



MATH 301: Foundations of Analysis

Spring 2022

Oberlin College

Course Information:

Lecture Times: MWF, 9:00–9:50 AM
 Location: Science Center A154

Instructor:

Nathan Gray
 Office: Rice 103
 Office Hours: TBA
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Prerequisites: Passing grades in both MATH 220 and MATH 231 are required (this includes prior experience in reading and writing proofs). Otherwise, instructor consent is required.

Textbook (required): *Understanding Analysis*, 2nd ed., Stephen Abbott, Springer, 2015.* We plan to cover much of chapters 1–7. Time permitting, we will discuss additional topics.

Course Description: This course is an introduction to real analysis, a fundamental language for much of modern mathematics. The main course topics are:

- (Chapter 1) structure of the real number system \mathbb{R} ; cardinality and countability
- (Chapter 2) sequences and series in \mathbb{R}
- (Chapter 3) topological notions of \mathbb{R}
- (Chapter 4) continuity and uniform continuity of functions
- (Chapter 5) differentiability of functions
- (Chapter 6) sequences and series of functions
- (Chapter 7) the Riemann integral
- (time permitting) metric spaces; additional topics.

We will begin by exploring basic properties of the real numbers, assuming only the most basic properties of the natural numbers (i.e., the numbers 1, 2, 3, . . .) before extending things to the reals.

We will then analyze sequences and series of real numbers, though the coverage will be much more rigorous than what is usually seen in calculus.

Then we will turn to some fundamental notions of analysis, e.g., distance, neighborhoods, open sets, closed sets, compactness, connectedness— notions that will allow us to establish a rigorous idea of what it means for a function to have a limit or to be continuous.

Then we will study differentiability as well as some related theorems often seen in first-semester calculus. Near the end of the semester, we will study sequences and series of functions, and then we will define the Riemann integral and study its properties.

Even though some of the material will be familiar to students, we will study things at a much deeper level, emphasizing mathematical rigor.

Course Load: Oberlin College complies with federal regulations defining a credit hour. In this course, all students are expected to have 12 hours per week of academically engaged time throughout the semester. This amounts to 9 hours per week of additional academic work outside of lectures.

*A free PDF version of Abbott's book will be made available to students.

Grade Items:

Homework: There will be weekly homework assignments. The lowest homework grade will be dropped at the end of the semester.

Students are expected to complete the assignments on their own. However, collaboration with classmates *before the write-up* is acceptable and encouraged, as long as each student writes and submits their own work. Collaboration during the write-up stage of an assignment, or handing in an assignment that is identical to a fellow classmate's work, is cheating and may result in a grade of zero for the assignment.

Exams: There will be two midterm exams (part in-class, part take-home) and a final exam.

Grading Policy: Course grades will be based on the grade items above. Every student's grades are a reflection of the student's mastery of the course material and the student's ability to communicate that mastery through written work.

Earning 90%, 80%, and 70% of the total points in the course will result in course letter grades *no stricter than* A-, B-, and C-, respectively. The cut-offs between letter grades may be

relaxed at the instructor's discretion, depending on the distribution of course numeric grades. This grading scheme rewards hard work, leaving little room for miraculous recovery.

Category	Grade Basis	Weight (each)	Weight (total)
Homework	lowest dropped		30%
Exams ($\times 2$)		22%	44%
Final Exam			26%
Total			100%

Technology:

L^AT_EX: Pronounced either "lay-tek" or "law-tek," this markup language is the standard typesetting program used in many scientific disciplines, primarily in mathematics.

At the beginning of the semester, students will be given a brief introduction on how to create documents using L^AT_EX. After this introduction, students will be required to use L^AT_EX for all of their written work in the course. Templates of L^AT_EX files will be provided.

Slack: This is an online communication platform that functions as a digital classroom community (with students supporting each others' learning) and as a searchable platform for messaging and content sharing.

Schedule: A tentative schedule can be found in the course's Slack workspace. It will be updated frequently.

Course Help: Studying mathematics, especially at the 300-level, can be difficult. Here is some advice:

- *Reading:* The relevant material should be read *before* lecture. Try to read and understand every statement mentioned in all of the examples and proofs. If necessary, reread the same material after lecture.
- *Participation:* Attend every lecture, and ask questions (interruptions are highly encouraged).
- *Homework:* Begin it immediately after lecture, doing as much as you can *on your own* for the first few days that it is assigned. During this period, you should not be discussing solutions with others. Once you have completed all that you can, you may discuss the problems with one or more classmates to get further help.
- *Peer support:* Talk to your classmates about the material either in person or on the Slack workspace.
- *Online solutions:* Do **not** search for homework solutions online. This creates a destructive habit; it also violates the Honor Code.

Attendance, Make-Up Policy: Students should understand the importance of attending lectures and doing the assigned work. A student who misses a lecture is responsible for any announcements made during that time. To determine what they missed, they should consult the Slack workspace or talk to a classmate. **Late homework is not accepted.** A legitimate absence due to a recognized Oberlin-related activity, a religious holiday, a verifiable illness, or an emergency will be reviewed on an individual basis. Concerning the exams, if a student must miss one, then they must obtain permission from the instructor in advance. With that said, **students who are sick should notify the instructor and stay home.**

Accommodations: Oberlin College is committed to providing equitable access to learning opportunities for all students. If you have a disability and are seeking accommodations, please contact the Disability Resources at the Center for Student Success. All requests for accommodations must go through that office. You should also contact the instructor *at least two weeks* before the accommodations are needed.

Scholastic Dishonesty: Forms of scholastic dishonesty that violate the Honor Code include: searching for homework solutions online; cheating on exams; taking or using past/present exam materials without instructor permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain grades dishonestly.

Collaboration during the write-up stage of a homework assignment, or handing in an assignment that is practically identical to a fellow classmate's work, is cheating and may result in a grade of zero for the assignment. More specifically, when collaborating with classmates, students are not permitted to share their fully worked-out solutions to the homework problems.

All students are expected to follow the Honor Code. If it is determined that a student has cheated on a course grade item, then the student will receive an automatic grade of zero for that item. Moreover, depending on the severity of the cheating, the student may be given a grade of F for the course and may face additional sanctions from Oberlin College.