Math 104: Introduction to Analysis

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Office Hours: Tuesday and Thursday 1-2pm in Evans 913, Wednesday 3-4pm on zoom

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Office Hours: Monday 2-5pm, Tuesday 12-2pm, Friday 2-4pm in Evans 747, Wednesday 12-3pm on zoom

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Lecture
Tuesday, Thursday 3:30pm-5:00pm in Etcheverry 3109. Tuesday 1/18/22 through Thursday 4/28/22.

Textbook
Elementary Analysis: The Theory of Calculus
Kenneth A. Ross, Springer, ISBN : 9781461462705
Available to download through the UC Berkeley library at
`https://search.library.berkeley.edu/permalink/01UCS_BER/1thfj9n/alma991004481749706532`

Additional Reading:

- *Principles of Mathematical Analysis*, Walter Rudin
- Michael Hutchings' notes on how to prove things: `https://math.berkeley.edu/~hutching/teach/proofs.pdf`

Course Content
We will study real numbers, metric spaces, sequences, continuous functions, differentiation, integration, and sequences of functions. See the schedule below for an approximate list of topics. We will study the language and tools of analysis and how to use them to prove things.

Most, but not all, of the content we will cover is in the textbook. We will cover most, but not all, of the content in the textbook. Order and style of presentation will differ from the textbook, but I will indicate where to find the relevant sections (see the schedule below). Homework and exams will cover precisely the material covered in class. I will post a brief summary of each lecture. The summaries will not have details, examples, or proofs, but they can serve as a reference for all of the concepts covered. Neither summaries nor the textbook can completely replace lecture.

Lecture structure
I will present definitions, concepts, and theorems, some with proof, and work through examples. Many of the proofs and examples will be similar the the ones found on homework and exam questions. I will illustrate methods and styles of high quality solutions.

I hope to encourage an open and interactive classroom. Please ask any questions at any time out of curiosity or confusion. Acknowledging and working through gaps in understanding is the best way to learn mathematics. It is likely that some of your classmates have the same question, and you are doing everyone a favor by asking. I will ask questions as well, to check understanding and keep us engaged with the material. I encourage you to try to answer, even if you are not completely sure. Trying ideas and making mistakes is an important park of learning and doing mathematics, and there will be absolutely no problems with nor repercussions for an incorrect answer. I will call on students who are volunteering, and never put anyone on the spot.

In order to succeed in this course, you should come to every lecture. If you cannot come to lecture for medical reasons or other emergency, please reach out to me to discuss catching up.

Homework
There will be 12 homework assignments. Homework problems will be posted on bCourses, gradescope, and the class webpage on Tuesdays. Solutions will be **due the following Tuesday, uploaded to gradescope by 10am**. Typed work or scans of neat handwritten work are both fine. You will be asked to match the pages of your submission to the assigned problems. The first HW will be due on 2/1. There will be no HW due on 3/15 or 3/22. HW 12 will be due on 5/5. **No late homework will be accepted**. The two lowest homework scores will be dropped. Working together is encouraged, but the homework you hand in must be written up by you in your own words or it will receive no credit. Two or three HW problems each week will be graded in detail, and the remaining HW problems will be checked for completion. **In order to succeed in this course, you should complete and understand every homework problem yourself, to the best of your ability, even if you do so after the homework is due, or after it is returned.**

Exams
There will be one midterm and one final exam, both in person. No electronic devices or outside materials will be allowed during the exams.

- Midterm, Thursday 3/10/21, in class, 3:30pm-5pm.
- Final Exam, Friday 5/13/22, location TBA, 7pm-10pm.

Grading

Final Grades will be determined by : Homework 30%, Midterm 30%, Final Exam 40%. Grades will be posted regularly on bCourses, and any mistakes should be reported immediately.

Communication and Help

For logistical questions and very brief/simple mathematics questions, please email me. For any mathematics question please come to my office hours, our GSI office hours, or send me an email to set up an individual meeting. Feel free to email me to set up an individual meeting to discuss any concerns or other questions as well.

Other Resources

Depending on availability this semester, there may be drop in tutoring for math 104 at the Student Learning Center:
`https://slc.berkeley.edu/programs/mathematics-and-statistics/drop-tutoring`

Follow this link for resources on integrity, accommodations and support in various areas of student life:
`https://evcp.berkeley.edu/programs-resources/academic-accommodations-hub`

Follow this link for help getting the technology you need:
`https://technology.berkeley.edu/STEP`

UC Berkeley is committed to creating a learning environment that meets the needs of its diverse student body. If you anticipate or experience any barriers to learning in this course, please feel welcome to discuss your concerns with me.

If you have a disability, or think you may have a disability, you can work with the Disabled Students' Program (DSP) to request an official accommodation. The Disabled Students' Program (DSP) is the campus office responsible for authorizing disability-related academic accommodations, in cooperation with the students themselves and their instructors. You can find more information about DSP, including contact information and the application process here: `https://dsp.berkeley.edu`. If you have already been approved for accommodations through DSP, please meet with me so we can develop an implementation plan together.

Tentative Schedule (subject to change)

Date	Topic	Section in Ross
Tu 1/18	Numbers	§1, 3
Th 1/20	Completeness	§4
Tu 1/25	Completeness II	§4
Th 1/27	Sequences and limits	§7 – 8
Tu 2/1	Limit theorems	§9
Th 2/3	Convergence theorems	§10
Tu 2/8	lim sup and lim inf	§10 – 11
Th 2/10	Subsequences	§12
Tu 2/15	Open, closed and compact sets	§13
Th 2/17	Metric Spaces	§13
Tu 2/22	Series	§14 – 15
Th 2/24	Continuous functions and limits	§17, §20
Tu 3/1	Properties of continuous functions	§18
Th 3/3	Uniform continuity	§19
Tu 3/8	Continuity: open, closed and compact sets	§21
Th 3/10	**Midterm**	
Tu 3/15	Connected Sets	§22
Th 3/17	Differentiation	§28
Tu 3/22	**No Class**	
Th 3/24	**No Class**	
Tu 3/29	Mean value theorem	§29
Th 3/31	L'Hospital's rule	§30
Tu 4/5	Integration	§32
Th 4/7	Properties of the integral	§33
Tu 4/12	Fundamental theorem of calculus	§34
Th 4/14	Uniform convergence	§24
Tu 4/19	Properties of uniform convergence	§25
Th 4/21	Power Series	§23
Tu 4/26	Differentiating and integrating power series	§26
Th 4/28	Taylor's theorem	§31