MA 717 — Functional Analysis
Spring 2018

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Office Hours:

Tuesday 11am-12:30pm
Thursday 6:30-7:50 pm
... and by appointment

This extensive branch of mathematics is involved in all higher analysis, and is basic knowledge to a researcher in probability and many of its applications, mathematical physics, dynamical systems, or partial differential equations. Besides being used in many pure mathematical disciplines, functional analytic techniques are now widely used in physics, applied mathematics, and engineering research.

1. Overview: This course will be an introduction to the field. We will survey the fundamentals, together with a number of standard applications to applied mathematics, probability, and dynamical systems. Topics covered will include some new aspects of measure theory on the line, topological vector spaces, Hilbert and Banach spaces and their geometry, ergodic theory, locally convex spaces, fixed point theorems, and theory of operators. Application portions of the course will include neural networks, machine learning, and wavelet theory.

2. Text: The text for this class is *Functional Analysis* by Reed and Simon, published by Academic Press. The book *Introductory Functional Analysis with Applications* by Erwin Kreyszig (John Wiley & Sons) will be a supplementary text, though Reed and Simon is self-contained. Kreyszig's book is excellent for a simple exposition of this material. There will be occasional handouts whose purpose will be to elaborate on the statements and proofs in Reed and Simon.

3. Problem Sets: These will generally be assigned out of the text, with an assignment due on Thursday of each week. Homework scores will contribute to 30% of the final grade.

4. Grading: Grades will be computed as follows. The first ten percent of the grade is free - just for coming to class (this means on time!). This will be a very important element of the course, and will be quite different from the 'textbook/problem set experience' that complements it. There will a midterm (either in-class or take-home) and a take-home final. The midterm will count 25%, and the final, 35% of the final grade.

5. Communication and writeups: In a course like this, it is natural to emphasize the notion of rigorous exposition. This is reflected in the need for rigor and care in written problem

solutions. I will emphasize the need for good written communication of ideas in the homework assignments, and the ability to formalize intuitive mathematical notions clearly. This will include the requirement of well written and thought-out problem solutions. Please write your proofs clearly, and in short sentences each of which follows easily from the previous ones. There is no such thing as too simple an argument or solution. Remember, communication is as important a part of any mathematics class as it is any other. Feel free to consult with me on what will be expected of you here.

6. Collaborative work: Learning is better done with others, and collaboration and discussion of problem sets in this course is encouraged. The purpose of this is to exchange ideas and methods conceptually, but not to 'copy solutions' from others. The final copies of problem solutions must be your own; direct copying/transcription of others' work is not permitted and is considered to be plagiarism by this and all other University codes of ethics (see below).