Number Concepts and Number Theory

MATH 615-801 (CRN 30701)

Instructor Information

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By appointment

Instructor Bio:

Please feel free to call me "Josh". I started teaching at Ball State in August 2022, and I am excited to be teaching math classes for educators. I have taught middle and high school math all over the west side of Indianapolis. I have bachelor's degrees in math and math teaching from Indiana State, a master's in math from IUPUI, a master's in educational psychology from Ball State, and a PhD in math education from North Carolina State. My research focuses on math anxiety in teachers, but I have my hands in projects on curriculum development, professional development, and other topics that pique my interests, including the history of math, which I believe has practical applications in the mathematics classroom. I love working with teachers, and I am excited to get to know each of you this semester.

Course Information

Course Description

Number development, number systems, properties and characteristics of classes of numbers, number sense, number theory, operations and their relationships, and algorithms.

Prerequisites

At least one year of teaching experience or permission of the department chairperson.

Course Content

Topics will include ancient forms of counting and numeration systems; base numeration systems other than ten; whole, decimal, and fractional number computation in bases other than ten; alternative algorithms for the four basic operations; properties and characteristics of classes of numbers; number theory; number sense; and modeling real-world situations.

Course Materials

Any course readings and other required resources will be provided by your instructor.

Course Objectives

In this course students will –

- Examine the development of numbers and counting.
- Evaluate, compare and contrast a variety of number systems, some still in use and others no longer used.
- Explain, compare and contrast algorithms within those systems.
- Identify and discuss properties and characteristics of classes of numbers.
- Identify and describe number theory topics such as primes, composites, factors, and multiples to provide additional depth of understanding of our current number system and to further build number sense.
- Apply this knowledge of number, number theory, and number systems to model real-life problems.

Course Rationale

Elementary and middle school teachers need both breadth and depth of knowledge of number development, number systems, and number theory, beyond the base ten numeration system and fundamental number theory they will teach in the classroom. Such breadth and depth of knowledge better enables them to teach for conceptual understanding rather than just for procedural understanding.

Consistent with the recommendations of the National Council of Teachers of Mathematics, the Conference Board of Mathematical Sciences, the Mathematical Association of America, and other national and state agencies, this course seeks to develop a deep understanding of worthwhile mathematical content knowledge and its related pedagogies and technologies. To achieve this goal, mathematical content knowledge, pedagogical knowledge, and technological knowledge are approached in an integrated manner using a variety of information, modeling, and human resources. The course content, assignments, and assessments are designed to emphasize the significance of the mathematical, pedagogical, and technological connections and to promote critical thinking and effective communication.

Course Modality/Structure

This course will be taught using a variety of methods, including readings, discussions, problem sets, and/or other formats appropriate to the content and goals of the course. Information will be delivered through an asynchronous online format. Generally speaking, assignments will be due at 11:59 PM ET on their respective due dates.

Course Assignments and Grading Policies

Course Modules

For this course, you will complete work in five modules, with additional minor assignments during the first and last week of the course. Each module will consist of two discussion boards, one problem set, and one quiz. Due dates are provided in the schedule below.

Course Schedule

Assignment	Due Date
Module 0: Welcome	
▶ 0.2 Introduction Discussion	Friday 8/28
▶ 0.3 Pre-test	Friday 8/28
Module 1: Number Systems (NS)	
▶ 1.2 NS Problem Set Discussion – First Post	Friday 8/28
▶ 1.2 NS Problem Set Discussion – Response Post	Tuesday 9/1
▶ 1.3 NS Problem Set	Friday 9/4
▶ 1.4 NS Pedagogy Discussion – First Post	Tuesday 9/8
▶ 1.4 NS Pedagogy Discussion – Response Post	Friday 9/11
▶ 1.5 NS Quiz	Sunday 9/13
Module 2: Algorithms (AG)	
▶ 2.2 AG Problem Set Discussion – First Post	Friday 9/18
▶ 2.2 AG Problem Set Discussion – Response Post	Tuesday 9/22
▶ 2.3 AG Problem Set	Friday 9/25
▶ 2.4 AG Pedagogy Discussion – First Post	Tuesday 9/29
▶ 2.4 AG Pedagogy Discussion – Response Post	Friday 10/2
▶ 2.5 AG Quiz	Sunday 10/4

Module 3: Elementary Number Theory (ENT)	
▶ 3.2 ENT Problem Set Discussion – First Post	Friday 10/9
▶ 3.2 ENT Problem Set Discussion – Response Post	Tuesday 10/13
▶ 3.3 ENT Problem Set	Friday 10/16
▶ 3.4 ENT Pedagogy Discussion – First Post	Tuesday 10/20
▶ 3.4 ENT Pedagogy Discussion – Response Post	Friday 10/23
▶ 3.5 ENT Quiz	Sunday 10/25
Module 4: Modular Arithmetic (MA)	
▶ 4.2 MA Problem Set Discussion – First Post	Friday 10/30
▶ 4.2 MA Problem Set Discussion – Response Post	Tuesday 11/3
▶ 4.3 MA Problem Set	Friday 11/6
▶ 4.4 MA Pedagogy Discussion – First Post	Tuesday 11/10
▶ 4.4 MA Pedagogy Discussion – Response Post	Friday 11/13
▶ 4.5 MA Quiz	Sunday 11/15
Module 5: Recreational Math (RM)	
▶ 5.2 RM Problem Set Discussion – First Post	Friday 11/20
▶ 5.2 RM Problem Set Discussion – Response Post	Tuesday 11/24
▶ 5.3 RM Problem Set	Tuesday 12/1*
▶ 5.4 RM Pedagogy Discussion – First Post	Tuesday 12/1
▶ 5.4 RM Pedagogy Discussion – Response Post	Friday 12/4
▶ 5.5 RM Quiz	Sunday 12/6
End of Semester	
▶ 6.3 Course Reflection	Wednesday 12/9

* Note: This due date is off-cycle to account for Thanksgiving Recess.

Course Assignments:

Each module will include the same four types of assignments.

- Discussions (20 points each): Course readings and discussions are designed to help you explore key aspects of the content of the course. For each module, you will engage in two discussion boards. One board involves discussing a problem (or problems) from the module's problem set, and the other focuses on pedagogical connections between

the material and your classrooms. There are separate due dates for initial and response posts, and each will be due at the end of the day listed in the course schedule above (11:59 PM ET).

- Problem Sets (40 points each): For each unit, you will have a collection of problems to solve. You are expected to clearly label all problems, show your work, and explain your reasoning (when requested). Simply providing answers will not be acceptable for homework submissions. You will be required to submit an electronic copy of your homework assignments and submit them via Canvas ***as a PDF file***. You are *not* required to submit typewritten solutions; it is acceptable to scan your handwritten work or paste photos of your work into a document. Please ensure the photos/scans are clear and your work is legible. Problem sets will generally be graded for completion rather than accuracy; however, your instructor reserves the right to grade assignments for accuracy if there are concerns about the quality of student submissions.
- Quizzes (20 points each): Quizzes are designed to assess your understanding of the material covered in each module. These will be designed similarly to the problem sets, although you should not expect the problems to be identical. You will also submit quizzes to Canvas in the same way that you submit Problem Sets (i.e., as a PDF file of your original work). You will be permitted to reference any materials shared on Canvas, including discussion boards, and you should plan to complete all other coursework in a module before beginning the Quiz.
- Other assignments: You will complete a few minor assignments during the first week of the course and Finals Week that include an ungraded pre-test and opportunities to reflect on your experiences related to number theory. These assignments are designed to enhance your experience in the course and, though ungraded, should be given appropriate attention.

Course Weights and Grading Scale

Assignments are weighted by points, and corresponding percentages are provided below. The Grading Scale for final course grades also follows.

Assignments	Points	Percent
Discussions (x10)		
▶ Problem Set (20%)	100	20%
▶ Pedagogy (20%)	100	20%
Problem Sets (x5)	200	40%
Quizzes (x5)	100	20%

Course Grade	Percentage Lower Bound
A	90%
B	80%
C	70%
D	60%
F	<60%

Course Statements and Policies

Feedback Policy

- I always try to respond to email from your official Ball State email address within 24 hours during the work/school week (Monday-Friday) and 48 hours on the weekend. Feel free to second a second email if I miss one of these windows.
- I will read every discussion post but I will not always personally comment on posts.
- I always plan to grade assignments and discussions within 1 week of submission.
- Contact me directly with questions or concerns about your performance in class.

Participation Policy

Your regular participation and timeliness are important to your academic success. In MATH 615, this will take the form of completing all assignments and participating in class discussions via Canvas. As this is an online course, it is up to every student to stay on track and not fall behind. You must be self-motivated and disciplined to meet all due dates. Developing a routine is encouraged. You are expected to submit each assignment by a specified time and date. See above for the Course Schedule and specific due dates, and below for the Late Work Policy.

Late Work Policy

All assignments are due by 11:59 PM ET on their respective due dates unless otherwise noted. Late work will be accepted at the instructor's discretion. Unless there are extenuating circumstances or prior arrangements have been made, a **10% per day** grade deduction will be applied for late assignments. With the exception of assignment *6.3 Course Reflection* (due Wednesday, 12/9), course assignments will not be accepted after 11:59 pm ET on the final day of classes, Monday, December 7.

Course Withdrawal

The course withdrawal period ends **Wednesday, October 28**. Before this date, students can elect to receive a "W" for the course by completing and submitting the proper form. The instructor's permission is not required. For details, see https://www.bsu.edu/about/administrativeoffices/registrar/registration-activities/withdraw-from-classes as well as Degree Requirements and Time Limits in the current Undergraduate Catalog OR Withdrawal Procedures in the current graduate catalog.

Assignment Submission Policy

- Written assignments should be submitted as .pdf documents unless otherwise indicated in the assignment description. If you take pictures of handwritten work, please paste these into a Word document and either *print*, *export*, or *download* your

file as a pdf. Alternatively, there are several free tools for scanning your work as a pdf with your phone, and I'm happy to provide suggestions and support as needed.

- Assignments should be submitted using the assignment links in Canvas**.**

Grading Policy

Appropriate evaluation of your academic performance is an integral part of your learning experience. In the absence of mistake, fraud, bad faith, or incompetence, I will be the key decision-maker on the assignment of grades. For information concerning grade appeals, consult the Ball State website.

University Policies

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. 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.

Attendance

This course is offered in an online, asynchronous format. Because of that, class attendance is not graded, and for clerical purposes (e.g. "last date of attendance") will be determined based on the date of the last assignment submission.

Ball State Academic Ethics

Honesty, trust, and personal responsibility are fundamental attributes of the university community. Academic dishonesty and other forms of academic misconduct threaten the foundation of an institution dedicated to the pursuit of knowledge and will not be tolerated. To maintain its credibility and reputation, and to equitably assign evaluations of

scholastic and creative performance, Ball State University is committed to maintaining a climate that upholds and values the highest standards of academic integrity. Visit the complete Student Academic Ethics Policy.

Also see Ball State's Code of Student Rights and Responsibilities.

Plagiarism Policy

Plagiarism is not acceptable, unless otherwise indicated for all assignments, you must work independently by yourself. Sharing of files is not permitted for any reason.

Potential Violations

Examples of academic integrity violations include but are not limited to:

- Working with another person on any assignment other than authorized group projects.
- Sharing or allowing others to access your files, whether done with permission or not.
- Use or possession of a file created by someone else.
- Reusing work from another semester, course, or section.
- Fraudulent submission of work.
- Using unauthorized materials during Exams.
- Impersonating someone else or having them impersonate you.
- Making fraudulent or dishonest statements regarding your work.
- Soliciting others, including AI tools, to complete work for you.
    - Using generative AI systems, such as ChatGPT, Microsoft CoPilot, Google Gemini, and others, is considered an academic integrity violation unless otherwise specified by an assignment or your instructor.
- Posting course files and resources on study or content sharing websites.

Canvas and Student Privacy

Canvas Accessibility

Canvas provides a user experience that is easy, simple, and intuitive. Special attention has been paid to making Canvas screen-readable. The Rich Content Editor encourages users to create accessible content pages (i.e. text formatting is accomplished using styles). Canvas is designed to allow limited customization of colors and schemes to be accessible for all

users. The National Federation of the Blind granted Canvas the Gold Level Web Certification in 2010.

Find more information by visiting the Canvas Voluntary Product Accessibility Template (VPAT).

FERPA and Privacy

As a student, your educational records are considered confidential. Under FERPA (Family Educational Rights and Privacy Act), your records are confidential and protected. Under most circumstances, your records will not be released without your written and signed consent. However, some directory information may be released to third parties without your prior consent unless a written request to restrict this is on file. You can learn more about student rights to privacy by reading Ball State's FERPA and Privacy and Protection.

Academic Support Services

The Writing Center

All writers improve with practice and feedback, so as a student in this course, you are encouraged to use the Writing Center (in Robert Bell 295 during weekdays, Bracken Library First Floor West in the evenings, or online during any of our regularly scheduled hours) to get additional feedback on your writing.

The Writing Center offers free planning, feedback, and accountability sessions (in person and online) to all students composing essays, reports, reflections, research projects, web content, lesson plans, slideshows, poster presentations, resumes, and other digital or print texts. To schedule a free appointment to discuss your writing, go to **http://www.bsu.edu/writingcenter**. Online and in-person appointments are available; however, plan ahead because appointments book quickly!

The Basic Needs Hub

If you are having difficulty affording enough food, do not have a safe and reliable place to sleep, and/or experiencing an emergency or crisis, help is available through the **Basic Needs Hub**. The Basic Needs Hub has information, resources, and provides individualized support to students. To talk with a supportive staff member about your experience, receive one on one assistance, or learn more about resources, you can submit a **Basic Needs Assistance Form**.

Title IX / Sex Discrimination

Ball State University is committed to maintaining an educational environment free from sex discrimination, including sexual harassment, sexual misconduct, dating and domestic violence, and stalking. Students who experience or witness conduct that may violate University policy are encouraged to seek support and assistance. The Title IX Office can

provide information about reporting options, supportive measures, and available resources. Contact the Title IX Office at 765-285-1545 or titleix@bsu.edu.

Please Note: As your instructor, I am a mandatory reporter. If you disclose information to me about conduct that may constitute sex discrimination or sexual misconduct, I am required to notify the Title IX Coordinator. The Title IX Office will reach out to discuss available resources, supportive measures, and reporting options. If you wish to speak with someone confidentially, you may contact the Counseling Center or the Center for Survivor Support.

Pregnancy and Related Conditions

Ball State University provides reasonable modifications for students affected by pregnancy, childbirth, or related medical conditions. Students seeking academic, housing, or other modifications are encouraged to contact the Title IX Office as early as possible to discuss available options and support. For assistance, contact the Title IX Office at 765-285-1545 or titleix@bsu.edu.

Subject to Change Statement

This syllabus and schedule are subject to change in the event of extenuating circumstances.

Syllabus updated 8/12/2026