Indiana University East
School of Natural Sciences and Mathematics
Department of Mathematics
MATH-M393 – Bridge to Abstract Mathematics
Course Syllabus
Fall 2025

Faculty: Randall Beeman, Adjunct Instructor
Email: rabeeman@iu.edu

Office Hours: There will be two weekly office hour via Zoom and others by appointment. The day(s)/time(s) will be determined during the first week and posted on the Canvas homepage.

Office Hour Link: Posted in Canvas

Course Description: Preparation for 400 level math courses. Teaches structures and strategies of proofs in a variety of mathematical settings: logic, sets, combinatorics, relations and functions and abstract algebra.

Prerequisite course(s): MATH-M216 or consent of instructor

Modality: Online, Asynchronous

Textbook: Smith, D., Eggen, M., and St. Andre, R.; A Transition to Advanced Mathematics, Cengage Learning, 8th Edition, 2014; ISBN: 978-1-285-46326-1 (e-textbook is available in Canvas)

Internet Access: You will need reliable internet access throughout the semester in order to participate in the course.

Technology: You will need the following in order to participate in this course:

1. Computer hardware requirements:
    - A laptop or desktop computer,
    - An internet connection,
    - Speakers and a microphone – built-in or USB plug-in or wireless Bluetooth (optional for participation in office hours),
    - A webcam or HD webcam - built-in or USB plug-in (optional for participation in office hours)
2. Computer software requirements:
    - Adobe Acrobat or a similar PDF reader,
    - Web Browser (Microsoft Edge is preferred; Google Chrome also works although it sometimes gives unexpected error messages),
    - Desktop version of Zoom (Optional),
    - Microsoft Word, PowerPoint,

- Suitable LaTeX document editor (optional).

3. Internet browser requirements:
   - Up-to-date,
   - Google Chrome or Mozilla Firefox are recommended.
4. Internet connection speed requirements:
   - Broadband wired or wireless (3G or 4G/LTE).

Campus Learning Outcomes: The faculty at Indiana University East have identified five campus learning outcomes. Upon completion of a bachelor's degree at Indiana University East, students can:

1. Communicate clearly and effectively in written and oral forms.
2. Access, use, and critically evaluate a variety of relevant information sources.
3. Apply principles of inquiry to define and analyze complex problems through reasoning and discovery.
4. Demonstrate the ability to relate within a multi-cultural world.
5. Demonstrate a deep understanding of a field of study.

This course will concentrate on the fifth learning outcome. This is a course for the B.S. and the B.A. in Mathematics. As such, the course contributes to the deep understanding of a field. Through this course, you will be familiar with basic techniques of proofs and with fundamental definitions related to the real number system and to the fundamental questions of algebra. It will prepare you to take proof-based courses such as real analysis, algebra, and topology in the future.

Course Learning Objectives: Upon successful completion of this course, you will be able to:

- (CLO 1) State basic definitions of common mathematical concepts (propositional and first-order logic, sets, relations, functions and cardinality).
- (CLO 2) Construct basic proofs in the context of basic number theory, sets, relations, functions and cardinality.
- (CLO 3) Provide examples and counterexamples in the context of basic number theory, sets, relations, functions and cardinality.

Office Hours and Communication: There are two weekly online office hour sessions available for this course as mentioned above. I ask that you post all questions that may be of interest to the entire class on discussion forums in Canvas. Your questions might be related to your homework, examples, exercises and other relevant course material you might locate in your textbook or elsewhere. If you have questions that are only of interest to you (for example, questions regarding an individual grade or any personal matter etc.), I ask that you use e-mail. I will answer emails within 24 hours on weekdays. Once you have tried these mechanisms, if your questions are not yet addressed, you may see me at my office hours.

I am willing to help you in office hours and through phone calls, but those sessions cannot be private tutoring arrangements. I will only consider helping you in such private sessions if there is enough evidence that you have regularly contributed in discussion forums, have started discussions on the problems you wish to discuss, have gone through lecture notes and recordings, hints, similar

examples and exercises that are discussed or in other words you have exhausted the help that is available for you.

Details on Course Work: This is an online class. We may cover multiple sections of the textbook each week. You are responsible to find time to watch the PowerPoint lectures and take notes as if you were sitting in a face-to-face classroom. When viewing the lecture on the PowerPoints and reading the textbook, you should focus your attention on the definitions and the proof techniques that are discussed. **Mathematics is learned by doing mathematics**. **It is not something that is understood well as a spectator**. After studying course materials, you should attempt the homework problems, and discuss the topics with your classmates, and instructor in the discussion forum. Most of assignment problems are related to proofs. You should not try and find "a problem just like it" that you can imitate. The main purpose of this course is to make you learn how to apply proof techniques in an entirely new setting. **For this reason, you should read the book and watch/listen to the PowerPoint presentations before attempting any homework problems!** Then you should read each problem very carefully and should understand it, then you should start to generate ideas based on what you have learned from the course materials.
In our study of mathematics, we build tools, strategies, proof techniques, definitions, theorems that help us prove new statements. When solving a problem, we need to use some or all of these pieces very carefully in a logical way. The main objective of this course is to train you so that you can establish mathematical results rigorously.

Homework: Doing homework is crucial to learn the content of a proof-based course, esp. this course. Practice all assigned homework problems that are marked 'practice' and get prepared to take quiz and to solve the remaining homework problems that are marked 'submit'. Manage your work in a notebook or in your device because one part of your midterm exam and final exam will be based on these problems. I encourage you to discuss these problems in weekly discussion forums by sharing your ideas and key strategies. Please do not post a complete solution/proof of a problem/statement and always encourage your peers to participate in the discussion.

You will submit two drafts of each homework assignment. In each homework assignment, the problems you are required to submit will be graded for correctness and count as 80% of score and the remaining 20% is given for completion of the required problems for the first submission. Do not include the practice problems in your homework submission. The second submission is graded entirely based on whether you have made revisions correctly.

Please start each problem on a separate page and leave enough space so that I can easily write comments when grading. You need to complete this part of quiz in multiple stages. When creating a mathematical proof/solution, it is very common that after writing a few steps, your method may not

work, and you may need to use a new method. Requiring multiple attempts is not an indication of lack of knowledge but a part of learning process.

1. Prepare a draft: To solve a problem, it is very helpful to begin with writing all pieces of information that you think are useful on a separate sheet of paper. Here you can re-state undefined terms, definitions, known facts and results that may be needed, and try few attempts. Writing what you want to prove and how you are going to get it by writing few backward steps is usually very helpful. Make arrows, diagrams, drawings, or whatever else that helps you. Once you find that the ideas or information you have are enough to scratch a proof/solution, organize them by marking only requiring ideas and information. You should not attempt to have a finished version of your proof on the first attempt. No mathematician produces work in this way, so why should you make an exception? If you need help, please share what you have tried. I will help you when I see that you have done your preparation well.

Please do not submit a draft for grading. It is only for your preparation to write a final proof/solution. I strongly recommend you prepare a draft because it helps you minimize the mistakes in the final version you are going to submit. I strongly suggest you continue revising your work and make changes until you are fully convinced.

A draft could look like the following.

Example: Prove that if x and y are even integers, then x + y is an even integer. (You repeat what you must prove!)

Proof. Suppose x is an even integer and y is an even integer.

Then x = 2m where m is an integer and y = 2n where n is an integer.

We want to show that x + y is an even integer,

i.e., x + y = 2(some integer). We have

x + y = 2m + 2n (using the representation of x and y from before), so

x + y = 2 (m + n) (using the distributive property).

Because m + n is an integer, 2 (m + n) is an even integer.

Thus x + y is an even integer as desired.

Therefore, if x and y are even integers, then x + y is an even integer. □

2. Prepare a final version and submit: In a draft, you may have written some details that may be clear from the context or some redundant arguments and reasoning which can be just removed to finalize your work. In the final version, you need to use the ideas from the first draft, your peer's recommendations and your own judgment to reduce details from the draft so that only essential elements are there.

The proof from the example could be pared down to:

Example: Prove that if x and y are even integers, then x + y is an even integer.

Proof: Suppose that x and y are even integers. Then $x=2m$and $y=2n$ for some integers m and n. Then $x+y=2(m+n)$. Thus $x+y$ is even because $m+n$ is an integer. Therefore, if x and y are even integers, x + y is an even integer. □

Method of submission: You need to either type your assignment in a Word/Latex document or scan neatly handwritten work and submit a single pdf file. NEVER upload multiple files. When downloading files for grading, only the last submission will be downloaded and the other will be missed.

Please note that your assignment must be legible. Write neatly or type! Typing may seem pretty time consuming and cumbersome at the beginning, and even it is not a mandatory part of the coursework, but it helps you revise your work easily without having you to re-write everything. Also, by typing your assignments you will develop your skill of typing mathematics, which would be a credential for the future, and can easily manage multiple files you create throughout the semester.

Late submission: An assignment must be submitted before deadline. If you miss the deadline, a late penalty of 20% will be applied within one week from the deadline for homework and quizzes and the assignment WILL NOT be accepted after one week. This is non-negotiable except there are unavoidable circumstances such as when you are sick and submit a doctor's note or when you have affected by harsh weather conditions and provide convincing evidence etc.

The final exam will not be accepted late under any circumstances. Under certain circumstances such as death of a close family member or extreme illness, you may request an incomplete. If the incomplete is granted/approved by the instructor and dean, you may take a make-up final exam at a later date determined by the instructor and delivered at the instructor's convenience (an incomplete could result in up to a one-year delay in your completion of the course and result in delays in program completion).

Grading one late assignment individually takes disproportionally longer than grading an assignment that was received on time. Also, it is very difficult to maintain consistency in grading late assignments. If you send an assignment late, it will be graded with the explicit understanding that you might encounter a slightly different grading standard than an on-time assignment. So, I urge you to avoid late submissions and complete assignments within the due date as far as possible.

Online Discussion: You should discuss all questions related to examples, exercises, and difficulties in any topic in the lectures and textbook, assignments such as homework, group projects, exams, and other technical issues in discussion forum in Canvas. Discussion forum is a main platform for students' engagement to get help from instructor and peers. **Participation in the discussion forum is mandatory and is a significant part of your overall course grade. Grades will be assigned for your participation in each discussion forum**.

You may contribute in two ways: either by asking an informed question, or by helping on someone else's question (NEVER answer fully, just share some ideas!). Your participation is more significant if you do not limit yourself in only asking questions but also equally ask questions and answer other's questions. Your post cannot be generic or something that can be copied from somewhere, so use it sparingly. NO CREDIT will be given for just asking a question without sharing what you tried to do and where you had a problem.

You need to post a **minimum of THREE times substantially** in a weekly discussion forum. Those posts must come on **two or more different days of that week**. A response to someone's posting is **SUBSTANTIAL** if it delivers conceptual mathematical ideas and insights. The responses like 'I agree with you', 'I did the same', 'my answer is same as yours', 'thank you', 'I appreciate your help' or something of similar platitudes are not considered as substantial posts. However, you can give such responses as needed, but NO CREDIT will be given for them as well.

Here are some examples:

Not Substantial	Substantial
I don't get it! (Not specific) What is the homework assignment for next week? (Not on topic)	I am not sure why we can say f(x) = y implies (x, y)∈ f. I thought f is a function, and not a set! (A specific question on topic)
Just look in the book on page 73! (Not specific – the answer does not help)	Functions can be construed as sets of ordered pairs. To say (x, y)∈ f means just the same thing as saying f(x) = y. (A specific answer)
Thank you – I understand now! (Not specific)	So there are two ways to denote a function; either by providing a formula, like f (x) = 2x + 3, or by providing a set of ordered pairs… and the same function can be expressed in one way or the other. (A summary of a previous answer that rephrases the original response and shows what you now understand).
I changed a misspelled word in the proof. (This isn't no English class, so spelling is not the core of the matter, even though it helps.)	I corrected the argument in the proof.

SI Sessions/Office Hours: Each week there will be two scheduled online office hour sessions and the others by appointment. There will be multiple SI sessions. I suggest you email me and the SI leader your questions at least a couple of hours before a session begins so that we can prepare to discuss with you.

Quiz: There will be 25-40 minutes long weekly quiz. It will be auto graded. Study definitions, examples, theorems and their proofs and practice homework problems (focusing on key techniques) to prepare for this part of quiz. Always focus on understanding concepts. Quiz problems in this part will be targeted to reflect your understanding of concepts. A typical problem may be either of: filling in the blanks, true/false, multiple choice, dropdown or matching etc.

Mid-term and Final Exams: Mid-term and final exams will be open book and open notes. In each exam, there will be two parts, Part A (concept understanding part, like Part A of a quiz), and Part B (problem solving part like homework). There will be 1 - 1.5 hours to complete Part A and 24 hours to complete Part B. Additional details and instructions will be given in an announcement later. Problems in an exam will be like those in quizzes and homework. So, it is essential that you manage these assignments so that you can find an assignment when needed. Have a good preparation on the covered course materials before taking an exam. Otherwise, it will be quite challenging to solve all exam problems within the assigned time.

Grades:

Your grade will be determined as the following:

Homework	30%
Online Discussion	15%
Quiz	10%
Exams	45% (midterm 1/3, final 2/3)

Your final grade will be calculated according to the following breakdown:

97% or above & below 100%: A+,	93% or above & below 97%: A,
90% or above & below 93%: A-	87% or above & below 90%: B+,
83% or above & below 87%: B,	80% or above & below 83%: B-,
77% or above & below 80%: C+,	73% or above & below 77%: C,
70% or above & below 73%: C-	67% or above & below 70%: D+
63% or above & below 67%: D	60% or above & below 63%: D-.

Anything below 60% is an F.

Please check the gradebook on Canvas regularly to verify that all your grades are recorded correctly.

Overview of IU East Grading Policies: The following includes highlights paraphrased from several campus or university policies pertaining to grades and grading. For more information, see the IU East Grading Policies site.

- Dropping courses:
  - Drop or add classes in the first through ninth week of classes

        - Drop or add classes after the auto "W" deadline
        - Faculty members are required to report any student on the Student Engagement Roster (SER) who stops attending a class and does not withdraw (with a grade of 'W' or 'F'). Failure of a course due to non-attendance may affect financial aid award amounts.
    - Incomplete:
      Requesting and changing an Incomplete grade
    - Grade appeal:
      Requesting and changing an Incomplete grade

Grade appeal: If you believe the grade received in a course is incorrect, you should follow the Grade Appeal Policy. The initial appeals process states that "[s]tudents who are dissatisfied with the grade received in a course should contact the instructor and attempt to resolve the matter amicably and informally. If the matter cannot be resolved, the student should consult the IU East Grade Appeal Policy and follow the procedures stated therein."

Honesty Statement: Academic honesty is fundamental to the activities and principles of this university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. All submitted written work is to be done by the student her/himself. The academic community regards academic dishonesty as an extremely serious matter, with serious consequences that range from reduction in grade, probation to expulsion. Using someone else's work as if it is your own— plagiarism— is a serious university offense and will be dealt with following university guidelines. You must cite borrowed ideas or text, including lecture material, regardless of whether it is a direct quote or a paraphrasing. When in doubt— cite. (See section III, Student Misconduct, of the Code of Student Rights, Responsibilities, and Conduct, available on the "Campus Course Policies" link, available on the left tab of your courses in Canvas).

I agree that students in an online class can acknowledge all outside sources in completing the homework assignments. Outside sources may be classmates, friends or books etc. It's quite reasonable to get some help from others, especially to get some ideas. Once you obtain them, you must not just copy them but understand and use them to write the solution in your own way. If I am not fully convinced that you have done your work with good grasp of concepts, I may ask you to be available for a phone call to discuss about it. You will have to convince me how you have done it. If you repeatedly fail to convince me that you are the author of the homework, I will consider this as cheating and apply all the penalties that this entails.

Basic Needs Security: Any students who face challenges securing their food or housing and believes this may affect their performance in the course should contact the Office of the Dean of Students (phone number: 765-973-8525) for support. Additionally, IU East employs a student

advocate (phone number: 765-973-8395), to help. Furthermore, please notify me if you are comfortable in doing so. This will enable me to point you toward available resources.

Mental Health: IU East offers free counseling services to all students on campus. The services range from one-on-one sessions with an IU East licensed clinical professional to group support sessions. The sessions are typically 1 hour long and can be done in person or through a secure zoom call. You must be present in the state of Indiana during the Zoom call. Students are offered up to six free sessions per semester. If you are seeking help, appointments can be made at 765-973-8646. To schedule an appointment online or find resources if you are struggling in any way, please visit this page https://www.iue.edu/healthy/mind/

Accessibility & Accommodations: Indiana University is dedicated to ensuring that students with disabilities have the support services and reasonable accommodations needed to provide equal access to academic programs. To request an accommodation, you must establish your eligibility by working with Accessible Educational Services (AES) on your campus - asiue@iue.edu . Additional information can be found at accessibility.iu.edu. Note that services are confidential, may take time to put into place, and are not retroactive; captions and alternate media for print materials may take three or more weeks to get produced. Please contact your campus AES office as soon as possible if accommodations are needed.

Indiana University Policy on Discrimination, Harassment, and Sexual Misconduct: As your instructor, one of my responsibilities is to create a positive learning environment for all students. IU policy prohibits sexual misconduct in any form, including sexual harassment, sexual assault, stalking, sexual exploitation, and dating and domestic violence. If you have experienced sexual misconduct, or know someone who has, the University can help. If you are seeking help and would like to speak to someone confidentially, you can make an appointment **with Jennifer Claypoole, Director of Mental Health – 765-973-8646**. For more information, you can visit our Chat with a Counselor site.

It is also important that you know that because of my role, University policy requires me to share information brought to my attention about potential sexual misconduct with the campus Deputy Sexual Misconduct & Title IX Coordinator or the University Sexual Misconduct & Title IX Coordinator. In that event, those individuals will work to ensure that appropriate measures are taken and resources are made available. Protecting student privacy is of utmost concern, and information will only be shared with those that need to know to ensure the University can respond and assist. I encourage you to visit stopsexualviolence.iu.edu to learn more.
Indiana University also prohibits discrimination on the basis of age, color, disability, ethnicity, sex, gender identity, gender expression, genetic information, marital status, national origin, race, religion, sexual orientation, or veteran status.
If you feel like you have experienced discrimination, harassment, or sexual misconduct and wish to make a report, please contact **Josie Brush, Deputy Sexual Misconduct & Title IX Coordinator for**

Regional Campuses– jvbrush@iu.edu – 812-855-7559 or make a report through the online reporting form here.

Bias Incident Reporting: Indiana University is committed to creating welcoming, inclusive, and respectful campus communities where everyone can thrive and do their best work—a place where all are treated with civility and respect. If you experience or witness an incident of bias, you should report it. For more information, see Bias Incident Reporting.

Intellectual Diversity: In this course, we may explore a variety of viewpoints relating to cultural and intellectual diversity when it is appropriate to the curriculum. In doing so, you will be exposed to multiple viewpoints, and you may be required to display understanding of them. However, you are free to make your own choices as to your beliefs.

Academic Support and Student Services: IU East offers a variety of services to assist you in your academic endeavors. This includes everything from advising for your courses to student counseling support. A list of the academic support and student services offered for our students can be found at the Student Success Hub. You can either click on the link or click on the tab named "Student Success Hub" found to your left in Canvas.

Technology and Support: You will participate in this course using the IU Canvas platform. Once you are in the platform you can learn how to use Canvas effectively by clicking the "Help" link on the top right of the course page on Canvas. In addition, the IU Knowledge Base is a good resource for any technical questions you may have.

Technical Difficulties: Contact the IT Help Desk at iueitsup@iu.edu or by calling 765-973-8375. Most problems can be resolved in less than 24 hours. If there is a system-wide service problem, you will receive email notices regarding the problems and its resolution.

Right of Revision: The instructor reserves the right to revise or adjust the course syllabus to best accommodate the pace and needs of the students.

Course Schedule:

Module	Topic	Coursework Assignments
1	1.1 Propositions	M1 | Discussion M1 | Homework M1 | Quiz
2	1.2 Conditionals	M2 | Discussion M2 | Homework M2 | Quiz
3	1.3: Quantifiers 1.4: Basic Proof Techniques I	M3 | Discussion M3 | Homework M3 | Quiz
4	1.5: Basic Proof Techniques II 1.6: Proofs Involving Quantifiers	M4 | Discussion M4 | Homework M4 | Quiz
5	2.1: Basic Concepts of Set Theory 2.2: Set Operations	M5 | Discussion M5 | Homework M5 | Quiz
6	2.2: Set Operations (Continued) 2.3: Extended Set Operations	M6 | Discussion M6 | Homework
7	2.4: Induction 2.5: Equivalent Forms of Induction	M7 | Discussion M7 | Homework M7 | Quiz
8	3.1: Relations	M8 | Discussion M8 | Homework M8 | Quiz
9	Midterm	M9 | Midterm Exam: Part 1 M9 | Midterm Exam: Part 2
10	3.2: Equivalence Relations 3.3: Partitions	M10 | Discussion M10 | Homework

Module	Topic	Coursework Assignments
		M10 | Quiz
11	4.1: Functions as a Relation 4.2: Constructions of Functions	M11 | Discussion M11 | Homework M11 | Quiz
12	4.3: Onto and One-to-One Functions 4.4: One-to-One Correspondences	M12 | Discussion M12 | Homework M12 | Quiz
13&14	4.5: Images of Sets	M13&14 | Discussion M13&14 | Homework M13&14 | Quiz
15	5.1: Equivalence of Sets	M15 | Discussion M15 | Homework M15 | Quiz
16	5.2: Infinite Sets 5.3: Countable Sets	M16 | Discussion M16 | Homework M16 | Quiz
	Finals Week	Final Exam Part 1 Final Exam Part 2

Note: Details of this tentative schedule may be changed during the semester at the instructor's discretion.