Math171: Fundamental Concepts of Analysis

Syllabus

Updated: October 18, 2024

1 Course Description

In this class, we will study the foundations of real analysis, at the level of generality up to metric spaces. This involves differential calculus, Riemann integrals, continuity and compactness in metric spaces, and basic point set topology. This class is recommended for Mathematics majors and required of honors Mathematics majors. It is a more advanced and general version of Math 115. It has the following prerequisites: Math 61CM, or 61DM, or Math 51 and Math 115. There is a writing requirement for this class: WIM guidence.

Class Times:

Days	Time	Location
Tuesdays, Thurdays	12pm - 1:30pm	Building 200, Room 205

2 Instructors

Principal Instructor: Joseph Miller

Office Hours: Wednesdays 2pm - 5pm, Building 380, Room 384-V.

Email: jkm314@stanford.edu

Teaching Assistants:

- *Name*: Elina Chatzidimitriou

  Office Hours: Mondays 7-8pm, Thursdays 5-6pm, Fridays 10:30-11:30am in Building 380, Room 380S

  Email: elinach@stanford.edu

- *Name*: Ruochuan Xu

  Office Hours: Tuesdays 3pm - 4:30pm, Wednesday 5-5:45pm, Thursday 3-3:45pm in Building 380, Room 380T

  Email: ruochuan@stanford.edu

3 Course Materials

Textbooks: The main reference for this class will be *Foundations of Mathematical Analysis* by Johnsonbaugh and Pfaffenberger. The secondary references are *Principles of Mathematical Analysis* by Rudin, and *Counterexamples in Analysis* by Gelbaum and Olmsted. We will not follow any textbook exactly, but these are all solid resources. If you use any reference on the assignments, you must cite your sources; See Section 6.

Websites: We will be using the following websites:

- Canvas: View assignments, class announcements, and class handouts.
- Gradescope: Submit homework and view exam grades.
- Overleaf: The recommended LaTeX editor for typesetting assignments.

4 Assignments & Exams

Homework Assignments: There will be 8 homework assignments due Fridays at 5pm on Gradescope. See Section 5 and Section 6 for details. It is highly recommended to use the typesetting language LaTeX to submit homework, and templates can be found on Canvas.

Midterm Exam: There will be an in-person, closed book exam scheduled for Wednesday, October 23rd at 6:30pm - 8pm. The exam room will be assigned later in the quarter. You will be allowed one 4"x6" index card (front and back) during the exam.

Final Exam: The final exam will be held on Friday, December 13th from 12:15pm - 3:15pm. The exam room will be assigned later in the quarter. You will be allowed one 4"x6" index card (front and back) during the exam.

Writing Project: You will be asked to write 5-10 pages of expository mathematics on a topic in analysis. A list of topics to choose from will be given around Week 3. A first draft will be due at the end of Week 7, and the final draft due at the last week. See Section 5 for details. This is part of the Writing In Mathematics (WIM) requirement.

Grading: The grade will be based on the following formula,

$$\text{Final Score} = 0.2 \times (\text{Writing Project}) + 0.2 \times (\text{Midterm}) + 0.3 \times (\text{Final}) + 0.3 \times (\text{Homework}),$$

where the writing project score is determined by

$$\text{Writing Project} = 0.25 \times (\text{First Draft}) + 0.75 \times (\text{Final Draft}).$$

5 Course Schedule

Homework will be due at 5pm on Gradescope on Fridays. The drafts of the writing project are due on Gradescope at 11:59pm on the indicated Saturday. We may only roughly follow the topics each week.

Week	Topics	Assignments
1	Introduction, Sets, Functions, $\mathbb{R}$	
2	Integers, Rationals, Countability, Sequences	HW 1, **October 4th**
3	Limits, Boundedness, Divergence, Monotonicity	HW 2, **October 11th**
4	Bolzano-Weierstrass, Cauchy, lim sup, Series	HW 3, **October 18th**
5	Convergence Tests, Power Series	**Midterm: October 23rd @ 6:30-8pm**
6	Function Limits, Continuity, Heine-Borel	HW 4, **November 1st**
7	Metric Spaces, Sequences, Open, Closed Sets	HW 5, **November 8th** First Draft: **November 9th @ 11:59pm**
8	Compactness, Connectedness, Completeness	HW 6, **November 15th**
9	Differential Calculus, Riemann-Stieltjes Basics	HW 7, **November 22nd**
10	Thanksgiving break	
11	Advanced Topics	HW 8, **December 6th** Final Draft: **December 7th @ 11:59pm**
12	Exam Week	**Final Exam:** **December 13th @ 12pm - 3:15pm**

6 Course Policies & Student Responsibilities

Attendance: Not required, but highly recommended.

Homework Policy: The lowest homework score will be dropped. No late homeworks will be accepted. Regrades may be requested via Gradescope within 48hrs of recieving the grade.

Plagiarism and Collaboration: Any assignment you upload must be written only by yourself. If you collaborate with your classmates or find an answer to a problem using an external source you must cite your sources. See the Stanford Honor Code for more details.

Final Exam Conflicts: It is your responsibility to make sure that you will be available at the announced final exam time and that you do not have two exams at the same time. Stanford's policy delcares that you accept the final exam schedule when you continue in the classes past the Final Study List deadline.

Alternate-Time Midterm: Students with course or competition-related exam conflicts must fill out the Google Form goto.stanford.edu/math171oae to make arrangements for an alternate exam sitting on the same day. No other schedule conflicts are accommodated.

Make-up Exams: There will be no make-up exams of any type. In order to be eligible for an incomplete ("I"), you must email the Principle Instructor before the last class meeting.

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Access & Accommodations: Stanford is committed to providing equal educational opportunities for disabled students. Disabled students are a valued and essential part of the Stanford community. We welcome you to our class. If you experience disability, please register with the Office of Accessible Education (OAE). Professional staff will evaluate your needs, support appropriate and reasonable accommodations, and prepare an Academic Accommodation Letter for faculty. To get started, or to re-initiate services, please visit oae.stanford.edu.

If you already have an Academic Accommodation Letter, please use the Google Form link goto.stanford.edu/math171oae to upload it and detail the specific accommodations you will need in this course. Letters are preferred by the end of week 2, and at least two weeks in advance of any exam, so we may partner with you and OAE to identify any barriers to access and inclusion that might be encountered in your experience of this course. New accommodation letters, or revised letters, are welcome throughout the quarter; please note that there may be constraints in fulfilling last-minute requests.

Resilient Teaching: Stanford as an institution is committed to the highest quality education, and as your teaching team, our first priority is to uphold your educational experience. To that end we are committed to following the syllabus as written here, including through short or long-term disruptions, such as public health emergencies, natural disasters, or protests and demonstrations. However, there may be extenuating circumstances that necessitate some changes. Should adjustments be necessary we will communicate clearly and promptly to ensure you understand the expectations and are positioned for successful learning.