Midterm Topics

The midterm exam for M611 will be in Blocker 148, Wednesday, Oct. 29, 7:00-9:00 p.m. The exam will cover course material prior to Green’s function, but will not cover Green’s functions. There will be four to six problems, depending on problem length, with some straightforward calculations and some proofs. You will need to bring your own paper.

1. Explicit calculations

Examples of problems we’ve solved by explicit calculation include the following:

- Solutions to linear constant-coefficient ODE
- Examples and counterexamples (e.g., find a function $f \in L^1(0,1) \setminus L^2(0,1)$)
- Derivatives and integrals of multidimensional functions
- Classification of PDE
- PDE solutions by the method of characteristics (simple cases)
- PDE solutions by reduction to a radial variable (as with the Laplacian)

2. Proofs

Examples of topics from which proof-based problems may be taken include the following:

- Using the Contraction Mapping Principle to prove existence/uniqueness for ODE and integral equations
- $L^p$ and related inequalities (e.g., we found Hölder’s inequality indispensible here)
- Differentiability of a function defined by integration over a kernel (LDCT)
- Properties and applications of mollifiers
- Properties of harmonic functions (this is a broad topic, and we spent a lot of time with it)
- Properties of solutions to Poisson’s equation, especially on $\mathbb{R}^n$ (Newtonian potential)