion will involve a few more-sophisticated proofs.

The final exam will be a take-home exam. The exam will be handed out on the final day of class (December 8^{th}) and it will be due at the end of our assigned final exam slot (9 PM on Friday, December 15^{th}).

Class Attendance

Class attendance is vital in this course. The content has a particularly "vertical" structure – topics will build heavily on one another. Missing material early on may cause serious trouble later in the semester.

Blackboard

All course materials can be found on the course Blackboard site. Go to `http://blackboard.oberlin.edu` to access them.

LaTeX

All problem sets must be written up in LaTeX. If you are unfamiliar with LaTeX, please speak with the instructor ASAP. Numerous LaTeX resources (including a homework template) can be found in the "LaTeX" folder on our course Blackboard site. I strongly recommend using ShareLaTeX, rather than downloading and installing it on your own computer. That way, if you have a question on your homework writeup, you can easily "share" your document with me.

Course Policies

Academic Honesty

Homework
When solving the weekly problem sets, you are welcome to consult with your class notes, textbook, classmates, and the instructor. However, you *may not* consult any books (other than our course textbook) or internet resources.

You are welcome (and encouraged!) to work with your classmates on the problem sets. In any collaborative efforts, you must abide by the following guidelines:

- You must list all collaborators on the cover sheet (there is no penalty for acknowledging collaboration on your homework);
- After discussing a problem with others, discard any written records and write up the solution in your own words.

Exams
You are not allowed to use any electronic device or consult any source other than the instructor during the in-class portion of the exams. In particular, this means *no calculators, smartphones, dumb phones, tablets, laptops, notes, textbooks, etc.* For the take-home exams, you may only use your class notes, textbook, problem sets, problem set solutions (posted on Blackboard), and your professor as resources. All other resources, including fellow humans, are off limits.

Note: Information about the Honor Code can be found at the following website: `http://www.oberlin.edu/students/links-life/honorcode.html`. All students are responsible for maintaining the highest standards of honesty and integrity in every phase of their academic careers. The penalties for academic dishonesty are serious and ignorance is not an acceptable defense.

Disabilities

Students in this course with disabilities, including "invisible" disabilities such as chronic diseases and learning disabilities, and who may need disability-related classroom accommodations, are encouraged to make an appointment to see their instructor as soon as possible.

Make-up Policy

Typically, a missed midterm exam cannot be made up. That said, I understand that some circumstances are beyond your control. Should you contract a serious illness or find yourself in an emergency situation, please contact me *immediately*. I will be happy to make arrangements with you under these types of extreme circumstances.

Religious Observances

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with me before the end of the third week of the semester to discuss appropriate accommodations.

Important Dates

Labor Day	September 4th (Monday)
Add/Drop Deadline	September 7th (Thursday)
Fall Break!	October 14th (Saturday) – October 22nd (Sunday)
Withdraw and P/NP Deadline	October 31st (Tuesday)
Thanksgiving Break	November 23rd (Thursday) – November 26th (Sunday)
Classes End	December 8th (Friday)
Reading Period	December 9th (Saturday) – December 12th (Tuesday)
Final Exam	December 15th (Friday)

Course Schedule

The following is an estimated schedule for the course. Please note that the midterm exam dates are tentative.

Lectures	Textbook Section	Brief Description
8/28	7.1, 7.2	Introduction to rings; Polynomial rings
8/30	7.3	Homomorphisms; Quotient rings
9/1	7.4	Quotient rings and properties of ideals
9/4		**No Class – Labor Day!**
9/6	7.5	Rings of fractions
9/8	7.6	Chinese Remainder Theorem
9/11	8.1, 9.1	Euclidean domains; Polynomial rings; **HW due**
9/13	8.2, 9.2	PIDs
9/15	8.3	Unique Factorization Domains
9/18		Classifying rings; **HW due**
9/20	9.3	Gauss' lemma and consequences
9/22	9.4	Irreducibility criteria
9/25	13.1	Characteristic, prime fields; **HW due**
9/27	13.1, 13.2	Finite extensions; Simple extensions
9/29		**Midterm Exam #1**
10/2	13.2	Algebraic extensions
10/4	13.2	Algebraic extensions
10/6	13.2, 13.3	Compass and straightedge constructions
10/9	13.3, 13.4	Splitting fields; **HW due**
10/11	13.4, 13.6	Splitting fields and cyclotomic polynomials
10/13	13.6	Cyclotomic polynomials
10/14 - 10/22	**No Class – Fall Break!**	
10/23	13.4, 13.6	Algebraic closures and uniqueness; **HW due**
10/25	13.5	Separable and inseparable extensions
10/27	13.5	Separable and inseparable extensions
10/30	14.1	Automorphism groups of fields; **HW due**
11/1	14.1	Fixed fields and automorphism groups
11/3	14.1	Fixed field and automorphism groups
11/6	14.2	Fundamental Theorem of Galois Theory
11/8	14.2	Fundamental Theorem of Galois Theory
11/10		**Midterm Exam #2**
11/13	14.2	Fundamental Theorem of Galois Theory; **HW due**
11/15	14.2	Fundamental Theorem of Galois Theory
11/17	14.3	Finite fields
11/19	14.4	**(Pre-Thanksgiving Make-up Class)** Composite extensions
11/20	14.4	Composite extensions and simple extensions
11/22		**Class Cancelled – Happy Thanksgiving!**
11/24		**No Class – Thanksgiving Break!**
11/27	14.5	Cyclotomic and abelian extensions; **HW due**
11/29	14.5	Finite abelian groups are Galois groups
12/1	14.6	Galois groups of polynomials
12/4	14.6	Galois groups of polynomials; **HW due**
12/6	14.7	Solvable and radical extensions
12/8	14.7	Insolvability of the quintic
12/15		Final Exam (7 – 9 PM)