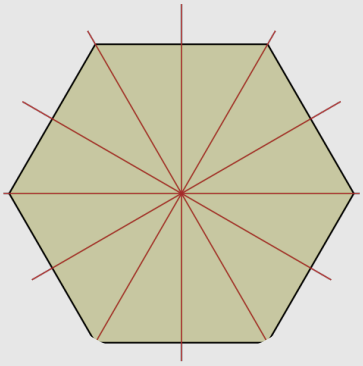

# Abstract Algebra I

Math 304-01 (3 cr.)
Dordt College Fall 2018

## Instructor Info


Mike Janssen, Ph.D., Assistant Professor of Mathematics

Office Hours TBD

SB 1608

(712) 722-6398

http://bit.ly/m304f18

mike.janssen@dordt.edu


## Course Info

MWF 2–2:50pm

CL 92

## Description

From the catalog: An introduction to algebraic structures focused on rings and fields. Connections between the ring of integers and the ring of polynomials over a field are developed and explored. Brief attention is given to groups. Prerequisite: grade of C– or higher in Mathematics 212; or permission of instructor.

## Overview

Algebra (Arabic, *al-jabr*) literally means "the reunion of broken parts." You have seen this before. In school algebra, you broke objects (usually polynomials) into "broken parts" via the process of *factorization*. One of the most celebrated results about the process of factorization in  is the Fundamental Theorem of Arithmetic, which states that factorization into primes is unique up to the ordering of the prime factors.

This course will seek to deeply explore the notion of factorization from an abstract perspective, mainly in the context of the polynomial ring $F[x]$. Specifically, we will seek to understand exactly which structural properties shared by  and $F[x]$ guarantee a notion of unique factorization. We will also explore *nonunique* factorization, which arrived on the scene in the 19th and 20th centuries and turned out to be crucial to Andrew Wiles's 1995 proof of Fermat's Last Theorem.

Our last weeks will be spent surveying the beautiful land of group theory. We hope to have time to draw strong connections between rings/field and groups, and catch a glimpse of the marvelous beauty and wonder that God has wrought in this hidden, abstract area of His Creation.

## Learning Objectives

- Demonstrate an ability to clearly understand and construct rigorous mathematical arguments (proofs) in the area of abstract algebra. (CD)
- Become comfortable using the fundamental definitions and theorems of ring/field theory. (CS)
- Reflect on the nature of mathematics, and the cultural activity of *doing* mathematics, from a Reformed perspective (RO/CS/CR).
- Communicate your work clearly as a member of the guild of mathematicians and a member of the Math 304 learning community. (CD)

## Important Dates

| | |
|---|---|
| Fridays (5pm) | Written homework due |
| September 14 | First Mondays Reflection due |
| October 19 | Midterm Exam (in-class) |
| October 19 | Take-home midterm exam due |
| December 12 | Project due |
| December TBA | Final Exam |

## Materials

### Required Materials

Regular access to a computer to access our course notes on Overleaf.com

### Other

Any required articles and book chapters will be provided on Canvas.

## Tentative Schedule

As the course will be driven by your work and interests, it is difficult to predict the amount of time that will be spent in each section. However, here is my best guess.

- Foundations/Integers: 2–3 weeks
- Fields: 1 week
- Rings: 3–4 weeks
- Factorization: 3 weeks
- Ideals and homomorphisms: 2 weeks
- Groups: 1–2 weeks

# Course Liturgies

## Typical Class Meeting

Before each class period, you will be assigned 3–5 problems from our course notes to work on before coming to class. You may not use any outside resources to help you solve these problems–no books, no websites, no friends who have taken this course before. You may work with others in the course, but you will need to ensure that you can completely understand and explain the proofs you come up with.

One of the main goals of this course is to improve your mathematical communication. Due to this, the majority of each class period will be devoted to you presenting your work on these problems to each other. You should expect that approximately 90% of the typical class period will consist of presentations and discussion.

At the start of each class meeting, you will have the opportunity to claim a problem to present. In general, you can claim at most one problem per class meeting. Once those have been assigned, volunteers will be solicited from the non-presenters to serve as *scribes*.

The presenter will have the responsibility of preparing the problem before coming to class. This individual will write the problem and solution up on the board, highlight the main points of the proof, and generally lead the class discussion. That is, merely writing the solution on the board will not be sufficient. The presenter will earn points as follows.

1 point. The proof is correct and complete, and all questions are answered.

1/2 point. The proof was prepared, but there are gaps and/or questions that are not satisfactorily answered.

1/4 point. The proof was either not prepared or is in completely the wrong direction.

The scribe will have the responsibility of taking notes on the presented proof and asking questions when something is not clear. They then will write up a formal version of the proof and submit it by the next class period. All problems are to be typed (in $\LaTeX$) at our course document on Overleaf.com. The scribe will earn 1/4 point when the proof is submitted.

## Written work

Each week (other than the week you have a take-home exam), you will be assigned two problems to write up and submit online by 5:00pm on Fridays. These will be written in LaTeX, and will generally not be problems that have been presented in class (though they may have been assigned as daily work). Each problem will be graded as a Pass or Retry. A proof/solution will earn a Pass if:

- It is correct.
- It follows the basic rules of grammar, spelling, etc., with minimal errors.
- It clearly shows how each step proceeds from the given information with no major mathematical gaps. The audience for each proof is a student who is familiar with the mathematical ideas discussed in the course and with the basic techniques, but has no familiarity with this problem.
- It is clear, in that the reader is always kept informed about what is going on and the logic of the solution is easy to follow.

A problem that does not receive a Pass may still show some merit, and I will provide feedback on what exactly is preventing you from passing. These problems will receive a Retry grade and can be resubmitted *one time* to receive full credit. If your solution shows no merit (e.g., you do not seem to have put any effort into the solution), you will receive no credit and no opportunity to resubmit.

## First Mondays Response

Our September First Mondays speaker is Dr. Francis Su, mathematician at Harvey Mudd College. You will write a 3–4 page response to his talk and the ensuing discussion. This will be due September 14.

## Project

There will be a project due at the end of the semester, the focus of which will be to build connections between the course content, an area of interest (e.g., computer science, education, etc.), and a Reformed world and life view. You will present your work in a poster-session style on the last day of class. Additional details are forthcoming.

### Midterm Exam

There will be one midterm exam during the semester. It will have an in-class and take-home component, each of which will consist of five problems. The exam will be assessed just like the written work. Problems included on the take-home component may be resubmitted if they are assessed as non-passing. The in-class portion may not be resubmitted.

### Final Exam

The final exam will also consist of an in-class component and a take-home component. Unlike the other work in the class, the final will be a traditional points-based exam, and will modify your final grade as follows.

- A score between 95% and 100% will cause your final grade to increase by one full letter grade.
- A score between 90% and 95% will cause your final grade to increase by 2/3 of a letter grade.
- A score between 85% and 90% will cause your final grade to increase by 1/3 of a letter grade.
- A score between 70% and 85% will not change your final grade.
- A score between 60% and 70% will drop your final grade by 1/3 of a letter.
- A score between 50% and 60% will drop your final grade by 2/3 of a letter.
- A score below 50% will drop your final grade by a full letter.

The take-home component of the final exam will be due at the in-class final exam time, which is December TBA at TBA.

## Final Grades

In general, your final grade will be the highest completed row (subject to modification by the final exam).

| Grade | Board work | Written work | Midterm | Paper | Project |
|---|---|---|---|---|---|
| A | 11 | 24/28 | 8/10 | 1 | 1 |
| A– | 11 | 24/28 | 7/10 | 1 | 1 |
| B+ | 10 | 23/28 | 7/10 | 1 | 1 |
| B | 10 | 22/28 | 6/10 | 1 | 1 |
| B– | 9 | 21/28 | 6/10 | 1 | 1 |
| C+ | 8 | 20/28 | 6/10 | 1 | 1 |
| C | 8 | 18/28 | 5/10 | 1 | 1 |
| C– | 7 | 16/28 | 5/10 | 1 | 1 |
| D | 6 | 14/28 | 4/10 | 0 | 0 |

## Other Important Information

Dordt College Student's Rights to Accommodations Policy: Any student who needs access to accommodations based on the impact of a documented disability should contact the Coordinator of Services for Students with Disabilities (CSSD): Marliss Van Der Zwaag, Academic Enrichment Center, `marliss.vanderzwaag@dordt.edu`, (712) 722-6490.

Dordt College Academic Dishonesty Policy: Dordt College is committed to developing a community of Christian scholars where all members accept the responsibility of practicing personal and academic integrity in obedience to biblical teaching. For students, this means not lying, cheating, or stealing others' work to gain academic advantage; it also means opposing academic dishonesty. Students found to be academically dishonest will receive academic sanctions from their professor (from a failing grade on the particular academic task to a failing grade in the course) and will be reported to the Student Life Committee for possible institutional sanctions (from a warning to dismissal from the college). Appeals in such matters will be handled by the student disciplinary process. For more information see the student handbook.