CAAM 423: PARTIAL DIFFERENTIAL EQUATIONS I – FALL 2011.

Personnel

- Instructor: Ricardo Alonso.
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- Class Meetings: T/Th 09:25 am - 10:40 am.
- Office Hours: After class or by appointment.

Course Information: In this course we give a comprehensive introduction to the ubiquitous topic of Partial Differential Equations. We study the most important linear equations, that is, the linear transport equation, Laplace equation, Heat equation and Wave equation. We also give a short introduction of Sobolev spaces and regularity theory for elliptic and parabolic differential equations. Finally, we introduce the method of stationary phase and give some interesting applications to the asymptotic theory of PDE's.

- Description:
  - *Section 1.* Basic notions of functional analysis, basic L^p space theory, important inequalities, and convolution and mollifiers. (2 Classes)
  - *Section 2.* Transport equation. Vlasov equation. (1 Class)
  - Section 3. First-order PDEs – the method of characteristics. (3 Classes)
  - *Section 4.* Laplace equation. Fundamental solution. Properties of Harmonic functions. Poisson equation. (3 Classes)
  - *Section 5.* Heat equation. Fundamental solution. Mean-value formulas and energy methods. (3 Classes)
  - *Section 6.* Wave equation. Solution by spherical means. Energy methods and Helmholtz's equation. (3 Classes)
  - *Section 7.* Introduction to Sobolev spaces and regularity theory for elliptic equations. (3 Classes)
  - *Section 8.* Fourier methods with applications to the Fractional Laplacian and Schrödinger equation. (3 Classes)
  - *Section 9.* Method of Stationary Phase and applications to the asymptotic theory of the wave equation. (3 Classes)
- Suggested Reading:
  - Partial Differential Equations by L. Evans.
  - Analysis by E. Lieb and M. Loss.
  - Functional Analysis, Sobolev Spaces and Partial Differential Equations by H. Brezis.

Work and Grades: We expect to offer between 10 and 12 assignments. The midterm date and format will be chosen by consensus in class.

- Homework 40% – Midterm 30% – Final 30%.