

MATH-6010 ADV SEMINAR IN MATH

Section 352, Spring 2016

Instructor: Dr. Jiahong Wu; Office: MS424;
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Hours of Class Meeting:

MWF, 1:30-2:20 @ MSCS 509

Office Hours:

Please feel free to stop by my office if you have questions or ideas on the materials covered in class.

Course Description and Course Content

This course has two purposes. The first is to provide a solid analysis and PDE background for those who intend to pursue an advanced degree in applied mathematics. The second is to present some of the developments on PDEs from fluid mechanics and geophysics, etc. The course will try to be self-contained. The following list outlines the major content of this course:

Basic functional analysis and Sobolev spaces: Banach space, inner product spaces, linear operators, dual spaces, weak and weak-star convergence, distributions, Fourier transforms, Hardy-Littlewood-Sobolev inequalities, Sobolev spaces, Holder space, Sobolev embedding inequalities.

Littlewood-Paley theory and Besov spaces: Partition of unity, Bernstein inequalities, homogeneous and inhomogeneous Besov spaces, paradifferential calculus

Transport and transport-diffusion equations: ODE inequalities, Osgood type Inequality, theory on transport equations and estimates, heat equation and transport- diffusion equations

Introduction to the incompressible Navier-Stokes equations: the Millennium Prize problem, Picard ODE existence theory, Leray-Hopf weak solutions, Fujita-Kato strong solutions

Some recent theory on the incompressible Navier-Stokes equations: Koch-Tataru theory, L^p solutions, various regularity criteria

Reference Books:

- A. Majda and A. Bertozzi, *Vorticity and Incompressible Flow*, Cambridge University Press, 2002.
- L.C. Evans, *Partial Differential Equations*, AMS, 2010.
- E. Stein, *Singular integrals and differentiability properties of functions*, Princeton University Press, 1970.
- H. Bahouri, J.-Y. Chemin and R. Danchin, *Fourier Analysis and Nonlinear PDEs*, Springer, 2011.

Grading Policy:

- Class Attendance—80% , Participation—20%
- Cut-offs for letter grades: A (90-100); B (75-89); C (60-74)