Math. 60650 Basic Partial Differential Equations

This is an introduction course for graduate students to learn fundamental concepts, theory and techniques in partial differential equations. The first part of this course will cover some basic theory for elliptic, parabolic and hyperbolic PDEs. The second part of the semester we will discuss the most important applications of partial differential equations in harmonic analysis and differential geometry.

The topics of the course include the following:

(1) Classical theory of solving basic linear elliptic and parabolic and hyperbolic partial differential equations.

(2) Variational approach using the energy methods and regularity of weak solutions.

(3) Boundary value value problems: The Dirichlet and Neumann boundary value problems.

(4) Applications of partial differential equations in Riemannian geometry, including the Hodge Theorem, the spectral theory for the eigenvalues of the Laplacian and the heat equations.

Textbook: I will use my own lecture notes (which will be posted on the web) and the following reference books.

References:

Prerequiste: I will try to make the course as self-contained as possible. But a basic understanding of real analysis will be helpful.

Homework and Project: Homework problems will be assigned. Each student will be asked to do an individual course project of a topic of your choice (this could be an extended homework problem). Each student will submit a paper on the topic and make a presentation in front of the class at the end of the semester.