**Math 35A : Advanced Calculus and Fourier Analysis**

Brandeis University • Spring 2019 • Tue and Fri - 12:30-13:50 • Gerstenzang 124

Charlie Cosnier-Horeau • cchoreau@brandeis.edu • Office hours We Thu 3-4pm in GS 200

**Graders and teaching assistant**

- **Langte Ma** • TA • ltmafixer@brandeis.edu • Office hours Fr 2-4pm in GS 311
- **Feipeng Qi** • grader • qfpeng99@brandeis.edu • Office hours TBA
- **Jill Stifano** • grader • jillstifano@brandeis.edu • Office hours Mo 1-2pm We 2-3pm in GS111

**Description of the course**

Math 35A is a course designed for math, science and economic majors, and all students interested in engineering and applications of mathematics. We will introduce the basic concepts of Fourier analysis and its generalizations, which have proved to be useful for solving problems arising in physics and other scientific fields.

The main idea of Fourier analysis is to express general functions as sums of more basic functions (such as sines and cosines), in pretty much the same way one can decompose vectors over sets of more simple vectors in the context of linear algebra. We will also discuss differential equations, and, by the end of the semester, the goal is to be able to solve some fundamental partial differential equations by expressing their solutions as sums of separable functions found using Fourier analysis.

If time permits, we will make an introduction to calculus of variations and minimization principles, which constitute another branch of applied mathematics that have had a major impact on physics, engineering and others.

**Outcomes of the lecture**

- Perform complex arithmetics. Estimate convergence of basic series.
- Fourier decomposition: represent continuous functions over a finite interval as sums of sines and cosines
- Estimate conditions on function $f(x)$ to ensure existence of a valid Fourier decomposition
- Construct general solutions to linear boundary value problems using the separation of variables and Fourier decomposition
- Compute Fourier integral representation of functions that are not periodic
- Express Laplace equation in cylindrical and spherical problems as known linear boundary value problems and solve them

**Outline of the lecture (tentative)**

- Introduction/review: complex numbers, series, convergence results
- Fourier decomposition of a function on a finite interval
- Fourier integral of a function on an infinite interval
- Partial differential equations from physics (heat equation, wave equation)
- Constructing general solutions with the method of separation of variables to solve boundary value problems.
- Applications of the method of separation of variables to linear boundary value problems in higher dimensions
- Introduction to calculus of variation and minimization problems

**Practical details**

**Textbook** *Fourier series and boundary value problems* by James Ward Brown and Ruel V. Churchill • 8th edition

**Prerequisites** linear algebra (15a or 22a) and multivariate calculus (20a or 22b), or higher and permission of the instructor • If you have any question, please ask.

**Grading** Final 40%, Midterm 1 20%, Midterm 2 20%, Homeworks 10%, Quizzes 10% • Homeworks, midterms and finals are mandatory to pass • The first midterm is planned for the 11th of October, the second for the 15th of November, and the exam for the 17th of December, from 9:15am to 12:15pm • Collisions with other university duty should be mentioned to me at least two weeks before the midterm/exam, and a make-up session will be issued • In case of document medical (or other) emergency, a make-up session will be issued as well.

**Calculators** are not allowed during exams or quizzes. • textbooks and lecture notes are not either.
Quizzes will be given regularly during class (roughly 15 minutes long) • Homeworks will be issued weekly and collected at the beginning of Friday class • You can collaborate if and only if each of you write down their own answers and the list of their collaborators • Deduction steps are worth the entirety of the grading, make sure to write down your entire reasoning • Staple your sheets together if your homework contains more than one.

Accessibility support Brandeis seeks to welcome and include all students • If you are a student who needs accommodations as outlined in an accommodations letter, please talk with me and present your letter of accommodation as soon as you can • I want to support you.
In order to provide test accommodations, I need the letter more than 48 hours in advance • I want to provide your accommodations, but cannot do so retroactively • If you have questions about documenting a disability or requesting accommodations, please contact Student Accessibility Support (SAS) at 781.736.3470 or access@brandeis.edu

Academic integrity You are expected to follow the University’s policy on academic integrity, which is distributed annually as Section 4 of the Rights and Responsibilities student code (see References below) • Instances of alleged dishonesty will be forwarded to the Department of Student Development and Conduct for possible referral to the Student Judicial System • If you have any questions about how these policies apply to your conduct in this course, please ask.

References

- Fourier series and boundary value problems by James Ward Brown and Ruel V. Churchill
- Fall 2019 calendar at Brandeis - [https://www.brandeis.edu/registrar/calendar/fall19.html](https://www.brandeis.edu/registrar/calendar/fall19.html)
- LATTE - [http://latte.brandeis.edu](http://latte.brandeis.edu)
- Student accessibility support - [https://www.brandeis.edu/accessibility/accommodations.html](https://www.brandeis.edu/accessibility/accommodations.html)
- Rights and Responsibilities student code - [https://www.brandeis.edu/studentlife/srsrc/rightsresponsibilities/index.html](https://www.brandeis.edu/studentlife/srsrc/rightsresponsibilities/index.html)