MATH 4111: Introduction to Analysis

Spring 2021

- **Instructor:** Meric Augat – maugat@wustl.edu
- **Office Hours:** TBA
- **Class Time:** MWF 10AM in St. Louis
- **Classroom:** Online only

- **About the course:** This course is the first part of a rigorous introduction to mathematical analysis. The introductory material will cover the basics of the real and complex number systems, set theory, point-set topology and metric spaces. Following this we are led to sequences and series, continuity, differentiation, integration and sequences of functions. It is unclear whether we will have sufficient time to address all these topics, but my sincere goal is fully address differentiation this semester.

  This is a **proof based** course – competency and familiarity with proofs is absolutely essential! The emphasis is on proving theorems, not on calculation techniques or applications of calculus to other disciplines.

- **Structure:** Each week I will record at least one lecture video for each day of class (this is an almost necessary step due to time zone issues). Each Monday and Wednesday of the week during the assigned class time, I will have office hours/discussion periods to go over lecture material, etc. Each Friday of the week during the assigned class time, there will be an explicit open discussion period aimed at facilitating group discussion. Since we will often have assignments due on Sundays, I want to encourage everyone to openly discuss aspects of the course and the assignments – I have no issue with open discussion of the homework and quiz problems as long as everyone is actively participating. I will do my best during these Friday sessions to act merely as guide, and I expect you – the students – to lead the discussion.

  This structure is a small experiment, and if I find the Friday sessions are not going as I had hoped, then I will modify things to try and get the results I want – whether that is scrubbing the idea in total, or introducing an incentive/disincentive for certain behavior.

- **Prerequisites:** Math 310 or instructor permission.

- **Textbook:** *Principals of Mathematical Analysis*, by Walter Rudin. This book is almost surely the most assigned book for undergraduate analysis and it has quite the reputation. Consider this excerpt from Andrew Locascio's review of the book:

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  It's hard to know where to start with "baby Rudin." There is probably no more well
  known, respected, loved, hated, and feared text in all of mathematical academia.
  Steven G. Krantz claims it's one of the books that made him a mathematician; "It was
  easy to say, and often true, that anyone who could survive a year of Rudin was a real
  mathematician." Vladimir Arnold, one of the champions of the "organic" approach to
  mathematics, reportedly called the book (in comparison to the lectures of Vladimir
  Zorich) "Bourbakian propaganda, stripping and sterilizing analysis of any soul or meaning
  beyond the symbols."
  At MIT, the book has been practically canonized:  I was once visited by some of my
  friends taking math in Cambridge and I was angrily dismissed as an ignorant dabbler
  for even suggesting any other text for undergraduate real analysis even existed.  On the
  other hand, there was a group of math and physics majors at NYU who bought 100 copies of
  the book merely to burn the entire pile as a statement of their contempt for it.
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- **Other Recommended Texts:** *Principals of Mathematical Anaylsis* is often considered to be quite terse, and as with any mathematics course you are highly encouraged to explore other texts. *Introduction to Analysis* by Maxwell Rosenlicht (this is the text I first learned analysis from as an undergraduate), *Advanced Calculus* by Gerald Folland, or *Primer of Modern Analysis* by Kennan Smith. All these texts will vary in their approaches to similar topics (and some may omit topics that others include).

- **Recommendations:** It is not enough to simply watch lecture videos and attend discussion sessions! Mathematics can only be fully understood if you are an *active* participant in it! It is hard to overemphasize how important is is to work through the topics and material on your own. Understanding a topic or idea is a reward from having struggled through examples and problems. I am a strong believer in approaching mathematics the way it is discovered: through examples. Paul Halmos once said,

  `The heart of mathematics consists of concrete examples and concrete problems. Big general theories are usually afterthoughts based on small but profound insights; the insights themselves come from concrete special cases.`

  Your approach should be no different! Exploring concrete examples and especially counterexamples (or even non-examples) is critical to a complete understanding of the course material. I recommend doing as many exercises as you can on your own, finding additional exercises, reproducing proofs of theorems yourself. To truly understand a theorem, you must understand why the hypotheses of the theorem are what they are; it is sometimes beneficial to remove a single hypothesis from a theorem and then construct a counterexample to the deficient theorem.

- **LaTeX:** At this stage of your mathematical career I suggest you learn how to typeset your mathematics using LaTeX – this language is the gold standard for mathematical and scientific typing (this syllabus was made in LaTeX). Typing out an argument in LaTeX almost always takes quite a bit longer than simply writing it and for this reason, any assignment that you write out using LaTeX will receive a 5% bonus on the assignment. This is simply an incentive for those who already plan to take on the extra labor of typing up an assignment, if your only motivation is the 5% bonus then your time can almost surely be more effectively used studying.

- **Assignments:** There will be bi-weekly homework assignments as well as Quizzes assigned for weeks 3, 7, 11 & 15. All assignments are to be done remotely and submitted online at Canvas. Homework will consist of 40% of the final grade, while each Quiz consists of 15% of the final grade.

  The assignments will be posted online on Canvas, and you should upload your solutions there. Your uploads must either be a .pdf file, or a .tex source file. The problem set of each week is due on **Sunday** of that week at **10:00PM** (in St. Louis). If you miss the deadline, you can submit your assignment late with a late penalty of 20% per day. Depending on the length of the problem set, a random subset of problems may be chosen to be graded rather than the entire assignment.

  All submissions to Canvas must either be a .pdf file, or a .tex source file for LaTeX. Please be aware of this and learn how to scan your work so that it is a .pdf file. If you have any questions about this, please contact me *before* any assignments are due and we can figure out what works best for you.

- **Letter Grade:** Your final letter grade will be computed based on the following wighted combination of your exams and homework grades.

Quiz I	Quiz II	Quiz III	Quiz IV	Homework
15%	15%	15%	15%	40%

The letter grade distributions are as follows:

Range	Grade
$[97, +\infty)$	A+
$[92, 97)$	A
$[89, 92)$	A–
$[86, 89)$	B+
$[82, 86)$	B
$[79, 82)$	B–
$[76, 79)$	C+
$[72, 76)$	C
$[69, 72)$	C–
$[66, 69)$	D+
$[62, 66)$	D
$[59, 62)$	D–
$[0, 59)$	F

For Pass/Fail, a score of $[66, +\infty)$ is Pass and $[0, 66)$ is a Fail.

- **Schedule:**

Week	Dates	Assigments Due	Notes
1	1/25–1/29		
2	2/1–2/5	Problem Set 1	PS1 Due 2/7
3	2/8–2/12	Quiz 1	Q1 Due 2/14
4	2/15–2/19	Problem Set 2	PS2 Due 2/21
5	2/22–2/26		
6	3/1–3/5	Problem Set 3	PS3 Due 3/7, Wellness Day – 3/3
7	3/8–3/12	Quiz 2	Q2 Due 3/14
8	3/15–3/19	Problem Set 4	PS4 Due 3/21
9	3/22–3/26		
10	3/29–4/2	Problem Set 5	PS4 Due 4/4
11	4/5–4/9	Quiz 3	Q3 Due 4/11
12	4/14–4/16	Problem Set 6	PS6 Due 4/18, Wellness Day – 4/12
13	4/19–4/23		
14	4/26–4/30	Problem Set 7	PS7 Due 5/2
15	5/3	Quiz 4	Q4 Due 5/11

This calendar is subject to change throughout the semester.

- **Disability Services:** If you require accommodations for a disability which affect your work during the exams or the class, please contact the Office of Disability Resources (DR) promptly to discuss appropriate arrangements.