

MATH 551 – Partial Differential Equations I

Instructor: Burak Gürel, TB 255.

Course Description and Content: This is the first graduate course on PDE. In contrast with the undergraduate version, we will look into PDE from a broader viewpoint in terms of dimension, domain, problem and solution type. In this first course our main target is linear PDE. As well known, analysis of a linear PDE varies with its character of being elliptic, parabolic or hyperbolic. Therefore investigating the foremost examples of these characters is important. To this end we will start off by Laplace's equation and carry on to the heat equation, and conclude with the wave equation. Our next objective is to define weak solutions and in order to do this we will introduce Sobolev spaces and elaborate on their certain properties. This part will look like a mini course on functional analysis. In the following step, general second order elliptic PDE and evolution equations will be discussed in the paradigm of Sobolev spaces. Along this path the notion of the Fourier transform will also be studied, which is only natural.

This being the aim of the course, it is a little ambitious for one semester. So the plan is going forward as much as possible without relinquishing our right to learn some facts and techniques relevant to the analysis of PDE.

Textbook: Our main source is *Partial Differential Equations* by Lawrence Evans published by AMS in the series Graduate Texts in Mathematics.

The content described above corresponds to chapters 2,5,6,7 of this book.

Course Webpage: web.boun.edu.tr/bgurel/Math551

Here I will try to upload some other useful sources which could be notes, problems or comments by various mathematicians on various topics.

Meetings: Lectures will take place Mondays and Wednesdays at TB 130, 9:00-10:50.

Background: Desirable background would be an undergraduate PDE course and knowledge of Lebesgue's L^p spaces. However, any resiliently hard working graduate or advanced undergraduate student is welcome. In any case, you are going to have to demonstrate some skills in multi-variable differential and integral calculus. Multi-variable mostly means n .

Math 551 is open to mathematics students by default (without consent). If you are not a mathematician but are interested in PDE, then please send a consent message.

Pace: I leave some calculus parts to you to study. These are in the maximally essential Appendix C. Other appendices are also good and needed, especially Appendix A which introduces notations. The flow speed of the course and amount of details in the lectures are going to be decided by us as a group.