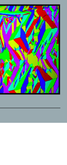
Measure, Integration and Real Analysis



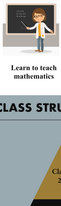
MST 317/617

Dr. John Gemmer: gemmerj@wfu.edu
Office: Manchester 388
Course Website: http://users.wfu.edu/gemmerj/math381F22.html
Canvas: The course syllabus and grades will be posted on Canvas
Office Hours: T 10:00-11:00, W 12:00-2:00, Th 1:00-3:00
Class Meeting Times: TTh 3:30-4:45
Class Location: Seminar room near my office

COURSE DESCRIPTION

In the 19th century it was discovered that there were serious deficiencies with the calculus that was developed by Newton, Leibniz, Lagrange, Euler, etc. Specifically, in the first decade of the 19th century Jean Baptiste Joseph Fourier invented a technique using infinite sums of trigonometric functions, called "Fourier Series", to solve the differential equations of heat conduction. The existence of such a series was met by skepticism for the following reasons: (i) what does it mean for a series of functions to converge, (ii) do all functions have a Fourier series, (iii) how can a sequence of continuous functions converge to a discontinuous function. To address these questions modern analysis, including measure theory, was developed to address such concerns and others. In this course you will learn the basics of measure theory. Specific topics will include a review of Riemann integration, abstract measures, Lebesgue integration, convergence theorems, and product measures. The course will be self paced and graded using a mastery based system (see below). However, I will provide a rough timetable to help you pace yourself throughout the course.

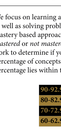
REQUIREMENTS



Prerequisites:
Real Analysis, e.g. MTH 311

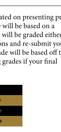
Textbook:
Measure, Integration and Real Analysis (Axler)

OBJECTIVES



Develop expertise in measure theory

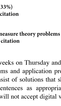
Apply measure theory concepts to applications



Develop Geometric Intuition in Analysis

Learn to teach mathematics

Learn to collaborate



Sharpen proof writing skills

CLASS STRUCTURE

EVALUATION

We focus on learning and mastery. In this course you will be evaluated on presenting proofs as well as solving problems. **There are no exams.** Your entire grade will be based on a mastery based approach. That is, for each category (see below) you will be graded either *mastered* or *not mastered yet*. For problems you can make corrections and re-submit your work to determine if you have mastered the concept. Your final grade will be based off the percentage of concepts mastered. You are guaranteed the following grades if your final percentage lies within the following ranges:

90-92.9: A-	93-100: A	
80-82.9: B-	83-86.9: B	87-89.9: B+
70-72.9: C-	73-76.9: C	77-79.9: C+
60-62.9: D-	63-66.9: D	67-69.9: D+

Presentation of proofs (33%)
In class presentations of proofs from the book

Completion of written proof problems (33%)
Open book, collaboration allowed with citation
Homework is due on Friday in class

Completion of written applications of measure theory problems (33%)
Open book, collaboration allowed with citation
Homework is due on Friday in class

Weekly Homework: New homework problems will be assigned most weeks on Thursday and can be handed in on Fridays. Each homework set will consist of proof problems and application problems. You can resubmit homework as often as you like. Homework must consist of solutions that show all steps, be your own work and be written clearly using complete sentences as appropriate (see homework policy). All homework will be submitted in class on paper. I will not accept digital versions of your homework.

In Class Presentations: Each class period students will have the opportunity to present a proof on the board without using any notes. The catch is that the student can ask questions from other classmates to assist them in the proof. In fact, you should think about this as an opportunity to teach your classmates. So feel free to use the Socratic approach and ask your colleagues what they think are any good ideas, etc. You will be graded on completion for these presentations. I want this to be a nice low stress way for you to get comfortable presenting math.

If you need to miss class due to a university sponsored activity, such as athletics. Please contact the faculty member as soon as possible to reschedule due dates.

COURSE ENVIRONMENT

Names/Pronouns

You **deserve** to be addressed in the manner you prefer. To guarantee that I address you properly, you are welcome to tell me your pronoun(s) and/or preferred name at any time, either in person or via email.

Diversity

We embrace diversity of age, background, beliefs, ethnicity, gender, gender identity, gender expression, national origin, religious affiliation, sexual orientation, and other visible and non-visible categories. **I do not tolerate discrimination.**

Accessibility

I want you to succeed in this course. Wake Forest University provides reasonable accommodations to students with disabilities. If you are in need of an accommodation, then please contact me privately as early in the term as possible. Retroactive accommodations may not be provided. Students requiring accommodations must also consult the Center for Learning, Access, and Student Success(118 Reynolda Hall, 336-758-5929, http://class.wfu.edu). For personal issues, stress, health problems or life circumstances see shs.wfu.edu/. Contact me if you have other special circumstances. **I will find resources for you.**

Title IX

You **deserve** a community free from discrimination, sexual harassment, a hostile environment, sexual assault, domestic violence, dating violence, and stalking. If you experience or know of a Title IX violation, you have many options for support and/or reporting; see titleix.wfu.edu/.

Emergency Fund

You **deserve** a learning environment in which all of your physiological and safety needs are met. If you are experiencing situations in which these needs are not met, e.g. you do not have adequate housing or sufficient food security, the Chaplain's Office has an emergency fund which can provide support: https://chaplain.wfu.edu/care-support/chaplains-emergency-fund/. In situations in which you need immediate assistance there is emergency funding available through the Department of Mathematics and Statistics. If you are in need of emergency help you are encouraged to reach out to a faculty member in the Department of Mathematics and Statistics who will work with the chair of the department to address your needs.

Course Resources

The department has a limited amount of funding for class materials. If you cannot afford class materials, you are encouraged to contact the chair of the department privately as early in the term as possible. Due to the limited amount of funds, students must exhaust all other sources of funding before applying to the department for assistance.

The Honor Code

At Wake Forest, we expect you to behave as honorable citizens of the class, the university, and the world as a whole. When you complete an assignment with your name on it, you are representing that everything you are turning in is your own work. That means that you do not copy from other students, textbooks, or websites. If at any time I become aware of cheating or plagiarism in this course, I will submit the information to the honor council.

COURSE CALENDAR SKETCH

Week 1:
1. 8/23: Intro to course, Lecture on Riemann integration, **Sections 1.A, 1.B**
2. 8/25: Student questions, student lectures, **Section 1.A, 1.B, Homework #1 Assigned.**

Week 2:
1. 8/30: Faculty lecture on outer measures, student questions, student lectures **Section 2.A**
2. 9/01: Student questions, student lectures, **Section 2.A, Homework #2 Assigned.**

Week 3:
1. 9/06: Lecture on measure spaces and functions, student questions, student lectures, **Section 2.B**
2. 9/08: Student questions, student lectures, **Section 2.B, Homework #3 Assigned.**

Week 4:
1. 9/13: Lecture on measures, student questions, student lectures, **Section 2.C,**
2. 9/15: Student questions, student lectures, **Section 2.C, Homework #4 Assigned.**

Week 5:
1. 9/20: Lecture on Lebesgue measure, student questions, student lectures, **Section 2.D**
2. 9/22: Student questions, student lectures, **Section 2.D, Homework #5 Assigned.**

Week 6:
1. 9/27: Lecture on convergence, student questions, student lectures, **Section 2.E**
2. 9/29: Student questions, student lectures, **Section 2.E, Homework #6 Assigned.**

Week 7:
1. 10/04: Lecture on integration, student questions, student lectures, **Section 3.A**
2. 10/06: Student questions, student lectures, **Section 3.A, Homework #7 Assigned.**

Week 8:
1. 10/11: Lecture on limits of integrals, student questions, student lectures, **Section 3.B**
2. 10/13: Student questions, student lectures, **Section 3.B, Homework #8 Assigned.**

Week 9
1. 10/18: Lecture on products of measures, student questions, student lectures, **Section 5.A,**
2. 10/20: Student questions, student lectures, **Section 5.A, Homework #9 Assigned.**

Week 10:
1. 10/25: Lecture on iterated integrals, student questions, student lectures, **Section 5.B,**
2. 10/27: Student questions, student lectures, **Section 5.A, Homework #10 Assigned.**

Week 11:
1. 11/01: Lecture on iterated integrals, student questions, student lectures, **Section 5.B,**
2. 11/03: Student questions, student lectures, **Section 5.B, Homework #11 Assigned.**

Week 12:
1. 11/08: Lebesgue integration in Euclidean space, student questions, student lectures, **Section 5.C,**
2. 11/10: Student questions, student lectures, **Section 5.C, Homework #12 Assigned.**

Week 13:
1. 11/15: Catch up week/bonus topics
2. 11/17: Catch up week/bonus topics

Week 14:
1. 11/22: **Thanksgiving break**
2. 11/24: **Thanksgiving break**

Week 15:
1. 11/29: Catch up week/bonus topics
2. 11/31: Catch up week/bonus topics

Final Exam: None

SUCCESS

Attend class

Participate constantly

Invest time

Concentrate on concepts in addition to calculations

Seek help when needed

Eliminate Virtual Distractions