MATH 7338 Syllabus

Functional Analysis, 3 credit hours

Fall 2026

Instructor Information

Instructor: Galyna Livshyts

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Office Hours: MW 1:45pm-3:15pm

General Course Information

Description

This course is a graduate introduction to functional analysis. The course studies major theorems of functional analysis together with spectral theory for bounded and unbounded operators. Core topics include the Hahn–Banach Theorem, compact and self-adjoint operators on Hilbert spaces, spectral theory of compact self-adjoint and general self-adjoint operators, weak and weak* topologies, Alaoglu's Theorem, and the Riesz Representation Theorem for C_0. Additional topics may include local theory of finite-dimensional Banach spaces and asymptotic geometric analysis, such as estimates for the Banach–Mazur distance, Dvoretzky's theorem, and the MM^* bound proved recently by Bizeul and Klartag, along with applications.

Prerequisites and Scheduling

Prerequisite: MATH 6338

Lecture hours: 3

Lab hours: 0

Recitation hours: 0

Total credit hours: 3

Course Learning Outcomes

Upon successful completion of this course, students should be able to:

- state and apply the major structural theorems of functional analysis, including the Hahn–Banach Theorem and related consequences;
- work fluently with bounded linear operators on Banach and Hilbert spaces;
- analyze compact and self-adjoint operators and use the spectral theorem in concrete and abstract settings;
- distinguish and use norm, weak, and weak* topologies in proofs and examples;
- apply representation theorems, including the Riesz Representation Theorem for C_0, in appropriate contexts;
- read, write, and communicate rigorous graduate-level proofs in operator theory and functional analysis.

Required Course Materials

Primary text:

- Vladimir Kadets, *A Course in Functional Analysis and Measure Theory*, 2018.

Additional texts:

- John B. Conway, *A Course in Functional Analysis*, 2nd edition.
- S. Artstein-Avidan, A. Giannopoulos, V. D. Milman, *Asymptotic Geometric Analysis*.

Additional reading, lecture notes, and supplementary references may be assigned or recommended during the semester.

Topic Outline

The course will cover the following topics:

- Review of linear operators and the Hahn–Banach Theorem.
- Compact and self-adjoint operators on Hilbert spaces.
- Spectral theory of compact self-adjoint operators.
- Spectral theory of self-adjoint operators.
- Weak and weak* topologies and Alaoglu's Theorem.
- Riesz Representation Theorem for C_0.
- Haar measure.
- Banach–Mazur distances between finite-dimensional spaces.
- The Bizeul–Klartag and E. Milman theorems regarding MM^* and applications.
- Dvoretzky's theorem.

Grading Policy

Final grades will be based on a combination of homework, a midterm, and a short in-class presentation on a pre-assigned topic. Any adjustments to the grading scheme will be announced in class and posted on Canvas.

Assignments

- Homework: 70%
- Midterm exam: 20%
- Short in-class presentation: 10%

Letter grades will be assigned according to standard cutoffs.

Description of Graded Components

- **Homework:** Students are expected to write complete and mathematically rigorous solutions. Homework will be assigned throughout the course, with each problem rated from 1 to 5 points in difficulty. Students will be free to select a subset of these problems amounting to a total of 15 points for the course.
- **Midterm exam or take-home exam:** The midterm will take place in person on November 9 and will be heavily based on the homework problems.
- **Presentation:** A short 15-minute presentation on a pre-assigned topic at some point during the semester.

Course Policies

Attendance and Participation

Regular attendance is expected. Because this is a proof-based graduate course, much of the learning happens through active engagement with definitions, examples, and arguments developed during class. Students who miss class are responsible for obtaining notes, announcements, and assignments from Canvas or from classmates.

Participation may include asking questions, contributing to discussions, and, where appropriate, presenting solutions or reading assignments. Students should notify the instructor as soon as possible in the event of a serious illness, an Institute-approved absence, or another significant circumstance affecting attendance.

Communication

Course announcements, assignments, and other materials will be distributed through Canvas. Students are responsible for monitoring Canvas and their Georgia Tech email regularly.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Collaboration on general ideas may be permitted on homework unless otherwise stated, but each student must write up and submit their own independent solutions. Any use of outside sources must be acknowledged clearly. Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, which will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your needs and obtain an accommodations letter. Please also email me as soon as possible so that we can arrange a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgment, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.