

Midterm Topics

The midterm exam for M611 will be in Blocker 220, Wednesday, Oct. 23, 7:00-9:00 p.m. The exam will cover course material prior to Green's functions, 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 indispensable 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)