INTRODUCTION TO REAL ANALYSIS-SPRING 2009

67-667 Tu, Th 6:00 PM – 7:30 PM Swart 2

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Office hours: Tu, Th: 12:40 PM – 1:40 PM, 1:50 PM – 2:50 PM, 5:05PM-5:55PM, Others by appointment

Text: Introduction to Analysis by Edward D. Gaughan (5th edition)

Course Outline:
Chapter 0: Preliminaries
Chapter 1: (Sequences) In this chapter we study limits of sequences of real numbers and some of the simple topological properties of the real line.
Chapter 2: (Limits of Functions) In this chapter we take a closer look at limits of functions than would have been possible in calculus courses.
Chapter 3: (Continuity) In this chapter we study properties of continuous functions and uniformly continuous functions
Chapter 4: (Differentiation) In this chapter we develop a proper understanding of the definition of the derivative and derive all the usual rules for differentiation.
Chapter 5: (Riemann Integral) There are a number of different integration processes. In this chapter we focus on the Riemann integral and a simple modification of the Riemann integral.
Chapter 6: (Infinite Series) In this chapter we take a closer look of infinite series of real numbers.
Chapter 7: (Sequences and Series of Functions) In this chapter we introduce uniform convergence and illustrate its importance.

- An introduction to analysis is the critical study of calculus. There is a great difference between the way you will see these topics in this book and the way they are presented in calculus courses. Your calculus courses covered many more topics than we can possibly study here. What we are going to do is take the critical look at some elementary topology of the number line and the theory of limits, continuity, differentiation and integration of functions of one variable. This list of topics does not seem very large, and yet you will be working very hard. Patience is required.
- Understand mathematical proofs.
- Discover the ideas necessary for the proof and express these ideas in mathematical language.
- Produce counter examples involving more abstract concepts.
- Construct examples and use them to make abstract ideas more concrete.
- Learn to write precisely and logically.
Exams: There will be three exams. Exam dates will be announced at least one week in advance. Make-ups for missed exams and quizzes will be available only in very special cases. Exam 1: 100 points, Exam 2: 100 points, Exam 3: 150 points

Homework & Quizzes: 75 points
Homework will be assigned each class. Selected homework problems will be collected and graded. These assignments must be well written. There will be some in-class quizzes.

Presentations & Class Participation: 50 points
You will be asked to present some problem solutions and proofs of some theorems. Class participation includes asking and answering questions, and regular attendance.

Dual-level course requirement: Graduate students taking this course are required to do the following. Demonstrate a deeper understanding of the course material than is expected of the undergraduates. This includes reading research papers or expository papers in real analysis. Assume a leadership role in the class. This includes presenting proofs of some theorems or leading problem solving groups.

Grading
\[ [90, 100] \text{ A}, \quad [87, 90) \text{ AB}, \quad [80, 87) \text{ B}, \quad [76, 80) \text{ BC} \]
\[ [68, 76) \text{ C}, \quad [63, 68) \text{ CD}, \quad [58, 63) \text{ D}, \quad [0, 58) \text{ F} \]

Remarks: Proofs are the mode of communication of Pure Mathematics. Even in applied mathematics, it is necessary to convince others that that your method and solution are valid. An argument presents reasons why some statements should be accepted as true. In mathematics, as opposed to other disciplines, these arguments are formal. You should have picked up some of the basic ideas of logic and the notion of proof if you have had a course in Linear Algebra or Abstract Algebra. As you proceed through this book, your knowledge of logic will deepen and your ability to write proofs will improve. There may be some frustration at first, but after getting past the initial hurdle of writing proofs, it can become a rewarding experience. Some of the proofs in this textbook have small gaps in them. You notice these gaps and take the time to fill in the missing details. Thinking about concepts, working with examples, and discussing the material with others is the best way to learn the contents of this book. Learning how to get started on a problem is an important skill to acquire.

Attendance: • Regular attendance is required.
• I will be taking attendance daily.
• Those having 2 or more unexcused absences will be penalized.

Remarks The goal of the course should be mastery of these core topics as well as problem-solving capability.
If you have any concerns or questions, feel free to see me during my office hours (scheduled or arranged).