MATH 356 : PRINCIPLES OF REAL ANALYSIS II
Fall 2018

Instructor: Dejan Slepčev
Course webpage: Available on CMU Canvas
Lectures MWF 1:30 in WEH 4709
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Text: Walter Rudin, *Principles of Mathematical Analysis*, 3rd edition, McGraw Hill 1976.

Description. This course is a continuation of the course *Principles of Real Analysis I* (Math 355). It provides a rigorous foundation of introductory mathematical analysis. Concepts encountered in calculus will be introduced rigorously, often in a broader context. The course will cover calculus on surfaces and manifolds, sequences of functions and spaces of functions.

Learning Objectives. You will learn both the fundamental concepts of mathematical analysis and how to rigorously establish claims related to them. The knowledge gained in this course is essential to a number of upper level mathematical courses and indeed necessary for studies of many mathematical disciplines (including analysis, numerical analysis, PDE, probability, and many branches of applied mathematics).

Homework (Problem Sets) will typically be posted on Mondays (except for the exam weeks) on the course's Canvas webpage. The solutions are due in class one week after the problems have been posted. Late homework will not receive score. The lowest homework grade will be dropped. Discussing the problem sets with your classmates is encouraged, as long as you are exchanging ideas and general knowledge, and not the solutions to the problems. In particular everyone must present his/her own solutions.

Evaluation. The exam score is based on two midterm exams and the final exam. It is calculated according to the following formula: Let $E1$ and $E2$ be the scores of the two midterm exams, EF the score on the final exam, and HW the homework total, all on the scale $0 - 100$.

$$Total = \max\{HW * 0.4 + (E1 + E2) * 0.15 + EF * 0.3, HW * 0.3 + (E1 + E2) * 0.1 + EF * 0.5\}.$$

The midterm exams will be held during class-time on Wednesday, October 3rd and on Friday, November 9th. The exams are closed book exams, however everyone is allowed to bring one (two sided) letter-sized sheet of notes.

Classroom conduct. The use personal electronic devices (including cell phones and laptops) during the lectures is not permitted. If you would like to take notes using such a device, talk to me.

Accommodations for Students with Disabilities. If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Wellness. Take care of yourself. Do your best to maintain a healthy lifestyle this semester by getting enough sleep, eating well, exercising, avoiding drugs, and taking some time to relax. This will help you achieve your goals and cope with stress.
All of us benefit from support during times of struggle. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful.
If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website athttp://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

Outline

I. **Basic Topology, Metric Spaces**

1. Metric spaces (definition and examples)
2. Topology of metric spaces (open and closed sets)
3. Compactness
4. Connectedness

II. **Sequences in Metric Spaces**

1. Convergence
2. Subsequences
3. Cauchy sequences
4. Completeness of metric spaces

III. **Sequences and Series of Functions**

1. Pointwise and uniform convergence
2. Properties of uniform convergence
3. Equicontinuity, Arzela-Ascoli compactness theorem (Theorem 7.25)
4. Power series (Theorem 8.1)

IV. **Functions of Several Variables**

1. Normed spaces
2. Differentiation (total derivative, partial derivatives, properties, chain rule)
3. Banach contraction principle
4. Inverse function and implicit function theorems
5. Jacobian
6. Higher order derivatives

V. **Integration in several dimensions**

1. Review of Riemann integral and its properties
2. Integration in $\mathbb{R}^d$
3. Integration along curves
4. Integration on surfaces
5. Divergence and Stokes theorems