Math 222: Foundations, Fall 2024
General Course Information

Professor: Noah Aydin **Office:** RBH319 **E-mail**: aydinn@kenyon.edu **Class Meetings**: MWF 11:10-12 in RBH 203
Course web page: http://www2.kenyon.edu/depts/math/aydin/teach/222
Office Hours: MWF: 10:10-11am, TR: 9:40-11 am, or by appointment. See my weekly schedule on the course website.
Textbook: Chapter Zero, C. Schumacher, 2nd ed, Addison Wesley. ISBN 0-201-43724-4
MSSC: Su/Tu/Thu 7-10 pm **Tutor:** Kyle Kelly **Software:** LaTeX typesetting system (on overleaf)

Course Overview: The central purpose of this course is to introduce you to careful use of language in the context of mathematical reasoning and proof. The course is meant to make you think about mathematics in a completely new way, in a more mature way. It should set you on the path to becoming a mathematical producer rather than mathematical consumer. As part of this venture, we will discuss the basic principles of logic and various proof techniques, applying them in the context of the essential building blocks of mathematical structures: sets, relations (including orderings and equivalence relations), functions, etc. While the class will introduce you to some new mathematics, the emphasis of the course is on process rather than content. You and your fellow students will prove virtually all the theorems yourselves and present them to each other in a seminar setting. Thus, I hope that the most important lines of communication will be between students rather than instructor to student as is the case in many classes.

Learning Objectives

- Learn the basic vocabulary, conventions, and principles for proving theorems
- Recognize different proof techniques (e.g., direct proof, proof by contradiction, induction, etc.) and construct proofs using these techniques
- Be able to read and unpack formal mathematical definitions
- Use definitions and assumptions correctly within mathematical proofs
- Handle quantifiers correctly in statements and proofs
- Use basic logical principles to support your reasoning
- Present mathematics both orally and in writing
- Be able to read, analyze, and evaluate proofs written by others
- Learn the basics of sets, relations, functions and cardinality
- Practice effective study skills, seek help when needed, persist in the face of difficulties, and recognize the value of productive failure in the learning process
- Interact positively with peers and faculty and engage in healthy collaborations, both in and out of the classroom

Grading and Evaluation Criteria:
Final grades will be determined based on the performance in the following components.

Component	Percentage
Daily Quizzes	15
Presentations, Participation, and Citizenship	15
Written Homework Assignments	15
3 Midterm Exams (10% each)	30
Final Exam	25

Exam Dates:

First Midterm: Wed, Sep 25 (in Class)
Second Midterm: Fri, Oct 11 (in Class)
Third Midterm: Nov 18-Nov 22 (Take home)
Cumulative Final: Friday Dec 20 (1:30 – 4:30pm)

Pass/D/Fail: Because the material in Foundations is so important in preparing mathematics majors for upper-level, proof-based coursework, no student is allowed to take the course Pass/D/Fail.

Course Structure: This class will be conducted as an inquiry-based course. What this means is that you will construct your own knowledge by working through a carefully curated set of questions designed to develop your understanding. You should not use any resources other than our class textbook, and conversations with other class members and with me. You will need to take intellectual risks in order to succeed: be open to struggling with the content and making mistakes. This is a normal part of the learning process. Indeed, more learning occurs when we make mistakes. And in general, mistakes enrich our class conversations. At the same time, you can count on me to provide scaffolding and to help you on your mathematical journey.

Foundations will be different from other math courses you have had. Because the purpose of the class is to change the way that you think and reason about mathematics, it is essential that you become immersed in the work of the course. It is not enough to respond to what an instructor does or tells you. You and your fellow students are the ones that make things happen in class. Without your active participation, nothing will happen. Perhaps more than in any class you take, you will get benefit out of the course in direct proportion to how much effort you put in. Thus class work is the most substantial portion of the grade. It has several components: short daily quizzes, written assignments, class presentations and class participation generally. (This last includes contributing to class discussions, asking good questions, and active participation when another student is presenting work at the board.) And of course, attendance. If you don't attend you can't participate. You are expected to be in class, if you aren't your grade will be adversely affected.

Classroom Environment: The nature of an inquiry-based course makes it even more imperative that our classroom environment is supportive and equitable. Make sure you are listening as much as you are speaking. Certainly, provide alternate points of view, ask questions, and discuss mistakes, but work to frame your statements in a positive and constructive manner.

Presentations, Participation, and Citizenship: Students are expected to attend all classes, and actively participate and contribute to in-class activities and discussions, as these comprise an essential part of your learning in this course. Much of the class will consist of students working in groups or presenting work to each other. You will be expected to do your share in this. To ensure that everybody comes to class prepared on a regular basis, I will often choose who presents at the board with the help of a die. I've found that by introducing an element of randomness, we avoid the problem arising when students expect a bye on one lesson because they presented during the previous lesson. Sometimes I will rely on volunteers to make presentations. This makes it possible for students to present the work about which they feel most confident. But the fact that so much of the grade depends on this participation means that all students must volunteer on a regular basis. Don't assume that because others volunteer, you (or your grade) are off the hook. Please read this document with more details about class presentations.

As a courtesy to your classmates and instructor (and for your own learning), I expect you to arrive on time and to avoid distractions and disruptions during the class. Electronic devices should not be used for any purpose not directly related to class activities. **Please avoid leaving the room during the class meeting.** If you have a medical condition that necessitates this, please inform me at the beginning of the semester.

Attendance & Tardiness Policies: Your attendance will be tracked and this data will contribute to your overall participation grade. After your first *unexcused* absence, each additional *unexcused absence* will lower your participation grade by 5%. Students needing to miss class should contact the professor in advance. Tardiness is distracting to others in the class (including the professor), so please arrive on time. After your first tardy, each additional tardy will lower your participation grade by 2%. Because excessive absences (20% of class meetings per department attendance policy) will prevent a student from meeting course requirements and achieving essential learning goals, more than 7 absences will lead to expulsion from the course. The attendance policy is established as realistic limits of the additional burden required for students who must miss class; they are not intended to be punitive measures.

Quizzes: One significant aspect of growing in mathematical maturity is to read formal mathematics with comprehension. In this course, you are expected to *read the textbook very carefully*. Come to the class prepared, having read the assigned sections of the textbook before each class. To encourage that you do the reading and to hold you accountable, there will be a quiz at the beginning of every class. The quizzes will be based on the assigned readings, and sometimes what we did in class in recent class sessions. Pay special attention to definitions. A thorough understanding of definitions of key concepts is essential to this course and proof-based courses for which Foundations is a prerequisite. The weight of any one of these quizzes will be very small. Moreover, a number of low scores will be dropped. What matters is the consistent work over the course of the semester. Do not be discouraged by a few low scores on quizzes. Many of the quizzes will be on Moodle, so bring a laptop to class every day.

Written Assignments: Since Math 222 is primarily a language course, you are expected to learn clearly and precisely to express mathematical ideas in writing. Many times during the semester you will be asked to write up and turn in the proof of some theorems or present solutions to problems. Your grade will be based on both the correctness and the form, that is, the clarity of expression, completeness, proper usage of both English and mathematical grammar, and whether you really said what

you meant to say. Of course, form and content cannot be entirely divorced. If your writing is sufficiently muddled that the reader cannot tell what you meant to say, then your grade will suffer. Likewise, if you really don't understand what it is you are trying to say, the writing will be fuzzy and unclear. However, it is not impossible to distinguish the factors (correctness and style); at times the grades may be separated so you can see where improvement is needed. When you write up an assignment, you are expected to include sufficiently many details to enlighten someone who does not already know what you are trying to say. This may require that you restate a definition or previous theorem and say how it is used in your proof. Do not be afraid to include too many details. If you are in doubt about whether or not to say something that you feel is pertinent, always do so.

Late and Make-up Policy: All assignments must be turned in at the beginning of the class period on the assigned due date, unless specified otherwise by the instructor. There will be no make-up for daily quizzes. Several low quiz scores will be dropped at the end of the semester. The only exception to this policy will be in situations in which *all* of the following conditions are met: i) the student has a legitimate excuse, ii) the student informs the instructor before the class, and iii) the student is able to take the quiz during the regular class time synchronously with the class, if that quiz happens to be on Moodle. For weekly homework assignments, each student will be allowed one "free" 24-hour extensions on homework assignments; no reason needs to be provided. Simply email the professor in advance of the due date (no later than the evening prior to the due date) to say you'd like to use one of your extension. After that, late homework will not be accepted. For exams, a make-up can only be granted with an official notice from one of the deans (the dean of academics or the dean of students).

Academic Honesty: The rules set forth in the 2024-2025 Course Catalog apply to all aspects of this course. In general, any work submitted for credit must result directly from your own understanding, thoughts, and ideas. Presenting the work of others as your own is strictly prohibited. You must follow the guidelines given in this document in general and mathematics department's guidelines for written homework in particular. Though collaboration is encouraged, you must write your proofs and your solutions independently. Using chatGPT or other generative AI tools are prohibited for any of the assignments or exams in this course. If you have any questions, please ask your professor for clarification.

Accessibility and Accommodations: Students who anticipate they may need accommodations in this course because of the impact of a learning, physical, or psychological disability are encouraged to meet with me privately early in the semester to discuss their concerns. In addition, students must contact Student Accessibility and Support Services (SASS) (740-427-5453 or sass@kenyon.edu), as soon as possible, to verify their eligibility for reasonable academic accommodations. Though I am happy to help you in any way I can, I cannot make any special accommodations without proper authorization from the SASS staff. Except in extraordinary circumstances (and at the very start of the course), accommodations must be certified and discussed with me at least one week before they are to take effect.

Names and Pronouns: In this class, we will respect one another's self-disclosed name, pronoun and identity. Students are encouraged to use gender-neutral language if they are not sure of someone's pronouns. For more information on Kenyon's commitment to diversity and non-discrimination, please refer to the Office for Civil Rights and/or the Office of Diversity, Equity, and Inclusion.

Non-Discrimination, Civil Rights and Title IX Compliance

Kenyon College does not discriminate in its educational programs and activities on the basis of race, color, national origin, ancestry, sex, gender, gender identity, gender expression, sexual orientation, disability, age, religion, medical condition, veteran status, marital status, genetic information, or any other characteristic protected by institutional policy or state, local, or federal law. The requirement of non-discrimination in educational programs and activities extends to employment and admission. As a faculty member, I am deeply invested in the well-being of each student I teach. I am here to assist you with your work in this course. If you come to me with non-course-related concerns, I will do my best to help. However, it is important for you to know that *all faculty, are considered Mandated Reporters* of any incidents of harassment, discrimination, and intimate partner violence and stalking. Meaning, I must report any such discussion to the Civil Rights/Title IX coordinator. I cannot keep information involving sexual harassment, sexual misconduct, interpersonal violence, or any other form of harassment or discrimination based on a protected characteristic, confidential. The Health and Counseling Center, the College chaplains, and the staff at New Directions Domestic Abuse Shelter & Rape Crisis Center are confidential resources. For further information, please refer to the following Kenyon College policies: Discrimination, Sexual Misconduct & Harassment: Title IX, VAWA, Title VII. Civil Rights Policy
ADA & Section 504 Student Grievance Procedures

Class Norms

- We are a community of learners and we help and support each other
- We are fully present and fully engaged
- Everyone should speak. Do not be shy to speak
- We are respectful of each other
- We offer friendly and constructive criticism
- Everyone has something to learn
- Everyone has expertise to offer
- Asking questions is essential for the learning process
- No human being is absolutely correct on all matters at all times (this certainly includes your professors)
- Not questioning an incorrect or invalid solution/argument is not helpful for anyone

How to Study for this Class

- Regular work and genuine engagement in the material are the most important aspects of deep learning in any class.
- Read the assigned sections from textbook BEFORE each class meeting. You may not understand everything in the first reading but that's OK. Do your best. Take notes to ask questions in class. Pay special attention to definitions.
- Come to the class and actively participate in problem solving other class activities and discussions. Do not hesitate to ask and answer questions, or contribute to class discussions in other ways. Daily quizzes and presentation of problems in class are significant part of your grade.
- Start doing homework problems early. Do not wait until the last minute. Take advantage of the tutoring help provided by MSSC. This is a small class which is an advantage to get more time from the tutor.
- Do homework problems regularly. Do a few problems every day instead of trying to do everything the night before an assignment is due.
- If you have any questions, some see Prof. Aydin during the regular office hours (no appointment needed) or make an appointment. See Prof Aydin's weekly schedule to find a mutually convenient time.
- You are welcome to chat with Professor Aydin for matters outside the course content as well.
- Form study groups. Research shows studying in groups is really beneficial. BUT make sure that you write your own solutions independently at the end. Follow Math Dept's guidelines on healthy collaboration.

Book Recommendation on Learning and Study Habits

The New Science of Learning: How to Learn in Harmony With Your Brain, by T. Doyle, and T. Zakrajsek
http://www.goodreads.com/book/show/17783567-the-new-science-of-learning

The 5 Elements of Effective Thinking, by E. B. Burger, and M. Starbird
http://www.goodreads.com/book/show/14891980-the-5-elements-of-effective-thinking#other_reviews