Advanced Calculus and Fourier Analysis  
MATH 35A - Fall 2018  

Instructor: Olivier Bernardi

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Office hours: Tuesday 3:00-4:30pm and Friday 1:30-2:00 (in Goldsmith 301).

Course description and objective: Math 35 (advanced calculus) is a course designed for math, science, and economics majors, and all students interested in engineering or the applications of mathematics. The class will introduce important concepts and mathematical tools for solving problems arising in physics and other scientific fields.

We will focus in particular on Fourier analysis and its generalizations. These techniques aim at expressing “general functions” as sums of “simple functions” (such as sine and cosine functions). We will also discuss differential equations from a practical point of view. At the end of the semester, students should have a good practical knowledge of how to solve some fundamental partial differential equations, by expressing their solutions as sums of separable functions found using Fourier analysis.

Expectation of students’ effort: Success in this course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for the class (reviewing class material, completing homeworks, preparation for exams, etc.).

Learning goals: There are three main goals:

- The first goal is to discuss how a function can be represented as a sum of “simple functions”. In particular, we shall discuss how continuous functions (on a finite interval) can be represented as a sum of cosine and sine functions. These representations, are called Fourier series decompositions.
• The second goal is to give a working understanding of differential equations and how they naturally arise in physics/engineering.

• The third goal is to discuss how Fourier series decompositions can be used to solve partial differential equations. We will treat in particular the heat equation and wave equation which are very important equations in physics. The idea is that general solutions of the partial differential equations can be constructed as sums of particular “separable solutions” which are expressed in terms of sine and cosine functions.

Course plan:
• Quick introduction/review of several basic mathematical concepts to be used throughout the class (complex numbers, series, convergence results).

• Fourier decomposition of a function on finite interval (this is one of the core topics and we will spend a lot of time on this). Roughly speaking we will show how to express such a function as a sum of cosine and sine functions.

• Fourier integral of a function on an infinite interval.

• Quick introduction/review of the concept of differential equation, and a few techniques to solve ordinary differential equations.

• Derivation of some fundamental partial differential equations from physics (in particular the heat equation and wave equation)

• Constructing general solutions of partial differential equations as series (or integral) of particular “separable solutions”, and using Fourier decomposition techniques to find the solution corresponding to the known initial state of the system (this is one of the core topics and we will spend a lot of time on this).

Textbook: We will use the book *Fourier Series and Boundary value Problems, 8th edition* (or later) by Brown and Churchill.

Prerequisite: I will assume proficiency in linear algebra and multivariate calculus. The prerequisite courses are therefore MATH15a or MATH22a, and MATH20a or MATH22b.

Grading Policy: Homeworks 25%, Midterms 50%, Final 25%.

Late homework policy: You will get a 10 points penalty if you are late by less than 24 hours. After 24 hours, the homework will not be accepted, unless you get a special extension to be requested and approved in advance.
Date of midterms: to be determined.

Disabilities: If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see me immediately.

Academic Integrity: You are expected to be familiar with, and to follow, the University’s policies on academic integrity. Please consult Brandeis University Rights and Responsibilities for all policies and procedures. All policies related to academic integrity apply to in-class and take home projects, assignments, exams, and quizzes. Students may only collaborate on assignments with permission from the instructor. Allegations of alleged academic dishonesty will be forwarded to the Director of Academic Integrity. Sanctions for academic dishonesty can include failing grades and/or suspension from the university.