18.100B REAL ANALYSIS

Fall 2020

Class schedule. Tuesday and Thursday 9:35 - 10:55 am EST.

Final. Friday 12/18, 9 am - 12 pm EST.

Website. `https://canvas.mit.edu/courses/3665`

Instructor. Tobias Holck Colding (colding@math.mit.edu)

Undergraduate TAs. Andrew Lin (lindrew@mit.edu) and Katie Gravel (kgravel@mit.edu).

Graduate TA. Donghao Wang (donghaow@mit.edu).

Office hours. All held at `https://mit.zoom.us/j/97471199889`:

Andrew: Tuesday 6-7 pm EST and Saturday 11 am-12 pm EST.

Katie: Monday 8-9 pm EST and Wednesday 5-6 pm EST.

Donghao: Wednesday 8-9 pm EST.

Toby: Monday 7-8 am EST.

Navigating Resources at MIT.

`http://bit.ly/mitnavigatingresources`

`https://registrar.mit.edu/classes-grades-evaluations/examinations/final-exam-schedule`

Textbooks.

- *Principles of Mathematical Analysis*, by W. Rudin. The latest edition is the 1976 third edition. That's not available to purchase as an ebook, but it has been digitized by the Internet Archive:
  `https://archive-org.libproxy.mit.edu/details/principlesofmath00rudi`
  You have to create a free personal Internet Archive account. You can then log in and borrow the book (for one hour at a time, looks like). Details are here:
  `https://help.archive.org/hc/en-us/articles/360016554912-Borrowing-From-The-Lending-Library`
  The 1964 2nd edition has been digitized by HathiTrust, and is available here:
  `https://catalog.hathitrust.org/api/volumes/oclc/527796.html`
  For this, click the yellow log in button in the corner to log in via Touchstone. You'll then see a link that says temporary access; click it to check out the book. Again, it can be borrowed for one hour, but you can renew it as many times as necessary. MIT doesn't have unlimited access, so everybody cannot view this at the same time. MIT does have print copies in the library.
- *Elementary Real Analysis, 2nd edition* (TBB), by B.S. Thomson, J.B. Bruckner, and A.M. Bruckner. TBB can be downloaded at:
  `classicalrealanalysis.info/com/documents/TBB-AllChapters-Landscape.pdf`
  (screen-optimized)
  `classicalrealanalysis.info/com/documents/TBB-AllChapters-Portrait.pdf`
  (print-optimized)

Course description. This course gives an introduction to analysis, and the goal is twofolds:

1. To learn how to prove mathematical theorems in analysis and how to write proofs.
2. To prove theorems in calculus in a rigorous way.

The course will start with real numbers, sequences and series, and point-set topology. We will continue on with single variable functions, continuity, derivatives and integrals. After that, we will move on to multivariable functions.

Problem Sets. The PSets will be assigned weekly on Canvas. They should be submitted on Thursdays by 4PM EST on Canvas. The graded assignments will be returned the following Thursday. The lowest PSet grade will be dropped.

We are planning on having 10 sets of homework. The first homework is due September 17, the 9th homework will be due before Thanksgiving break on November 19, and the 10th (last) homework is due on December 3.

Collaboration. Collaboration on homework is very much encouraged. However, no collaboration on the midterm or final is allowed. Also, even though collaboration on homework is encouraged, everyone should hand in their own personal sets of homework.

Exams. There will be one "in-class" midterm on Thursday October 22. The midterm exam is online to be taken during the class time. The exam will be loaded to Canvas and you are expected to write it and upload your answers. For those of you whose time zone prohibits you taking the exam during the class time EDT, then an alternative time is arranged. We will have an honesty pledge on the 1st page to help with academic integrity and the exams will be open book.

The final exam will be three hours and take place on December 18 from 9-12.

Course grade. PSets: (50%) 1.5-hour midterm: (20%), 3-hour final: (30%)

Late Homework/Makeup exam. Late homework submissions within one week will be graded, but they will not be graded if they are submitted even later. For unexcused late submissions, scores are multiplied by 1/2. To be excused, you must obtain a note from the Student Support Services (S3) (walk to room 5-104 or call 617-253-4861).

If you are sick or have other conflicts (e.g. sports games) to attending the midterm or final, please email me (colding@math.mit.edu) ASAP. Makeup exam will only be granted if you have a notice from S3 or other justification documents.

Lectures. The lectures will be given live on zoom and will be recorded. Links to lectures as well as the recordings can be found on the Canvas website.

Inclusiveness. We value an inclusive environment. If you need disability accommodations to access this class, please communicate with us early in the semester. If you have an accommodation letter, please forward a PDF copy to myself, the TAs, as well as Elise Brown (elisegb@mit.edu) so that we can understand your needs and implement your approved accommodations. If you have not yet been approved for accommodations, please contact Disability and Access Services at das-student@mit.edu to learn about their procedures. We encourage you to do so early in the term to allow sufficient time for implementation of services/accommodations that you may need.

Course schedule (updated October 25):

		Date	Rudin	TBB	Material
1	T	Sep 1	Ch 1 (p.1-7)	1.1-1.4	Introduction to Real numbers
2	R	Sep 3	Ch 1 (p.7-11)	1.5-1.6	Introduction to Real numbers
3	T	Sep 8	Ch 1 (p.11-12)	2.1-2.2, 2.4	Extended reals; Sequences
4	R	Sep 10	Ch 3 (p.47-51)	2.7, 2.9, 2.11	Limits; Monotone Convergence theorem; Cauchy sequences
5	T	Sep 15	Ch 3 (p. 51-57)	2.11-2.12, 3.4	Bolzano-Weierstrass theorem; Cauchy sequences; Series
6	R	Sep 17	Ch 3 (p.65-69)	2.11, 3.5-3.6	Convergence tests for series; Bolzano-Weierstrass theorem
7	T	Sep 22	Ch 3 (p.69-70)	2.13, 10.2, 5.4	Limsup and liminf; Power series; Continuous functions
8	R	Sep 24	Ch 4 (p. 85-89)	5.5	Continuous functions, Exponential function
9	T	Sep 29		5.4, 13.1-2	Extreme and Intermediate Value Theorem; Metric spaces
10	R	Oct 1	Ch 2 (p.26-29)	13.4	Convergence in metric spaces; Operations on sets
11	T	Oct 6	Ch 2 (p.30-39)	5.1-5.2	Open and closed sets; Compactness
12	R	Oct 8	Ch 2 (p.30-39)		Sequential compactness; Heine-Borel theorem
	T	Oct 13			No class (Mondays schedule)
13	R	Oct 15	Ch 2 (p.39-40)	7.2, 7.3	Compact sets; Continuous functions; Derivatives
14	T	Oct 20			Review
15	R	Oct 22			"In-class" midterm
16	T	Oct 27	Ch 5 (p.107-111)	7.6, 7.11-12	Mean Value Theorem; L'Hospital's Rule; Taylor expansion
17	R	Oct 29	Ch 6 (p.120-122)	8.6	Riemann Integrals
18	T	Nov 3	Ch 6 (p.122-133)	8.3	Integrable functions
19	R	Nov 5	Ch 6 (p.133-136)	8.3	Fundamental Theorem of Calculus
20	T	Nov 10	Ch 7 (p.143-151)	9.2-9.4	Pointwise convergence; Uniform convergence
21	R	Nov 12	Ch 7 (p.151-154)	9.5-9.6	Integrals and derivatives under uniform convergence
22	T	Nov 17	Ch 9 (p.204-220)	12.2	Multivariable functions; total and partial derivatives
23	R	Nov 19	Ch 9 (p. 221-228)	12.6	Inverse Function Theorem I
		Nov 21-29			Thanksgiving vacation
24	T	Dec 1	Ch 9 (p. 221-228)	12.6	Inverse Function Theorem II
25	R	Dec 3	Ch 9 (p. 221-228)	12.6	Implicit Function Theorem III
26	T	Dec 8			Review
		Dec 18			Final (9 am-noon EST, 3 pm-6 pm, and 9 pm-midnight)