MATHEMATICS 4170
PARTIAL DIFFERENTIAL EQUATIONS II

Initially, the study of partial differential equations (PDEs) was motivated by certain PDEs arising in the mathematical modeling of specific physical phenomena. In the second half of the 18th century, Euler and d'Alembert made the first significant contribution when they studied the wave equation,

$$\frac{\partial^2 u}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2};$$

this equation representing a simple model for a vibrating string. The 19th century saw a phenomenal growth in the study of PDEs: Fourier's work on trigonometric series now bearing his name, and the Fourier integral (discovered by Fourier, Cauchy, and Poisson) provided the tools to analyze other types of (linear) second-order PDEs like the heat equation and Laplace's equation. Until the middle part of the 19th century, the solution of PDEs was done in a formal way, arguing from physical considerations. In the second part of the century, the problem of existence and uniqueness of solutions was investigated; here, fundamental contributions were made by Riemann, Hadamard, Kowalewski, Picard and many others.

This course will be concerned mainly with the analysis of solutions to initial and boundary-value problems for linear second-order PDEs. In addition, it will provide an introduction to linear and quasilinear first-order PDEs.

Text. *Partial Differential Equations: An Introduction* by D. Colton (Random House), or a similar book.

Marks. The distribution varies with the instructor, but the following is typical:

Assignments (approx. 6)	30%
Tests	30%
Final exam	40%

Calendar description. **4170 Partial Differential Equations II** covers first order equations, Cauchy problems, Cauchy-Kowalewska theorem, second order equations, canonical forms, wave equations in higher dimensions, method of spherical means, Duhamel's principle, potential equation, Dirichlet and Neuman problem, Green's function and fundamental solution, potential theory, heat equation, Riemann's method of integration, method of plane and Riemann waves for systems of PDEs of the first order.
Prerequisite: Mathematics 4160.

Offered. Alternating winters.