Welcome to the Fall 2026 iteration of MAT 218 at Grinnell College! The goal of this Bridges to Advanced Mathematics course is to develop your proof-writing and creative problem-solving skills, with number theory as the backdrop. This syllabus is specific to Section 02 of the course. If you are one of my students, I highly recommend you read the document in its entirety. Additional information about the course can be found on the course webpage.

Instructor Info

Instructor: Dr. Jadyn V. Breland (*he/him/his*)
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Webpage: https://jadynbreland.com
Office: Noyce 2516

Student Hours: Monday 2:45–4:00 PM
Tuesday 10:00 AM–12:00 PM
Wednesday 2:45–4:00 PM
In my office — drop in, no appointment needed.

Course Info & Resources

Course: MAT 218: Elementary Number Theory
Term: Fall 2026
Credits: 4

Section 02: MWF 10:00–10:50 a.m.
Location: Noyce 2517

Textbook *Number Theory Through Inquiry*, by Marshall, Odell, and Starbird (MAA Press, 2007). You do not need to buy the textbook; you have unlimited access online through the Grinnell College Library using the link above.

Course Webpage All course materials will be posted on our course webpage.

Canvas The Canvas webpage will be used minimally for hosting grades and making announcements.

Course Mentor Thanks to the Math Lab, we have a course mentor: Seb Corry (corryseb@grinnell.edu). He will hold regular sessions for this course. Seb will be an excellent resource and I strongly encourage you to attend. I will announce the times and format in class once they are set.

Course Topics This course covers fundamental concepts in number theory, including: divisibility and congruence, linear Diophantine equations, elementary properties of prime numbers, the Fundamental Theorem of Arithmetic, the Chinese remainder theorem, Fermat's Little Theorem and Euler's Theorem, public key cryptography, primitive roots, and quadratic reciprocity. Proof writing and creative problem solving will be heavily emphasized.

Learning Outcomes Upon successful completion of the course, students will be able to do the following:

(a) Recall the basic definitions, theorems, and techniques of elementary number theory.
(b) Distinguish truth from falsehood, create examples/counterexamples, and formulate basic conjectures.
(c) Construct concise and correct proofs, and identify flaws in proposed proofs.
(d) Communicate mathematical ideas and arguments in clear, convincing, and concise language, both written and oral.

In addition, students will further develop as independent, self-directed learners with the confidence to explore unfamiliar problems and ideas.

How This Course Works

Inquiry-Based Learning In this course, we will incorporate ideas from an educational philosophy called Inquiry-Based Learning (IBL). Roughly speaking, IBL is a student-centered method of teaching that engages students in sense-making activities and challenges them to create or discover mathematics. This style of teaching and learning contrasts sharply with the traditional mathematics lecture, where the instructor talks and students (attempt to) passively receive information.

This is not a lecture-driven course, nor one where mimicking prefabricated examples will ensure success. You'll be expected to actively build your own understanding of the material, with support from me, our course mentor, and your classmates. Many of the problems and ideas we'll encounter will be unfamiliar and will challenge you to think in new ways. You will experience frustration and failure before you experience understanding. This is all a part of the normal learning process. In short, if you are doing things well, you should be confused at different points over the course of the semester. The material is too rich for a human being to completely understand it immediately.

There is a great deal of recent scholarship suggesting that students learn better when they are actively engaged in the learning process—one meta-analysis of 225 studies found that failure rates under traditional lecturing were 55% higher than under active learning. You cannot master the electric guitar by watching Buckethead shred, nor can you become a chess grandmaster by watching Magnus Carlsen on Twitch. In a similar fashion, you cannot master number theory by simply watching; you must *do* number theory! Therefore, a significant portion of our class meetings will be reserved for doing mathematics in a supportive and collaborative environment.

About the textbook. The textbook *Number Theory Through Inquiry* is designed to be used with a transition-to-proof course. It contains a sequence of questions and theorem statements *without proofs*; you will provide them yourself.

Course Structure Class meetings will primarily consist of student-led presentations, discussion of the problems, and group work. A meeting may also include:

- summary of the major steps and techniques in the solution of a finished problem;
- exploration of alternative approaches, possible generalizations, consequences, special cases, and converses;
- discussion of relationships to previously assigned or solved problems;
- explanation of unfamiliar mathematical concepts as needed.

Rules of the Game When it comes to completing assignments, you should *not* look to resources outside of the context of this course for help. You should not be consulting the web, other textbooks, other faculty, or students outside of this section of the course in an attempt to find solutions to the problems you are assigned. This also includes websites like Chegg and Course Hero, or generative AI such as ChatGPT or Gemini. On the other hand, you are allowed and encouraged to utilize each other, the textbook, me, your course mentor Seb, and your own intuition. **If you need additional resources, please come talk to me and we will work together on a plan of action**.

As we proceed through the problem/theorem sequence in the textbook, you may wonder which results you are allowed to use. In general, you may use the basic algebra and ordering of the integers, the Well-Ordering Principle, standard logic and proof techniques such as cases, contradiction, contraposition, and induction, any result we have proven earlier in the sequence, and anything I have explicitly granted us. When in doubt: *prove it before you use it.* Many of these proof techniques will be discussed as we encounter them. When using a previous result from the textbook you should cite it by number.

Rights of the Learner As a student in this class, you have the right:

(a) to be confused,
(b) to make mistakes & revise your thinking,
(c) to speak, listen, and be heard, and
(d) to enjoy doing mathematics.

Commitment to the Learning Community In our classroom, diversity and individual differences are respected, appreciated, and recognized as a source of strength. Students in this class are encouraged and expected to speak up and participate during class and to carefully and respectfully listen to each other. Every member of this class must show respect for every other member of this class. Any attitudes or actions that are destructive to the sense of community that we strive to create are not welcome and will not be tolerated.

Assessments & Grades

Homework 10%

Homework will be assigned most class meetings. The assignments will be announced in class and then posted on the course webpage. Students are expected to complete each assignment prior to walking into the next class meeting. Homework assignments will primarily consist of completing problems and proving theorems from the Number Theory Through Inquiry textbook. The significant majority of our time in class will be devoted to students presenting some subset (maybe all) of the proofs/solutions that are due that day.

During class, you are encouraged to annotate your work in light of presentations made in class; however, **you must use a different color than what you used to complete your homework**. This will allow me to distinguish between the work you completed before class, and the revisions you made during class. I will always have some colored pens you can borrow, but I prefer if you bring your own.

Homework assignments will be collected at the end of class. You are free to write and/or annotate your homework using a tablet (e.g., an iPad), but you still must annotate your work in a different color and then promptly email me your homework (with annotations) at the end of class. Homework will be assessed using the following rubric:

Score	Criteria
4	Sufficient effort was put into nearly all the problems.
2	Some problems were omitted and/or sufficient effort was not exhibited.
1	Many problems omitted and/or minimal effort exhibited.
0	Assignment was not turned in.

No late homework will be accepted. Instead, I will **drop your lowest 3 homework scores** to account for any absences.

Some homework problems will be straightforward while others are intended to be challenging. You should anticipate not knowing what to do on some of the problems at first glance. You may have several false starts. Some frustration, maybe even a lot of frustration, should be expected. This is part of the natural learning process. On the other hand, it is not my intention to leave you to fend for yourselves. I am here to help and I want to help. You are encouraged to seek assistance while adhering to the Rules of the Game. Please visit office hours and ask questions! I am always willing to give hints/nudges, so please ask.

Quizzes — 15%

There will be 5 short in-class quizzes, tentatively scheduled for the following Fridays:

Quiz	Date
Quiz 1	September 11
Quiz 2	September 25
Quiz 3	October 30
Quiz 4	November 13
Quiz 5	December 4

Each quiz will be 15 minutes long and will be based on a problem that has been presented in class. I will post in advance a list of problems the quiz may draw from. To prepare for the quizzes I suggest that you attempt the homework yourself, discuss the homework with your classmates, participate in class, and revise your proofs/solutions in light of presentations. Each problem on a quiz will be assessed using the following rubric:

Score	Criteria
4	This is correct and well-written mathematics!
3	This is a good piece of work, yet there are some mathematical errors or some writing errors that need addressing.
2	There is some good intuition here, but there is at least one serious flaw.
1	I don't understand this, but I see that you have worked on it.
0	I believe that you have not worked on this problem enough or have not submitted any work.

Make-up quizzes will only be given under extreme circumstances, as judged by me. It would be best to communicate conflicts ahead of time. Each quiz is worth 3% of your final score.

Presentations & Engagement — 25%

Expectations of the presenter. Student presentations form the backbone of the course. The atmosphere of the class should be informal and friendly, but we take the presentations seriously. A few expectations when you are the one at the board:

- The purpose of a presentation is to make the ideas of a solution clear to your classmates, not to prove to me that you have done the problem.
- Explain your reasoning as you go along, rather than writing everything down and then turning around to explain it.
- Your classmates are allowed (and encouraged!) to ask questions at any point, and it is your responsibility to answer them as best you can.

You are encouraged to present your creative ideas even if you are not confident that your proof/solution is correct! A proof that turns out to be wrong in an interesting way often produces the most productive discussion and reveals insights into the problem that aren't visible from a correct proof. However, you should present only if you have spent time thinking about the problem and have something meaningful to contribute.

Assessing presentations. Presentations are assessed using the following rubric:

Specification	Criteria
U	**Unsatisfactory**. Minimal progress was made or the student was unprepared.
I	**In progress**. The student made an honest attempt at the problem but recognized a flaw that prevented them from being able to complete the problem during the presentation. Alternatively, the student reported on their current progress on a problem and attempted to convey where or why they are currently "stuck".
M	**Meets Expectations**. The student demonstrated an understanding of the problem and presented the key ideas. Perhaps some details were omitted or interesting mistakes were made. The presentation led to fruitful class discussion.
E	**Exceeds Expectations**. The presentation was flawless and the student demonstrated keen insight into the problem. The presentation led to fruitful class discussion.

You should try to avoid unsatisfactory (U) presentations. An in progress (I) presentation is not a bad thing; each of us will occasionally get stuck. You should strive for the majority of your presentations to either meet (M) or exceed (E) expectations. Most presentations will meet expectations (M) while presentations that exceed expectations (E) will be rare.

Selecting presenters. In general, I will curate the list of student presenters each class meeting. A presenter is a student who either volunteered (V) or was chosen (C) by me. If you are chosen to present but would prefer not to present that particular problem, you can either negotiate presenting a different problem or take a pass (P).

Mark	Criteria
V	**Volunteered**. Student volunteered during class or in advance to present.
C	**Chosen**. Student was selected by the instructor and agreed to present.
P	**Pass**. Student was selected to present, but asked to take a pass. Allowed at most two.

For each presentation I will record one of V, C, or P, and one of U, I, M, or E based on the rubric. The most common pair will likely be CM (the student was chosen to present and the presentation met expectations).

Engagement. Most of the time you will *not* be presenting, and what you do during that time is just as important. You are expected to engage meaningfully with the presentations and participate respectfully in class discussions. This includes:

- asking relevant questions;
- scribing (at the board) for an argument the class is building together;
- supplying an example or a counterexample when the class is stuck;
- offering a different approach to a proof we have just seen;
- noticing a gap in a presented argument and naming it.

Engagement is assessed using the following rubric:

Mark	Criteria
U	**Unsatisfactory**. Student was often disengaged or disrespectful. Alternatively, the student regularly missed class.
M	**Meets Expectations**. Student was consistently respectful, engaged, and contributed to meaningful class discussions. In addition, the student regularly attended class.
E	**Exceeds Expectations**. Student's presence in the classroom truly enhances the learning environment.

Determining Presentation & Participation grades. Your grade is determined by how often you present and by your ability to foster productive class discussion, both at the board and as an audience member. The greatest determining factor is your willingness to present regularly. You should aim to present at least twice before each exam, provided that sufficient opportunities are available.

Grade Range	Criteria
90–100%	Student receives M or E for engagement. Student averages at least 2 presentations before each exam. Student often volunteers to present and some of these problems are challenging. Most presentations receive M or E.
80–89%	Student receives M or E for engagement. Student averages at least 1 presentation before each exam. Student occasionally volunteers to present. Most presentations receive M.
70–79%	Student receives M for engagement. Student averages less than 1 presentation before each exam. Student rarely volunteers to present and actively avoids presenting challenging problems. Some presentations receive U.
60–69%	Student receives U for engagement. Student rarely presents and actively avoids presenting challenging problems. Some presentations receive U.
Below 60%	Student receives U for engagement. Student rarely or never presents and has completely disengaged from the class community.

Placement within a range is at my discretion, based on the full record of your presentations and engagement over the semester. I anticipate that most students will fall in the 80–89% range.

Exams — 15% each

There will be two in-class exams, given during our regular class meeting on the following dates:

Exam Number	Exam Date
Exam 1	Friday, October 9
Exam 2	Monday, November 23

Exams are not comprehensive. I will let you know in advance the topics of the exam. You will have the entire class to work on the exam. Make-up exams will only be given under extreme circumstances, as judged by me. It would be best to communicate conflicts ahead of time.

Final Exam — 20%

The final exam is cumulative and covers everything we do this semester. The Registrar has scheduled it for **Thursday, December 17, 2:00–5:00 p.m.** College policy does not permit either of us to change this schedule without the Registrar's approval, so please plan your December travel accordingly.

Assessment Distribution In summary, your final score in the course will be calculated as the weighted average of the assessments described above.

Assessment	%	Assessment	%
Homework	10	Exam 1	15
Quizzes	15	Exam 2	15
Presentations & Engagement	25	Final Exam	20
		Total	**100**

Letter Grades Your final letter grade depends on your final score. Final letter grades are assigned according to the following score ranges:

A	93–100
A−	90–92

B+	86–89
B	83–85
B−	80–82

C+	76–79
C	73–75
C−	70–72

D	60–69
F	0–59

Your final score will be rounded to the nearest whole number before this table is applied; for example, a score of 89.5 becomes 90 and earns an A−, while a score of 89.4 becomes 89 and earns a B+. Score ranges may be adjusted in your favor according to class performance.

College Resources & Policies

Academic Honesty All students must adhere to Grinnell's academic honesty policy which can be found here.

Workload This is a 4-credit course. Grinnell expects that a 4-credit course involves about twelve hours of work per week in total. If you are consistently spending much more than that, please come talk to me.

Accessibility and Disability Resources Grinnell College makes reasonable accommodations for students with documented disabilities. Students with disabilities partner with Accessibility and Disability Resources (ADR) to make academic accommodation letters available to faculty via the accommodation portal. If you have not already worked with the Office of Disability Resources and believe you may require academic accommodations for this course, Disability Resources staff can be reached via e-mail at `access@grinnell.edu`, by making an appointment via the accommodation portal, or by stopping by Steiner Hall.

Religious Observance I encourage students who plan to observe holy days/times that coincide with class meetings or assignment due dates to consult with me in the first three weeks of classes so that we may reach a mutual understanding of how you can meet the terms of your religious observance and also the requirements for this course.

Academic Support If you have other needs not addressed above, please let me know soon so that we can work together for the best possible learning environment. In some cases, I will recommend consulting with the Academic Success Center (ASC). They are an excellent resource for developing strategies for your learning, and they can connect you with other resources. If I notice that you are encountering

difficulty, and I have reached out to you and not received a response, or if you have missed multiple class sessions or are not meeting our class objectives repeatedly, I will submit an academic alert via the ASC's SAL portal. A message notifying you of my concern will get sent to you, along with the ASC staff and your adviser(s), so that they can reach out to you with additional offers of support.

Title IX and Pregnancy-Related Conditions Grinnell College is committed to providing learning, living, and working environments free from discrimination and harassment. For this reason, it is important to report if you or someone you know is experiencing any form of sexual harassment. Your professor is responsible to pass reports made to them to the Title IX Coordinator. If you want to make a report to a confidential resource, your professor can direct you to those spaces.

If you are a pregnant student, have pregnancy-related conditions, or are a parenting student who wishes to request reasonable related supportive measures from the College under Title IX, please email the Title IX Coordinator at titleix@grinnell.edu. The Title IX Coordinator will work with Disability Resources and your professors to provide reasonable supportive measures in support of your education while pregnant or as a parent.

I RESERVE THE RIGHT TO CHANGE ANY PART OF THE SYLLABUS ABOVE.

YOU WILL BE PROMPTLY NOTIFIED OF ANY CHANGES VIA EMAIL.

Much of the structure of this course and the language in this syllabus, including all of the grading rubrics, was borrowed and/or modified from Dana C. Ernst's syllabi at Northern Arizona University, as were the "Rights of the Learner," which he in turn adapted from a list written by Crystal Kalinec-Craig.