Math 5040: Topics in Applied Analysis I

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Lectures: MWF 1:25 PM-2:15 PM in MONT 245.

Office hours: MWF 2:15-3:15 PM in MONT 328, but feel free to stop in any time or e-mail to set up an appointment.

Class web page: www.math.uconn.edu/~connors/math5040s17/index.html

Textbook: *Introduction to the Numerical Analysis of Incompressible Viscous Flows*, William Layton, SIAM, 2008.

Synopsis: This course is appropriate for mathematics students who are interested in applications and numerical analysis, as well as other students with a strong mathematical background. The topic is computational fluid dynamics (CFD), focusing on the case of incompressible, viscous flows approximated using finite element methods. An introduction to some Hilbert spaces and functional-analytic concepts will be provided in conjunction with Galerkin-finite element methods to approximate fluid flows, and techniques to analyze the numerical properties of the ensuing algorithms. The partial differential equations (Navier-Stokes) used to model the fluid behavior are discussed, including both physical and analytical concepts. The Kolmogorov theory of turbulence is presented, along with methods to approximate the large scales of turbulent flows. Upon completion of the course, students should have a basic understanding of fluid mechanics, the Navier-Stokes equations, finite-element algorithms to approximate flows, and methods to analyze convergence and stability properties of algorithms. A computational project will be required, which will provide some hands-on CFD experience.

Homework: Homework will be assigned bi-weekly (roughly) that will cover some critical theoretical concepts of the course.

Final Project: A coding project will be required, for which students will use FreeFem++. This software package is free and provides a high-level language to implement CFD algorithms using the techniques developed in the course. In addition, it is a flexible and efficient code package to approximate solutions to most partial differential equations using finite element methods.

Grading: The final project will count for 25% of the final grade. Homework will account for the other 75%.