CAAM 499

Introduction to Distribution Theory and Applications to PDE

Mon/Wed, 4:15pm-5:30pm, KCK 107

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Register for course through Canvas: http://www.rice.edu/canvas/
Duncan Hall 278
Office Hours: Tuesday 11am-1pm and by appointment

This syllabus may be subject to change as the course progresses

Course Description: This course will provide an introduction to the theory of distributions (generalized functions) and their application to linear PDEs. Requiring differentiability of solutions to a PDE is often restrictive and unnatural for analyzing physically meaningful solutions that appear in physics and engineering. Distribution theory resolves many of these issues and gives mathematical meaning to objects such as the Dirac delta function, the Green's function of a partial differential operator, and weak solutions of PDEs. Distributions are also natural objects when doing inverse problems that occur in seismic and medical imaging.
We will define distributions and address a number of issues that occur in the applied sciences such as

1. What is the Dirac delta function?
2. What is the Green's function for a PDE and how do we construct it?
3. Why are solutions to Laplace's equation always infinitely differentiable?
4. What are weak solutions and how do they relate to classic solutions?

In the latter part of the course, we will introduce Hörmander's oscillatory integrals that are used in imaging physical structures.

Prerequisite(s): No knowledge of PDEs nor functional analysis will be assumed. Students must have a background in multivariable calculus, vector calculus, and be familiar with the basic principles of real analysis. Some familiarity with complex analysis is helpful but not required.
Credit Hours: 3

Main Text: *A Guide to Distribution Theory and Fourier Transforms*
Author: R. Strichartz

Available online for download: https://xa.yimg.com/kq/groups/17537685/739216167/name/56009170-A-Guide-to-Distribution-Theory-and-Fourier-Transforms-Robert-S-Strichartz-9780849382734.pdf

On Reserve: *Introduction to Distribution Theory*, 2nd Edition
Author: M. Joshi and Friedlander

Grade Distribution:

Homework	70%
Quiz (take home)	5%
Midterm Exam (take home)	10%
Final Exam (take home)	15%

Course Policies:

- **General**
  - Quizzes and exams are closed book, closed notes.
  - **No makeup quizzes or exams will be given.**
- **Homeworks**
  - Homeworks will generally be due at the end of class on Wednesdays. They may also be turned in by 11am Thursday morning in Duncan Hall Mailroom DH 1092 in my mailbox. I will announce if there is a change for any particular week.
  - Students are expected to write their own homework assignments but are encouraged to discuss problems with peers. **Offering** and **accepting** solutions from others is an act of **plagiarism**, which is a serious offense and **all involved parties will be penalized according to the Academic Honesty Policy**.
  - Please justify all steps in your write-up and be as detailed as possible so that I may give more partial credit.
  - **No late assignments will be accepted under any circumstances, but the two lowest homework scores will be dropped**.
- **Attendance and Absences**
  - Attendance is not required, but I may deviate at times from the textbook and you will be responsible for such class material.
- **Students with disabilities**
  - If you have a documented disability that may affect academic performance, you should: 1) make sure this documentation is on file with Disability Support Services (Allen Center, Room 111 / mailto:adarice@rice.edu¿ adarice@rice.edu / x5841) to determine the accommodations you need; and 2) meet with me to discuss your accommodation needs.