Partial Differential Equations

Math 6326, Fall 2019.

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This course will provide an introduction to the analysis of elliptic boundary value problems using modern analysis. The emphasis is on weak formulations and the representation of solutions of the problems. The examples to be treated arise from appplications and often are closely related to the Laplacian. Issues regarding the dependence on solutions on the domain, the boundary conditions and the approximation of solutions will be covered.

The prerequisite is competence in multivariable calculus and real analysis. Ideally a student should have done well in M6320-21 and having a working knowledge of Lebesgue integration and classical Fourier analysis. The basic constructions of linear analysis in Hilbert and Banach spaces will also be assumed.

The material in the course will parallel the treatment of topics in the lecture notes of John Hunter that are available here (with the author's permission). I suggest that potential students review the material of chapter 1 before classes start as it will be used. The course will cover material related to chapters 2-4 of Hunter's notes and further topics about eigenproblems, bases of Hilbert spaces and boundary traces.

There is no prescribed text and other texts that may be of interest include the first three chapters of "Hilbert Space Methods in Partial Differential Equations" by Ralph E. Showalter (Dover or free online) and some of the text "Elliptic Equations: An Introductory Course",by Michel Chipot, Birkhauser, 2009. The Universitext "Functional Analysis, Sobolev Spaces and Partial Differential Equations" by Haim Brezis, Springer 2011 provides a thorough treatment of the functional analysis used. These three texts may be good reference texts for the material treated in the course.