

MATH 1010- ANALYSIS: FUNCTIONS OF ONE VARIABLE

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Text: “Elementary Analysis: The Theory of Calculus” (Second Edition) by Kenneth A. Ross Available free online at: <https://link.springer.com/book/10.1007%2F978-1-4614-6271-2>

Supplementary handouts will be uploaded to Canvas.

Prerequisites: Calculus. Linear algebra may be taken concurrently. This course is a steppingstone to many higher-level courses.

General goals: Understanding logical constructions, practice in constructing mathematical proofs, understanding the basic foundations of calculus, and learning some more advanced concepts in analysis. This is a proof-based course.

Syllabus:

1. REAL NUMBERS. Sets and quantifiers. \mathbb{N} , \mathbb{Q} , \mathbb{R} . Completeness and construction of \mathbb{R} .
2. SEQUENCES. Limits and limit theorems for sequences. Cauchy sequences, subsequences, \limsup and \liminf . Infinite series and convergence tests.
3. CONTINUITY. Properties of continuous functions. Uniform continuity. Limits of functions.
4. SEQUENCES AND SERIES OF FUNCTIONS. Uniform convergence of sequences. Uniform convergence of series. Power series.
5. DIFFERENTIATION. Basics, mean value theorem, Taylor’s theorem. Uniform convergence and differentiation.
6. INTEGRATION. Riemann integral, fundamental theorem of calculus. Uniform convergence and integration.
7. OPTIONAL TOPICS (if time permits).

Online lectures: The course is offered fully online. Live lectures will be broadcast from 2pm-2:50pm (EST) MWF via Zoom with link posted on Canvas. All lectures will be recorded and posted on Canvas after each class. However, you are strongly encouraged to attend live lectures, ask questions

and join discussions.

Office hours: Instructor and Teaching Assistant will hold weekly office hours. The times and Zoom links will be posted on Canvas.

Homework: Homework is an integral part of the course. It is collected weekly through Gradescope and will be partially graded. After each class you should try to do the homework problems as soon as the relevant content is covered. It is crucial to do the homework carefully with mathematical simplicity and precision. In order to ensure that assignments can be graded promptly, *late assignments will not be accepted under any circumstances*. The two lowest homework grades will be dropped.

You are encouraged to discuss the homework with fellow students, but you must write up the assignments on your own. Your grader will be giving feedback on the structure of your assignments, so that you can sharpen your proof-writing skill.

Exams: This course has two midterm exams and a final exam, all of which will be administered online. The 14-hour midterm exam windows are scheduled to begin on the evenings of Friday, June 18 and Friday, July 23. The 24-hour final exam window is tentatively scheduled to begin on Tuesday, August 10. Students who are unavailable during an entire exam window will need to notify us in advance.

You will download the exam file at the beginning of the session, and you will be able to scan and submit solutions written on the printed problems, or solutions written on your own blank paper. Exams are **partially open-book**. This means you are allowed to use some resources but not others.

You are ALLOWED to use:

- The textbook and handouts for this course
- Notes you have taken yourself during this course
- Solutions you have created yourself when solving problems in this course

You are NOT ALLOWED to use:

- Calculators or other calculating devices
- Websites, apps, or other electronic/internet references
- Communication with other people
- Books or publications other than the course textbook
- Notes or solutions from other courses
- Notes or solutions created by other people

Grading: Your final grade for the course will be determined based on a numerical weighted average calculated as follows:

- 25 %– Homework (the lowest two dropped)
- 20 % – Midterm 1

- 20 % – Midterm 2
- 35 %– Final exam.

Your homework assignments and exams will be assessed not only based on correctness but also on the structure of solutions.

Individual grades are not curved. However, cutoffs between letter grades are not determined until the end of the semester. The purpose of this is to give us the flexibility to give higher letter grades to students who come close to the traditional cutoffs. On the other hand, the following rules are fixed

- The cutoff between C and NC will be no higher than 65%
- The cutoff between B and C will be no higher than 80%,
- The cutoff between A and B will be no higher than 90%.

Academic Integrity: Brown University is committed to the highest standard of academic integrity. Any student who engages in any form of cheating, plagiarism and misrepresentation of facts will receive at minimum a grade of zero for the paper in question. It is your responsibility to read and understand The Academic Code.

Expectations and Advice:

You should read the assigned material before each class.

If this is your first proof-based course, it is absolutely normal if you struggle in the beginning. You are thus strongly encouraged to attend live lectures and office hours, which are the best opportunities to ask questions. Make sure that you understand the material covered in a class before moving on to the next one.

Careful understanding of definitions is crucial for this course. Always give your own examples after each definition.

There will be a lot of theorems that are stated and rigorously proved. Understanding a theorem includes not only the literal statement but also its meaning and applicability. Very often, ideas used to prove a theorem can be useful in other theorems/problems.

Do not take for granted any fact unless you are told so. Do not write any statement that you cannot explain to your grader and instructor. When you write a solution, imagine you are writing it to publish in an undergraduate textbook!

There is often more than one way to solve a problem. Choose the method that makes the most sense to you rather than the method used by other students or books. After finishing your own proof, compare it with other proofs and criticize.

By the end of the course, you should be able to write well organized rigorous mathematical proofs.

Resources for Help:

Your instructor and TA both hold office hours on Zoom. Information on timing and how to access these sessions will be available on Canvas.

Your instructor and TA are both available by e-mail, which may lead to a quicker resolution than waiting for office hours.

The math department operates the Math Resource Center, a walk-in help center with sessions throughout the week. MRC sessions can be accessed virtually this semester.

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