

APM 351: Differential Equations in Mathematical Physics

Announcement of Midterm Test

When and where?

Wednesday, November 15, in class (9:10-10am, BA 1220). Closed books, closed notes.

Topics

The test will cover the first six chapters of Strauss. Specifically:

- *What is a PDE?* What is a solution? Initial and boundary values. Well-posed problems.
- *First-order linear equations.* Physical motivation. The method of characteristics.
- *The wave equation on the real line.* Physical motivation. The general form of the solution; D'Alembert's formula. Causality and energy; finite speed of propagation, domain of dependence, domain of influence.
- *The diffusion equation on the real line.* Physical motivation. Maximum principle, energy methods. Fundamental solution.
- *Reflections and sources.* The diffusion equation and the wave equation on the half-line. Even and odd reflection, periodic continuation. Duhamel's formula for solving inhomogeneous problems.
- *Boundary-value problems for the wave equation and the diffusion equation.* Separation of variables. Dirichlet, Neumann, periodic, and Robin boundary conditions. Eigenvalues and eigenfunctions. Positive definiteness.
- *Fourier series.* How to compute the Fourier coefficients of a given function. Real, even, odd, and periodic functions. Orthogonality and mean square convergence in L^2 . Bessel's inequality and Parseval's identity. Pointwise vs. uniform convergence. How to integrate and differentiate Fourier series.
- *Harmonic functions.* Physical motivation. Laplace's equation in Cartesian and polar coordinates. Relationship with holomorphic function. The weak and strong maximum principle. Poisson's formula in two dimensions. Mean value property.