

Math 416: Theory of Numbers

Instructor: Guy David

Spring 2026 Syllabus

Class Information: MWF, 10:00 - 10:50 pm, in Whiting Business 213.

All additional class information, assignments, etc. will be posted on the **Canvas website**.

Instructor Information: Guy David, gcdavid@bsu.edu.

I will generally respond to emails within 24 hours Monday-Friday.

Office: Robert Bell 421. Office phone: (765) 285-8640

Office hours will be held multiple times each week. See Canvas for information.

Prerequisites: C- or better in MATH 215 or permission of the department chairperson.

Required textbook and materials: *Elementary Number Theory & Its Applications*, 7th Edition, by Kenneth H. Rosen. You will also need access to a scanner or smartphone scanner app to make pdfs.

Official course description, objectives, and rationale

Course Description: Topics include the division algorithm; positional notation; divisibility; primes; congruences; divisibility criteria; the sigma, divisor, and phi functions; Diophantine equations; linear, polynomial, and simultaneous congruences; theorems of Fermat, Euler, Lagrange, and Wilson; quadratic reciprocity.

Course Objectives: This course introduces students to a study of the deeper properties of the integers (whole numbers) and various aspects of elementary number theory. (“Elementary” indicates that no complex analysis will be used; complex analysis is however important in more advanced work in number theory.)

- Solve Diophantine equations, as well as linear, polynomial, and simultaneous congruences.
- Apply factorization algorithms to numbers of moderate size.
- Apply probabilistic primality tests to large numbers (with the aid of a computer) and analyze their reliability.
- Explain connections between number theory functions using Möbius inversion.
- Perform calculations using primitive roots and index.
- Identify quadratic residues.
- Compose elementary proofs related to the topics of the course.

Course Rationale: Sharing its origin with mystical speculations on numbers, number theory has grown into a vast and beautiful branch of mathematics with connections with many other branches of mathematics, as well as computer science and cryptography. It gives students exposure to problem-solving and proof in a mathematical area with minimal prerequisites. It is well suited for prospective secondary school teachers and others with an interest in pure mathematics. MATH 416 primarily serves Mathematics majors and Mathematics Teaching majors.

Coursework

Reading

You will be expected to read the appropriate sections of the textbook as well as other readings posted online. **Reading mathematics is not like reading most prose.** It is an active experience involving pencil and paper: you should be checking to see if you understand each sentence, flipping back to recall earlier definitions and theorems, coming up with examples, trying to prove statements or do computations yourself, etc.

Homework

There will be **weekly homework sets** in the course. These will be posted on Canvas each **Friday** and will usually be due **by 9:00 am** on the following **Friday**. They will consist of problems from the textbook as well as some assigned by me. You should explain your solutions to these problems **clearly and in full detail**. Write in **complete sentences** where appropriate. You should **never turn in the first draft of your homework**: take a second draft to organize your arguments clearly.

All students should **scan and upload pdfs of your homework to Canvas**. Instructions are on Canvas. Do not directly upload smartphone photos. Please let me know if you think this will be difficult for you.

Late homework will generally not be accepted. However, the lowest homework score will be dropped from your final grade. If you are having difficulties meeting deadlines, talk to me and we will try to work something out.

When you sign your name to your homework, you are attesting that it is your own work. You are welcome (encouraged!) to work with your classmates. You are welcome (encouraged!) to talk to me for (substantial!) assistance on the problems. However, **when you write up your answers, you should do it on your own in language that you understand**. Copying text from a classmate, online resource, or AI system (even if “slightly modified”) is not acceptable. To avoid the pitfalls of outsourcing your own thinking, I ask that you do not use generative AI systems at all to help with your homework. I reserve the right to ask you for an in-person chat about things that you have written in your homework.

Homework assignments will generally have some selected problems graded carefully for correctness and some for completion. **You should always talk to me about problems you don’t understand.**

Exams

There will be **three 50-minute midterm exams and one 2-hour final exam**. All four of these exams will be **in person**. The midterm exams are tentatively scheduled for **Jan. 30, Feb. 27, and Mar. 30**, with the final exam on **April 29 from 9:45-11:45 am**. Generally, only exceptional circumstances (documented illness, family emergency) call for rescheduling an exam. Talk to me if you have an issue.

Communication

All information about the course will be posted on our **Canvas website**. I’m happy to discuss mathematics or anything related to the course by email or during my office hours. **If you would like to talk live during a time**

outside of my usual office hours, then send me an email and we will set up a time to chat.

Grading

Your final course grade will be computed as: 15% Homework, 20% each Midterm Exam, 25% Final Exam.

At the end of the course, I will use the above scheme to assign you a numerical grade, which will be converted into a letter grade by a table like the following:

A	A-	B+	B	B-	C+	C	D	F
≥ 93	90-93	87-90	83-87	80-83	77-80	70-77	60-70	<60

I may adjust these cutoffs downwards (i.e., to be more lenient) at the end of the semester, depending on the overall difficulty of the assignments and exams.

There is no form of “extra credit” in the course beyond the assignments and exams explained in this syllabus. **The best way to get a good grade in the course is to attend class, do all assigned readings and problems, and ask questions during class and office hours.**

Attendance

Students in MATH 416 are expected to attend class. While I also plan to make lecture videos available, I do not consider this a substitute for attending class. Attending class in person will be associated with a small bonus to your homework grades. **If you do miss class, it is your responsibility** to learn the material we discussed on your own. You can do this by reviewing the textbook sections and lecture videos, and of course I am happy to help in office hours.

Class time should be for **active learning**, not passive watching. Please arrive on time and participate in class discussions: ask questions and propose ideas. Please do not use your phone, laptop, etc. during class time, unless instructed otherwise.

Other policies and resources

We will abide by the Student Academic Ethics Policy. This includes a commitment to **not representing the work of others as your own**. Copying solutions from a classmate, book, AI system, or website is a violation of these policies.

I may modify this syllabus and the course calendar during the semester.

University Statement

We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse.

Disability Statement

If you need course adaptations or accommodations because of a disability, please contact the instructor of record as soon as possible. Ball State's Disability Services Office coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability Services can be contacted at 765-285-5293 or dsd@bsu.edu.

Freedom of Expression

In this course, we are committed to fostering a learning environment that values intellectual diversity, encourages free expression, and promotes open inquiry. As members of the Ball State Community, we treat each person in the Ball State community with civility, courtesy, compassion, and dignity and respect and learn from differences in people, ideas, and opinions. Please review Ball State University's Statement on Freedom of Expression, the resources on Ball State's Freedom of Expression webpage, and Ball State's Beneficence Pledge.