MAT 1060H: Introduction to Partial Differential Equations

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Prerequisites: Ideally, you've taken an undergraduate ODE course, an undergraduate PDE course, as well as a course on measure and integration. That said, if you're comfortable with Calculus in one and higher dimensions and you work hard then you'll definitely get something out of the course.

Textbook: The textbook is "Partial Differential Equations: Methods and Applications" by Robert C. McOwen. Second Edition. Other helpful books are "Partial Differential Equations" by Lawrence C. Evans, "Partial differential equations" by Fritz John, "Partial differential equations: an introduction" by Walter Strauss, and "Applied Partial Differential Equations" by Richard Haberman. John's book is at the same level as Evans' but has a different approach. Haberman's and Strauss' books are at the undergraduate level and are more accessible if you're having difficulty.

Assessment: A fifty minute, open book midterm on a Tuesday (date to be chosen, worth 25%). A two-hour open-book final exam (date to be chosen, worth 45%). In addition, there will be seven problem sets, worth 30% of the course mark. They'll be due Sept 26, Oct 8, Oct 17, Oct 29, Nov 7, Nov 19, and Nov 28. I encourage you to work in a group on the homework and to hand in a single joint homework.

Material to be covered:
Chapter 1: First-Order Equations
§1.1 The Cauchy Problem for Quasilinear Equations
§1.2 Weak Solutions for Quasilinear Equations
§1.3 General Nonlinear Equations

Chapter 2: Principles for Higher-Order Equations
§2.1 The Cauchy Problem
§2.2 Second-Order Equations in Two Variables
§2.3 Linear Equations and Generalized Solutions

Chapter 3: The Wave Equation
§3.1 The One-Dimensional Wave Equation
§3.2 Higher Dimensions
§3.3 Energy Methods
§3.4 Lower-Order Terms
§3.5 Applications to Light and Sound

Chapter 4: The Laplace Equation
§4.1 Introduction to the Laplace Equation
§4.2 Potential Theory and Green's Functions
§4.3 Existence Theory
§4.4 Eigenvalues of the Laplacian
§4.5 Applications to Vector Fields

Chapter 5: The Heat Equation
§5.1 The Heat Equation in a Bounded Domain
§5.2 The Pure Initial Value Problem
§5.3.Regularity and Similarity
§5.4 Application to Fluid Dynamics