Advanced Real Analysis (Math 618)

Spring 2026

Technicalities

Instructor: Clayton Shonkwiler (clayton.shonkwiler@colostate.edu)
Office: Weber 206C
Course web page: https://www.math.colostate.edu/~clayton/teaching/m618s26/
Text: *Topics in Linear and Nonlinear Functional Analysis*, by Gerald Teschl, which is available free online at https://www.mat.univie.ac.at/~gerald/ftp/book-fa/
Time/Location: 12:00–12:50 Monday, Wednesday, Friday, Clark C 361
Office Hours: Wednesday 2:00–3:00 and Thursday 1:00–2:00, or by appointment

Summary of the Course

The course will be an introduction to Hilbert and Banach spaces, with applications to Fourier analysis and partial differential equations.

We will start with the basic theory of infinite-dimensional vector spaces and operators and come to grips with standard function spaces like L^2 and their connections to Fourier analysis. Then we will develop the theory of compact operators, with applications to linear PDEs. After introducing the main technical tools for Banach spaces, including Baire's theorem and the Hahn–Banach theorem, we will end with some spectral theory, including the Gelfand representation theorem.

Familiarity with basic real analysis (e.g., MATH 517) is important, as is good working knowledge of (finite-dimensional) linear algebra.

The following books may be useful additional resources:

- *Topics in Real Analysis*, by Gerald Teschl (https://www.mat.univie.ac.at/~gerald/ftp/book-ra/index.html)
- *Principles of Functional Analysis*, by Martin Schechter
- *Functional Analysis, An Introduction*, by Yuli Eidelman, Vitali Milman, and Antonis Tsolomitis
- *Lecture Notes on Functional Analysis*, by Alberto Bressan
- *An Introductory Course in Functional Analysis*, by Adam Bowers and Nigel J. Kalton

1 Grading

This is an advanced graduate course, so your grade will be based on homework and a final project:

Homework: 60%
Final Project: 30%
Class Participation: 10%

2 Disclaimer

The course syllabus is a general plan for the course; deviations announced in class may be necessary.

3 Anticipated Schedule

Topic	**Weeks**
Introduction and motivation	3
Hilbert spaces	2
Compact operators	3
Banach spaces	2
Bounded operators	2
Spectral theory	2