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tags: mth350, syllabus

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## MTH 350-01: Modern Algebra 1, Winter 2021

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**Welcome to MTH 350!** I'm Dr. Robert Talbert, Professor of Mathematics, and I am grateful that you are signed up for the course and am looking forward to working with you this semester.

### What's MTH 350 all about?

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The algebra and arithmetic we learn in school are full of facts that students tend to accept without question. In MTH 350, we will **discover the real rules behind much of algebra**, and then try to see **how far we can bend the rules before they break**.

MTH 350 takes on two big questions in mathematics:

1. **How do arithmetic and algebra actually work?** For example, you probably know that every positive integer can be factored into a product of prime numbers, like  $20 = 2 \times 2 \times 5$ . But can you explain *why* this is true, for *all* positive integers?
2. **Can the rules of arithmetic and algebra be extended to mathematical objects that aren't necessarily numbers?** Take multiplication for example. We multiply numbers together, but we multiply things like matrices together too. How much of our rules for multiplication of *numbers*, work for *matrices*? Does matrix multiplication satisfy the commutative property, or the associative property? Can you “divide” matrices? Can we “factor” a matrix into a product of “prime” matrices? Is there even a sensible definition of these concepts?

This twofold process of discovering the rules of how something works and then finding out where those rules can be applied, is called **abstraction**. Building strong skills in mathematical abstraction is perhaps the main goal of this course (which is sometimes called “abstract algebra”). Abstraction is not something to be feared or avoided! It is to be *embraced*, because **abstraction solves problems**.

Specifically, MTH 350 focuses on:

- **Arithmetic and the theory of numbers.** We'll look closely “under the hood” of what we know about arithmetic and whole numbers. We will build up the rules of arithmetic from a minimal set of axioms and see how and why it all works.
- **Rings.** We will then look at the concept of a *ring*, a generalized **algebraic structure** that includes all our familiar number systems but also objects that are *not* numbers. This will allow us to extend the rules of arithmetic to other kinds of things.
- **Fields.** As we look at rings, we'll be keeping an eye on rings where something like “division” can be

done. Those kinds of structures are called *fields*.

The concepts in this course are also useful in the real world. For example, most modern cryptographic systems that protect your digital data are based on the math in MTH 350. And if you are a preservice teacher, you will come away from MTH 350 able to communicate to your future students not only what the rules of algebra *are*, but *why they work*. You'll have the opportunity to explore either of these applications and more as part of the course.

**MTH 350 is a proof-based course.** A prerequisite for this course is MTH 210, and we will be engaging in proof activities daily. You need to be comfortable with proof and open to improving your proof skills through persistent work in order to succeed in the course. If you are concerned about your preparation regarding proof, please contact me.

MTH 350 is challenging, made even moreso by the pandemic and the online format of the course. However please note that **my primary role in this course is to help you learn and succeed in the course**. Please call on me at any time (see below) if you have any needs whatsoever.

**Prerequisites:** [MTH 210](#) and either [MTH 225](#) or [MTH 204](#).

## Course Objectives

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After successful completion of the course, students will be able to...

1. Write to communicate the topics of abstract algebra using accepted proof writing conventions, explanations, and correct mathematical notation.
2. Identify fundamental structures of abstract algebra including rings, fields, and integral domains.
3. Comprehend abstract definitions and theorem statements by building examples and non-examples of definitions, and drawing conclusions using definitions and theorems given mathematical information.
4. Demonstrate problem solving skills in the context of abstract algebra topics through consideration of examples, pattern exploration, conjecture, proof construction, and generalization of results.
5. Analyze similarities and differences between algebraic structures including rings, fields, and integral domains.

## Key Information

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- **Course mode:** This section of MTH 350 is **synchronous online**, which means we will meet online (through Zoom) at regularly scheduled times. Please note **I do not plan on being on campus this semester**.
- **Class meetings:** TR 11:30-12:45 online. Class sessions will be held on Zoom; the link and passcode are found on Blackboard in the *Syllabus and Calendar* area.
- **Definition of a "week":** For this class, a "week" runs from 12:01am Eastern time on Monday through 11:59pm Eastern time on the following Sunday.
- **Professor contact:** Email at [talbertr@gvsu.edu](mailto:talbertr@gvsu.edu), or direct-message me on Campuswire. If you have a

question that the entire class might answer, please post it to the Class Feed on Campuswire instead of in a private message.

- **Professor availability:** I check messages regularly between the hours of 7:00am and 5:00pm on weekdays, and once on Saturdays; if you contact me during those hours and your message needs a reply, you can expect to receive one within a few hours, often sooner. *Outside of those hours, particularly on weekends, I am offline and not checking messages.* Please plan accordingly as you schedule your work.
- **Drop-in hours:** These will be held on Campuswire via Live Sessions feature. You do *not* need an appointment for drop-in hours. Specific drop-in times will be determined during week 1.
- **Textbook:** *Abstract Algebra: An Inquiry-Based Approach* by Hodge, Schlicker, and Sundstrom.
- **Course materials:** All course files, the class calendar, class forms, and most graded assignments are housed on Blackboard (<http://mybb.gvsu.edu>).
- **Course announcements and communication:** Course announcements, discussion, and other communication will be housed on **Campuswire** (<https://campuswire.com/c/G43C11C2E/>). You will also be able to use a service called **Remind** which pushes reminders to you via text message.

## What will class meetings be like?

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Your work in the class will follow a pattern that will involve you **before**, **during**, and **after** our meetings:

- **BEFORE each class:** You'll complete a **Daily Prep** assignment in which you'll read parts of the text, watch recorded lectures, and complete assignments that will get you up to speed on the basic ideas of new material.
- **DURING each class:** Class time is reserved for *doing math*, together and individually. We will focus on activities that **apply the basics** that you learn in Daily Prep and get you ready for more advanced work later.
- **AFTER each class:** You'll apply and extend the ideas we practice during class through different kinds of graded work.

Since you learn math by *doing* math, class time will be prioritized for doing active work (both individually and in groups) on applications of basic concepts. You'll be expected to gain enough fluency on those basics to be productive in class, by doing your Daily Prep assignments. Lectures during class will be infrequent, short, and targeted at specific questions from your work rather than a general introduction to concepts. Also, **there are no timed tests or quizzes during class meetings.**

## What assignments will there be?

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- **Weekly Practice:** Homework sets given weekly that help you build the basic skills needed for understanding the course concepts. There are 12 of these planned.
- **Problem Sets:** Extended problem sets, mostly involving writing proofs. Some of these will be used in your Proof Portfolio (below). There are 6 of these planned.
- **Daily Prep:** Daily reading and (sometimes) videos, with exercises and questions to be submitted prior

to class. These will help you learn the basics of new material and prepare you for higher-level focused work in class. There are 24 of these planned.

- **Workshops:** Weekly discussion threads on Campuswire that will have you collaborate on relevant course-related tasks like analysis of proofs, breakdowns of definitions and theorems, and other activities. There are 12 of these planned.
- **Startup and Review Assignments:** Assignments done during the first half of the semester to build (or rebuild) your fluency with the course and the prerequisite mathematics, particularly from MTH 210. There are 6 of these planned.

There are also two major assignments in the course that only happen once. More information on both of these will be given later in the semester:

- **Proof Portfolio:** A collection of your best proof-writing work, gathered from your Problem Sets.
- **Project:** You'll work individually or in a pair to explore a topic related to, but not necessarily covered in the course. Topics will be left up to you but can include research questions, applications to real-life problems, or applications of the course to K-12 teaching situations. The project will involve a written product, a "trailer" video, and a brief presentation to the class during the last week of classes.

We *do not* have a final exam in the course; however we will reserve the final exam time slot (April 27 from 10:00-11:50am) in case we need more time for project presentations.

## How do I earn a grade in the course?

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Your grade in the course is earned by **demonstrating evidence of skill on the main concepts in the course** and by **showing appropriate engagement with the course**. And this is done by completing the assignments outlined above, at a reasonably high level of quality.

In our class, **there are no points or percentages** on any items. Instead, the work you turn in will be evaluated against **quality standards** that will be made clear on each assignment. If your work meets the standard, then you will receive full credit for it. Otherwise, you will get helpful feedback and, on most items, the chance to reflect on the feedback, revise your work, and then resubmit it for regrading.

This feedback loop represents and supports the way that people learn: By trying things, making mistakes, reflecting on those mistakes, and then trying again. **You can make mistakes without penalty** as long as you *eventually* demonstrate evidence of skill.

The individual types of assignments are marked as follows:

Assignment	How it's marked
Weekly Practice	<b>E</b> (Excellent), <b>M</b> (Meets Expectations), <b>P</b> (Progressing), or <b>X</b> (Not Assessable)
Problem Sets	<b>E</b> (Excellent), <b>M</b> (Meets Expectations), <b>P</b> (Progressing), or <b>X</b> (Not Assessable)

Daily Prep Assignment	Pass or No Pass	How it's marked
Workshops	Pass or No Pass	
Startup/Review Assignments	Pass or No Pass	
Proof Portfolio	High Pass, Pass, or No Pass	
Project	High Pass, Pass, or No Pass	

The criteria for the different marks are explained in the “*How are individual assignments graded?*” section below.

Your final grade in the course is determined by the following table. Each grade has a *requirement* specified in its row in the table. **To earn a grade, you will need to meet *all* the requirements in the row for that grade.** Put differently, your grade is the **highest** grade level for which **all** the requirements in a row of the table have been met or exceeded.

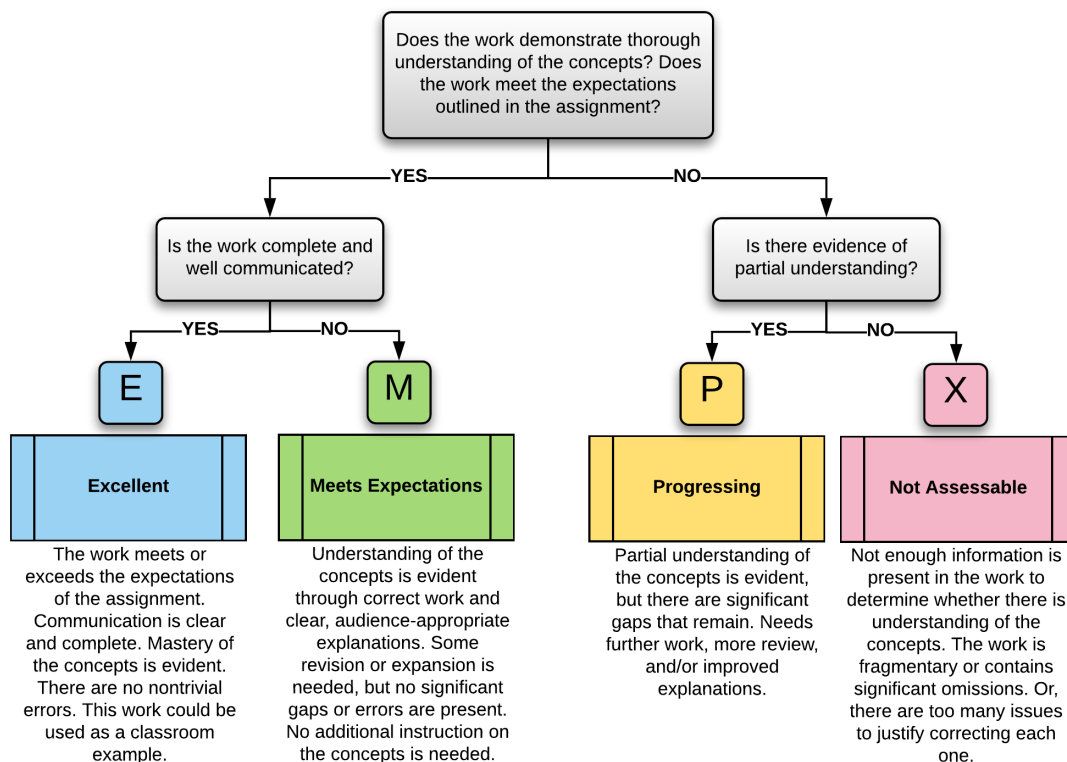
Grade	Weekly Practice (M or E)	Problem Sets (M or E)	Daily Prep passed	Workshops passed	Proof Portfolio + Project	Startup/Review passed
A	10 (out of 12)	5 (out of 6)	20 (out of 24)	10 (out of 12)	Pass on one; High Pass on the other	6 (out of 6)
B	9	4	18	8	Pass on both	6
C	8	3	16	6	Pass on Proof Portfolio	6
D	4	1	10	2	Pass on one	n/a

A grade of F is given if **none** of the rows has been fully completed.

**Plus/minus grades:** Plus/minus grades will be assigned at my discretion based on how close you are to the next higher or lower grade level.

## How are individual assignments graded?

- **Weekly Practice** and **Problem Sets:** Each type has its own standards for “acceptable work” outlined in the “Standards for Grading” document found on Blackboard in the *Syllabus and Calendar* area. The grading process is outlined in the flowchart below:



EMPX rubric based on the EMRF rubric, due to Rodney Stutzman and Kimberly Race: <http://eric.ed.gov/?id=EJ717675>  
EMRN rubric adaptation by Robert Talbert is licensed under CC BY-SA 4.0



- **Daily Prep:** A *Pass* mark is given if the Daily Prep is turned in before its deadline and if *each item* on the Daily Prep has a response that represents a *good faith effort to be right*. **Mistakes are not penalized.** A *No Pass* is given if an item is left blank (even accidentally), has an answer but it shows insufficient effort (including responses like “I don’t know”), or if the Daily Prep is late.
- **Workshops:** A *Pass* mark is given if you give a response to the discussion prompt that is correct, clearly expressed, substantive, and given before the discussion is closed. A *No Pass* is given otherwise.
- **Startup/Review assignments:** The Pass/No Pass criteria for these are specified on the individual assignments.
- **Proof Portfolio and Project:** The criteria for the different marks will be given in detail later in the semester.

## How do I revise and resubmit my work?

Instead of earning partial credit, on most assignments you will have the opportunity to revise and resubmit your work based on feedback that I provide, if the work doesn’t meet its standard for acceptability.

**Mistakes, and work that does not meet the standard for acceptability, are typically not penalized.** Instead, if your work has enough errors that it would benefit from redoing parts of it or the whole thing, you’ll get the chance to do so. This again is because **human beings learn from making mistakes and fixing them with feedback and reflection.**

- **Weekly Practice:** Each Weekly Practice may be revised **once**. To revise, simply reflect on the feedback that's given, make corrections or rewrites to the original, and then upload the work again to Blackboard.
- **Problem Sets:** Each Problem Set may be revised **once per week**. To revise, simply reflect on the feedback that's given, make corrections or rewrites to the original, and then upload the work again to Blackboard.
- **Daily Prep** assignments *may not* be revised or resubmitted. They are graded on completeness and effort only, and therefore can only be done once.
- **Workshop** responses will get immediate feedback (privately if necessary) if the response doesn't meet "Pass" quality, and you can fix it on the spot. However you won't be able to go back in and revise a response after the discussion is closed.
- **Startup and Review Assignments:** Review assignments consist primarily of online quizzes that can be reattempted as many times as needed prior to their deadlines.
- **Proof portfolio:** This will be detailed later in the semester, but your portfolio will consist of work from your Problem Sets, so see the revision policies for those above.
- **Project:** The project may not be revised, but checkpoints for your work will be built into the project timeline, so you will have the chance to get feedback and make adjustments as you go.

Please note: **Revisions of Weekly Practice or Problem Sets marked "X" cost one token** (see below).

Also please note that **I do not typically look over student work before it is submitted**. Requests to review student work prior to submission will usually be declined. Instead, when you are submitting work, make sure to double-check your work prior to submitting it, to make sure that all required components are present and that, to your understanding, your work meets the criteria for acceptable quality. If you submit your work and it needs revision, you can revise it.

**Tokens:** Each student starts the semester with 5 **tokens**, which can be used to purchase exceptions to the course rules. The token "menu" is below. To spend a token, go to the *Token Spending* form (found in the in the *Submit a Form* area on Blackboard), fill it out, and submit it. Once the form is submitted, the item you purchased is yours; you do not need permission or confirmation. Everything listed here costs 1 token:

- Revise a Weekly Practice a second time. (Third, fourth, etc. revisions of a single Weekly Practice are not allowed.)
- Revise a second Problem Set in a given week. (Third, fourth, etc. revisions of a single Problem Set in a week are not allowed.)
- Extend any deadline *except for Daily Prep* by 12 hours.
- Revise a Weekly Practice or Problem Set marked "X".
- Convert a "No Pass" on a Daily Prep to a "Pass".
- Convert a "No Pass" on a Workshop response to a "Pass".

## What else do I need to know? (Additional course policies)

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### Attendance and deadlines

**Attendance:** You will need to participate actively in each class meeting to get the most out of the course and avoid having to teach yourself the material. Attendance will be taken but not graded; I will follow up with students with excessive absences, but no direct penalty is incurred. You do not need to seek permission to miss a class. However, realize that excessive absences will severely limit your ability to learn the subject.

**Zoom meeting guidelines:** Our class meetings will be done through Zoom. When we meet, please **mute your audio but turn your video feed on**. Having the video feed on helps me to interact better with you, and it will help you focus and learn. If you are not comfortable with having video on, please at least **use a picture of yourself** that appears on screen when you mute the video. We will also work in breakout rooms frequently; when doing so, **if you are working collaboratively with a group, make sure to turn both your audio and video on, and participate actively**.

**Deadlines and late work:** Deadlines are generally strictly enforced, and late work will not be accepted. However, you can spend tokens to extend deadlines. Daily Prep and Workshop deadlines cannot be extended, but you can spend a token to change a grade on those to Pass if needed.

## Collaboration and academic honesty

I highly encourage you to collaborate with your classmates whenever collaboration is allowed. However, realize that *collaboration is not always allowed* and in all cases, there are limitations on how you can collaborate. In particular:

- On **Weekly Practices** and **Problem Sets**, your work must represent *your own understanding* in *your own words*. You may not use solutions, directly or indirectly, from any sources — including other students, past students, online sources, or other textbooks.
- On **all other assignments**, you may collaborate with others, but you must contribute significantly to the assignment, and your work must represent *your own understanding* in *your own words*.

You are responsible for understanding this policy and the [GVSU Student Code](#). Violations will result, at minimum, in a mark of “X” or “No Pass” on the assignment. Serious or repeat violations of this policy will result in increasingly horrible consequences, including being barred from further submissions of the assignment, or even failure of the class.

## Technology

Being an online class, we will use a variety of technological tools to learn.

- MTH 350 doesn't focus much on computing things, so graphing calculators are not very useful. It's fine to have one, but you'll probably not use it much.
- Instead, you *do need* a **laptop or tablet device** running a **modern web browser** (such as Chrome, Edge, or Firefox) and **reliable access to high-speed internet** so that we can use web-based tools for our work.
- You also need an **active GVSU network account** so you can access email, Blackboard, and Google Docs.



- Preferably, your device should have a **touchscreen** that allows **writing on the screen with a stylus**. If you don't have such a device, consider purchasing a [drawing pad](#) that connects your computer via USB; many are under \$50.
- The software tools we use in the course are all free and either web-based or available as apps on multiple platforms. We will introduce and train on these when needed.

If you encounter issues with technology, please use the appropriate source of help:

- *For help with Blackboard:* Email the Blackboard Help Desk at [bbadmin@gvsu.edu](mailto:bbadmin@gvsu.edu) or call (616) 331-8526. For hours of operation and more information see <https://www.gvsu.edu/elearn/help/>.
- *For help with the GVSU network, email, or printing:* Email the GVSU IT Help Desk at [helpdesk@gvsu.edu](mailto:helpdesk@gvsu.edu); or call (616) 331-2101 or toll free (855) 435-7488. For hours of operation and more information see <https://www.gvsu.edu/it/>.
- *For specific help with your computer:* Try the GVSU IT Help Desk (see previous bullet) or contact your equipment manufacturer or computer store.
- *For help with course tools such as Campuswire:* Ask a question on the **#tech** channel on Campuswire, seek out the help documentation in the tool, or do a targeted Google search.

Please note that I (**Prof. Talbert**) **am not able to provide student tech support** as I do not have access to your accounts or knowledge of your hardware. I can help with questions about course tools (Desmos, etc.) but please ask those questions on Campuswire so others can see and help too.

## Getting help and support

**Special learning needs:** If you have special needs because of learning, physical or other disabilities, it is your responsibility to contact Disability Support Resources (DSR) at 616-331-2490 or <http://www.gvsu.edu/dsr/>. DSR will help you arrange accommodations. Then, speak with me in person about making those accommodations and ensure that they are consistent with your arrangements with DSR.

**Basic needs security:** If you have difficulty affording groceries or accessing sufficient food to eat every day, or if you lack a safe and stable place to live, I encourage you to visit [Replenish](#), a food resource for GVSU students. If you are comfortable doing so, please speak with me about your circumstances so that I can advocate for you and to connect you with other campus resources.

**Gender identity and expression:** If, for purposes of gender identity and expression, your official name (in Banner) does not match your preferred name, your name can be updated in Blackboard. Please contact the registrar's office to submit this request. The registrar's office will contact the Blackboard administrator to make the change and will also contact your professors to inform them that your name in Banner will not match the name in Blackboard.

## Credits

I borrowed a lot from the MTH 201 syllabus of Prof. David Clark.

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## Appendix: Initial course schedule and important dates

Please note, all dated items are found in the course calendar (Blackboard, in the *Syllabus and Calendar* area) and all updates to this initial schedule will be made there. Also, *this schedule is not all-inclusive*: Due dates, additional events, etc. appear on the course calendar. **If there is an apparent date conflict on course documents, that calendar is always considered to be correct.**

Dates	Course module	Textbook coverage	Topics
January 19-22	1	Startup and Investigation 1	Axioms of arithmetic
January 25-29	2	Investigation 2	Divisibility of integers; integer congruence
February 1-5	3	Investigation 3	Greatest common divisors
February 8-12	4	Investigation 4	Prime numbers; the Fundamental Theorem of Algebra; primes in other number systems
February 15-19	5	Investigation 5 part 1	Equivalence relations and classes, $\mathbb{Z}_n$
February 22-26	6	Investigation 5 part 2	Properties of $\mathbb{Z}_n$ units and zero divisors
March 1-5	7	Investigation 6	Algebra in other number systems; algebra with matrices and sets
March 8-12	8	Investigation 7 part 1	Ring axioms through multiplicative inverses
March 15-19	9	Investigation 7 part 2	Units, zero divisors; integral domains and fields
March 22-26	10	Investigation 8	Integer multiplication and exponentiation in rings; the characteristic of a ring
March 29-April 2	Free Week!	Free day on 3/30; Mental health day on 4/1	Nothing
April 5-9	11	Investigation 9	Subrings, subfields, field extensions
April 12-16	12	Investigation 10	Ring isomorphisms, isomorphism invariants

Other important dates:

- Friday March 19: Deadline to drop Winter 2021 classes with a "W"
- Tuesday March 30: Free day, no class meeting but exclusive drop-in hours during class time for MTH 350 only
- Thursday April 1: Mental Health day, no class meeting
- Friday April 23 11:59pm Eastern: Deadline for token requests
- Tuesday April 27: Final Exam period (10:00-11:50, hold for project presentation overflow) and deadline for Proof Portfolio (11:59pm Eastern)