Math 3345 - Foundations of Higher Mathematics

Autumn 2024

Instructor: Prof. Maria Angelica Cueto (cueto.5@osu.edu)

Course information

Websites: https://carmen.osu.edu ; https://people.math.osu.edu/cueto.5/teaching/3345/Au24

Lectures: M-W-F 1:50-2:45pm in Scott Laboratory (SO) N054.

Office Hours: Mondays and Wednesdays 3-4pm (room to be determined).

Course description: The focus of this class is learning how to read and write mathematical proofs. The mathematical content, while important, is secondary to the reading and writing goals. Consequently, the standards from writing in this class will be higher than in other math classes you might have taken in the past. Students are expected to memorize definitions and statements of theorems.

Prerequisites:
Math, IMME, STAT, STEMED-PRE or STEMED-BS: C-or better in 2153, 2162.xx, 2173, or 2182H; or credit for 254.xx, 263.xx or 263.01H.
CIS, CSE or ECE: C-or better in both CSE 2321 and: C-or better in 1152, 1161.xx, 1172, 1181H, 1534, or 1544; or credit for 153.xx, 154, 162.xx, or 162.01H.

Content: Introduction to logic, proof techniques, set theory, number theory, real numbers.
The following topics will be covered:

- Propositional calculus; quantifiers.
- Simple examples of mathematical proofs.
- Mathematical induction.
- Sets and functions: surjections, injections, bijections.
- Infinite sets: countable and uncountable.

Textbook Neil Falkner, *The Fundamentals of Higher Mathematics*. Autumn 2024 edition. (A free pdf copy of the textbook will be posted on Carmen.)

Grading. The grade will be based on homework assignments and participation (20%), two midterms (20% each), and the final exam (40%). Just reading and understanding the book will suffice to pass the course. Individual test scores will not be curved. Raw scores will be used to determine overall course scores. The course's final grade will be determined by applying cut-offs to the total course scores.

- *Homework.* Homework is an essential component of this course. Its goal is to *help you understand* the material as well as *to develop writing skills for communicating mathematics*. It is thus imperative that you start working on it as soon as it is assigned, and seek help if you are stuck on a problem.

  Homework will be assigned on a weekly basis (typically due on Fridays, with few exceptions indicated on the schedule at the end of this document.) There will be a list of 5-10 problems (often taken from the textbook) to submit, and a second list for practice and discussion. **Late homework will not be accepted without medical excuse**.

Assignments will be submitted in person, during class time (either handwritten solutions or typeset). Being able to communicate your ideas clearly and effectively in writing is an important component of your undergraduate education and it is the central goal of this class. To emphasize this, *each homework will be graded for both correctness and clarity of presentation.* **The two lowest homework scores will be dropped.**

There will a total of 12 homeworks (see the course schedule for due dates). Only a subset of the problems from each set will be graded. Each homework set will be worth 20 points (15 points in total for graded problems plus up to 5 extra points for completion of the assignment).

You are encouraged to discuss the problems with the instructors and your classmates, but your write ups must be your own. Remember: the homework is intended to help you learn the material and develop thinking and writing skills. *Solutions to these problems can be found online, but you will learn very little if you do not think about them yourself first.* Do your best to *think hard about the exercises on your own before you ask for help.* If you use other people's ideas, including from an online source, you *must state this explicitly.* Failure to do so is considered academic misconduct and plagiarism, which is a serious offense.

- *Exams.* There will be two midterm exams and a final exam. Dates of these exams are included in the Course Schedule (at the end of this document). All exams will be closed-book.

- *Class Participation and Attendance.* Doing math is a human activity. We will cover the material in an interactive fashion each lecture. It is important to stay actively engaged with the material and connected with both instructors and classmates, e.g. by attending lectures and asking for help during office hours.

  Lectures will be approached as active learning sessions, in particular, through occasional discussions in small groups. Reading of the material from the textbook ahead of time is encouraged, but not required. I expect students to attend class. Frequent absences are likely to be noted and may factor into the grade in borderline cases.

General policies

Academic Misconduct Statement: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term academic misconduct includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-48.7). For additional information, see the Code of Student Conduct at http://studentlife.osu.edu/csc/.

Statement on Title IX: Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at titleix@osu.edu

Your mental health: As a student you may experience a range of issues that can cause barriers to learning such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a students ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about

the broad range of confidential mental health services available on campus via the Office of Student Lifes Counseling and Consultation Service (CCS) by visiting https://ccs.osu.edu or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766. Emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at https://suicidepreventionlifeline.org

Respiratory Virus Guidance: The Centers for Disease Control and Prevention released new guidance (link is external) for people who test positive for COVID-19. The CDC no longer recommends a five-day isolation for those infected with the virus. Instead, individuals can leave home after they have been fever-free for at least 24 hours and have mild and improving symptoms. This move aligns COVID-19 guidance with other common respiratory viral illnesses, such as the flu.

Stay home and away from others if you are experiencing symptoms of a respiratory virus, including fever, chills, fatigue, cough, runny nose and headache.

You may return to normal activities when both are true for at least 24 hours:

- Symptoms are improving.
- Fever-free without using fever-reducing medication

In particular, please do not come to class if you believe you might have a respiratory illness.

Disability Statement: The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let me know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; http://www.ods.slds.edu/.

Course Schedule

The following schedule is tentative only. You will be notified of any changes by email, or in class. The most recent version of this syllabus will remain available at the course's webpage. The section numbers refer to those on the course's textbook.

Week	Topics	Sections	HW
1 8/20-23	Motivation, Propositional Calculus.	§1, §2	HW1 due on 8/30
2 8/26-30	Conditional sentences; Quantifiers.	§2, §3	HW2 due on 9/6
September 2 - Labor day, no class			
3 9/2-6	Quantifiers; Induction.	§3, §5	HW3 due on 9/13
4 9/9-13	Axioms of integers; Even and odd Integers; Even and odd proofs.	§4	HW4 due on 9/20
5 9/16-20	Real and Rational Numbers; Divisibility; Primes; Infinitude of primes; Pascal's Triangle; Binomial Theorem	§4, §5	HW5 due on 9/25 **Wednesday**
6 9/23-27	Insight vs. Induction; Division Algorithm;	§6	No homework
Midterm 1 on Monday September 30			
7 9/30-10/4	Complete induction; Fundamental Theorem of Arithmetic.	§5, §7	HW6 due on 10/9 **Wednesday**
Autumn break - October 10–11. No classes.			
8 10/7-11	Euclidean Algorithm; Greatest Common Divisors; Congruences.	§7, §4	HW7 due on 10/18
9 10/14-18	Sets; Subsets; Set Builders; Venn Diagrams; Whole Numbers as Sets; Set Operations.	§10	HW8 due on 10/25
10 10/21-25	Set Operations; Intersections and Unions; De Morgan's Laws; Distributive Laws.	§10	HW9 due on 11/1
11 10/28-11/1	Cartesian Products; Functions: restrictions, extensions, gluing, compositions, surjections, injections.	§10, §11	HW10 due on 11/8
12 11/4-8	Bijections and Inverse functions; Cardinality of a set; Equinumerous sets.	§11, §13	HW11 due on 11/22
November 11 - Veteran's day, no class			
Midterm 2 on Friday November 15			
13 11/11-15	Review		No homework
14 11/18-22	Infinite sets; Countable sets; Countability of $\mathbb{Q}$; Cantor's Diagonal Lemma; Uncountability of $\mathbb{R}$.	§13, §15, §16	HW12 due on 12/2 **Monday**
Thanksgiving break - November 27–29. No classes			
15 11/25-29	General Diagonal Lemma; Russell's Paradox.	§16	No homework
16 12/2-4	Review		No homework
Final exam: Wednesday December 11 2:00-3:45pm.			