

Introduction to Partial Differential Equations

Math 133-01 – Spring 2009

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Course Synopsis

Heat, wave, and potential equations: scientific context, derivation, techniques of solution, and qualitative properties. Topics to include Fourier series and transforms, eigenvalue problems, maximum principles, Green's functions, and characteristics. Intended primarily for mathematics majors and those with similar backgrounds.

Prerequisites

Mathematics 108 or 131 or consent of instructor. Some knowledge of analysis is helpful but not necessary. (Math 108 is not yet mentioned in the catalog, but the material is comparable to what is taught in Math 131.)

Synopsis of course content

This course is intended for mathematics majors, but it is also suitable for engineers and scientists with a genuine interest in mathematics. We will study Laplace's equation, the heat equation, and the wave equation, which serve as canonical models of more general elliptic, parabolic, and hyperbolic PDEs. We will emphasize qualitative properties of solutions, as well as explicit formulae for solutions. Topics and techniques may include Fourier series, separation of variables, distributions, Fourier transform, Green's functions, calculus of variations, the method of characteristics, and discrete approximations.

Textbooks

- *Introduction to Partial Differential Equations with MATLAB*, Jeffrey M. Cooper

Other references:

- *An Introduction to Partial Differential Equations*, Yehuda Pinchover and Jacob Rubinstein

Assignments

Weekly problem sets will include theory, analysis and computational projects. A written solution and hardcopy of every code, input or output must be submitted for each problem. An electronic copy of our code must also be submitted to me via e-mail, in a unique zip or tar/gzip file. Requests for extensions on homework should be done before the due date; unexcused late assignments will be penalized. You are encouraged to discuss the homework problems with your classmates, but your final submission must be entirely your own independent work (see the Duke Community Standard).

Homework

There will be weekly homework assignments.

Exams

There will be a midterm and a final. Grade to be based on weekly assignments and exams.