

MATH 8803 SYLLABUS

FALL 2021

Course Number: Math 8803 HEI

Course Name: Measure Theory for Engineers

Lecture Time: TuTh 2:00-3:15 p.m.

Lecture Room: Mason 3132

Instructor: Christopher Heil
Office: Skiles 218D
Email Address: heil@math.gatech.edu

Office Hours: Held virtually through BlueJeans, hours to be announced

Course Web Page: Canvas

Prerequisites: Math 4317 (Analysis I)

First class: Tuesday, August 24, 2020.

Covid.

- Lectures will be given in-person but will be broadcast live via BlueJeans, and the lectures will be recorded and made available on Canvas for later viewing.
- Please attempt to maintain social distancing in the classroom.
- Out of concern for your health and mine, I will wear a mask in the classroom and ask that you give me and your fellow classmates this same consideration. The Centers for Disease Control and Prevention recommends the use of face coverings inside public buildings even by fully vaccinated individuals. I understand that wearing a mask can be an inconvenience, but they have been shown to slow the spread of this virus. Wearing a mask is protection for yourself and a sign of care for the health of others. Your cooperation and understanding on this matter are much appreciated.

- If you have not done so, I encourage you to get vaccinated now. Doing so at Tech is easy and free. We know the vaccines are effective protection against Covid-19, including the new variants, and the best way to protect yourself and others. If you are unvaccinated, you are at risk of contracting Covid-19 and infecting others, with potentially severe consequences for you or someone else. Please seek medical advice from your healthcare provider or a member of our Stamps Health Services team led by Dr. Ben Holton, if you have doubts or concerns about getting vaccinated.

Objective. The goal of this course is to present an introduction to measure theory and related topics, with a focus on those topics in analysis that we believe are of the most utility in engineering and other sciences.

- This course covers many of the topics that are presented in MATH 6337. However, the material is more focused. Some topics, such as bounded variation and differentiation, that are covered in detail in MATH 6337 will be omitted from MATH 8803. Some topics, such as absolute continuity and the Fundamental Theorem of Calculus, are presented but not covered in detail. Some theorems whose full proofs are presented in MATH 6337 will be stated but not proved in MATH 8803. The theory of Lebesgue measure is first developed in the one-dimensional setting in MATH 8803, though topics in higher dimensions (such as Fubini's and Tonelli's Theorems) are also presented. Abstract measure theory will be covered.
- The appropriate course for Math Ph.D. students is MATH 6337 (Real Analysis I). In particular, students preparing to take the Comprehensive Exam in Analysis should take MATH 6337.
- A student who completes MATH 8803 should be prepared to take other classes for which MATH 6337 is a prerequisite.
- It is intended that you should not receive credit for both MATH 6337 and MATH 8803 HEI.
- This is a proof-based graduate-level course in mathematics that builds on the type of mathematical training that is presented in undergraduate mathematics courses. In particular, a student in this course must be fluent in the topics that are covered in a standard undergraduate real analysis course (such as MATH 4317) in order to be successful in this class.
- Homeworks and exams in MATH 8803 will require rigorous proofs. All assignments in MATH 8803 allow collaboration (exams in MATH 6337 typically do not).

Piazza. Piazza is enabled for for class discussion. You can post questions to me or to the class here. Our class signup link is at: <http://piazza.com/gatech/fall2021/math8803hei>

Lecture Notes: C. Heil, *Measure Theory for Scientists and Engineers* (posted to Canvas).

Chapter 1: A Review of Real Analysis. This covers background material from MATH 4317 and will not be presented in class.

Chapter 2: Lebesgue Measure.

Chapter 3: Measurable Functions and Modes of Convergence.

Chapter 4: The Lebesgue Integral.

Chapter 5: Higher Dimensions and Repeated Integration.

Chapter 6: Abstract Measure Theory.

Comparison Text: The text that is used for MATH 6337 (Real Analysis I) is C. Heil, *Introduction to Real Analysis*.

Ebook available for free from SpringerLink:

<https://link.springer.com/book/10.1007/978-3-030-26903-6>

Additional material available at

<http://people.math.gatech.edu/~heil/real>

These are copyrighted materials. Please be respectful of the author's intellectual property and do not re-post or distribute the Ebook or lecture notes without permission.

Here are some other related books that may be useful as comparison texts.

- Stein and Shakarchi, *Real Analysis*
- Wheeden and Zygmund, *Measure and Integral*
- Folland, *Real Analysis*, 2nd Ed.

Grading. We will have 6 homework assignments and one take-home final exam.

6 Homeworks	25 points each
<u>Final Exam (take home)</u>	<u>50 points</u>
TOTAL	200 points

Letter grades will be based on your accumulated points at the end of the semester, according to standard 90%, 80%, 70%, 60% cutoffs (although I may adjust the cutoffs downward at the end of the semester, depending on class distribution):

180–200	A
160–179	B
140–159	C
120–139	D
0–119	F

At the end of the course, I'll evaluate the class distribution and decide if a curve is needed. I'll only curve *down* from the above cutoffs, not up.

Homework. All assessments will be electronic. Homework assignments will be posted on Canvas, and papers will be submitted electronically through Canvas. A subset of the problems on each assignment will be selected for grading. Late homeworks will not be accepted without advance permission.

Homeworks must be written in clear, complete sentences. You will not receive credit if the grader does not understand your writing.

I encourage you to type your homeworks using TeX or another mathematical typesetting system. I will provide sample TeX files that you can use as templates. Handwritten homeworks are acceptable, but be sure to write only on the *front side* of the page, otherwise bleed-through will be a problem. Use a good scanner to create a pdf file that you can submit through Canvas. Don't try to take pictures of the paper with a phone, it's just not readable.

You are allowed (and encouraged) to work together with other students on the homework, as long as you each *independently* write up your own solutions. You are also allowed (and encouraged) to ask me questions, although you should try to think about the problems before asking.

Academic Dishonesty All students are expected to comply with the Georgia Tech Honor Code. Any evidence of cheating or other violations of the Georgia Tech Honor Code will be submitted directly to the Dean of Students. The institute honor code is available at <http://www.honor.gatech.edu>

Accommodations for Students with Disabilities. If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or <http://disabilityservices.gatech.edu/> as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.