Course Syllabus

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MATH 597 Winter 2025

Instructor: Professor Mattias Jonsson (mattiasj@umich.edu (mailto:mattiasj@umich.edu)). Office: EH 3076

GSI: Han Le (hanle@umich.edu (mailto:hanle@umich.edu))

Classes: MWF 11:00 -11:50 am in EH 1084

Office hours: TBA

Main Textbook: Real Analysis by Gerald Folland (ISBN 978-0471317166)

Supplementary Textbooks:

- An Introduction of Measure Theory by Terence Tao (online version of the book at author's website (https://terrytao.wordpress.com/books/an-introduction-to-measure-theory/)).
- Measure, Integration & Real Analysis by Sheldon Axler (online version of the book at author's website (https://measure.axler.net/)).

Other Books:

- Real Analysis: Measure Theory, Integration, and Hilbert Spaces by E. Stein and R. Shakarchi (ISBN 978-0691113869)
- Real Analysis by Royden and Fitzpatrick (ISBN 978-0134689494)

Homework: There will be (roughly) weekly homework assignments. The homework sets play a vital role in this course. Students are encouraged to discuss with other students, but they have to write their own solutions and submit individually. Show your work in your solutions. Submit your homework on Gradescope (see the left tab - you will need to scan a pdf file (https://help.gradescope.com/article/0chl25eed3-student-scan-mobile-device) of your solution and upload it (https://help.gradescope.com/article/ccbpppziu9-student-submit-work#submitting_a_pdf) . IMPORTANT: MAKE SURE TO ASSIGN PAGES to QUESTIONS when you submit on Gradescope.) Late submissions are not accepted unless there is a compelling reason. The lowest homework score will be dropped.

Grade: Homework (35%), Midterm (25%), Final (40%). See the historical grade distribution. (https://atlas.ai.umich.edu/course/MATH%20597/)

Midterm exam: The midterm exam will take place on Wednesday February 26, 6-8pm (120 minutes). The exam is a closed-book test. Location: TBA.

Final exam: The final exam will take place on Friday April 25 4:00-6:00pm (120 minutes). The exam is a closed-book test. The final exam is cumulative. Location TBA.

Course Description:
MATH 597 is a theoretical and rigorous course on real analysis at the level of the first year math Ph.D. students. It is one of the alpha courses for the beginning math Ph.D. students. Highly advanced undergraduate math students

and students from other areas may take this course but they should expect that the workload is heavy and the pace is fast.

Prerequisites: The student should have strong background in basic analysis (Advanced Calculus; MATH 451 or 295 or 297) and linear algebra (MATH 217 or 296), and should have taken several advanced abstract math courses. The student should be familiar with mathematical logic, some basic set theory, and basic point-set topology (at least metric spaces). MATH 590 (Introduction to Topology) is encouraged before taking this course. Additional knowledge in analysis (such as differential equations, Fourier series, probability, complex analysis, etc) will be helpful, but is not required.

Topics to be covered:
We will roughly follow [Folland] covering Chapters 1, 2, 3 and some of Chapters 5, 6, 8. For some parts, we may follow [Tao] or [Axler].

1. Abstract measures (including the Caratheodory extension theorem, the Hahn-Kolmogorov theorem, and the construction of Lebesgue-Stieltjes measures on the real line)
2. Integration (including dominated convergence theorem)
3. Product measures (including Tonelli-Fubini theorem)
4. Differentiation on Euclidean space (including Hardy-Littlewood maximal function and Lebesgue differentiation theorem)
5. Functions of bounded variation and almost everywhere differentiability (including the fundamental theorem of Calculus)
6. Signed and complex measures (including the Lebesgue-Radon-Nikodym theorem)
7. Banach spaces and Hilbert spaces
8. Lp spaces
9. Introduction of Fourier analysis

General comments:

- Use office hours frequently.
- This course is a fast-paced course with an extensive homework load and in-class exams. The students are expected to keep up with the class by reading the textbook and solving the exercise problems from the book.
- It is expected that students attend all classes, follow lectures, read the textbook, and do all the homework assignments.
- No cell phones are allowed during class.
- Discussions and collaborations among students in solving homework problems are highly encouraged. However, you must write down and submit your own solutions.
- No late homework is accepted unless there is a compelling reason. If you have an excuse, let me know in advance.
- Calculators, books, and notes are not allowed during the exams. If the exam time overlaps with another exam of yours, let me know well in advance. If you need any special accommodations for the exam, also let me know in advance.
- Enjoy the class!

Accommodations for Students with Disabilities: If you think you need an accommodation for a disability, please let me know (by email) as soon as possible. In particular, a Verified Individualized Services and Accommodations (VISA) form must be provided to me so that I can accommodate your request. The form should be given to me as

early as possible so that there is a time for me to make an arrangement for the exam. The **Services for Students with Disabilities (SSD) (https://ssd.umich.edu/)** Office issues VISA forms.

Faculty/student interactions: please see the document **here (https://facultysenate.umich.edu/resources/)** .

Course Summary:

Date	Details	Due
Fri Jan 10, 2025	**HW0** (https://umich.instructure.com/courses/742104/assignments/2566439)	due by 11:59pm
Fri Jan 17, 2025	**HW1** (https://umich.instructure.com/courses/742104/assignments/2566440)	due by 11:59pm