UNIVERSITY OF BRITISH COLUMBIA

Math 516, Fall 2017 Mon/Wed/Fri 1:00-1:50, MATX 1118

PARTIAL DIFFERENTIAL EQUATIONS I: Introduction to Elliptic and Parabolic PDE

This course is an introduction to the qualitative theory of partial differential equations, emphasizing elliptic and parabolic problems. It should be useful to students with interests in applied mathematics, differential geometry, mathematical physics, probability, harmonic analysis, dynamical systems, and other areas, as well as to PDE-focused students.

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Rough Course Outline:

- **Classical linear equations:** Laplace, heat, and wave equations, and their fundamental solutions; properties of solutions of the Laplace/Poisson and heat equations: mean value properties, regularity, maximum principles, uniqueness for boundary (and initial) value problems.
- **Second-order elliptic equations:** weak solutions; regularity; maximum principles; method of sub- and super-solutions; application to semilinear elliptic problems
- **Second-order parabolic equations:** weak solutions; regularity; maximum principles; method of sub- and super-solutions; semigroup theory; application to semilinear parabolic equations
- **Further developments:** L^p theory: Calderon-Zygmund inequality; Schauder theory: Hölder estimates, method of continuity, Perron's subsolution method; DeGiorgi-Nash-Moser theory: application to quasilinear elliptic problems
- **Analytical tools** we will review/expose along the way as needed: some functional analysis, L^p and Sobolev spaces, Fourier transform, weak convergence, etc.

Pre/co-requisites: Basic analysis, such as Math 400/421 (or equivalent) would be helpful, as would some previous exposure to PDE.

References: A number of books will prove useful, but our basic reference is

- *Partial Differential Equations*, by Lawrence C. Evans, AMS, 1998.

Course homepage: http://www.math.ubc.ca/∼gustaf/M516/

Grading: is based on homework assignments.

Updated Sep. 6, 2017