Numerical Solution of Partial Differential Equations

Applied and Comp Math 922

Section: G100

Term: 2009 Fall

Instructor: Nilima Nigam
Office Hours: M-W, 1pm-2:30 pm, or by appointment

Discussion Topics: This is an introduction to finite difference, finite element and spectral methods for partial differential equations. To keep the exposition simple during lectures, we shall discuss these methods and their analysis in the context of the heat, wave and Laplace equations. We will also confine ourselves to simple geometries and boundary conditions. However, this would be a dead-boring course if we never tried these methods on more interesting applications. You (the student) will explore these methods in more complex situations as part of your assignments and project.

Grading: Homework: 40% of the total grade.
Projects : 15% of the total grade.
Tests : 15% of the grade on Oct. 26, 2009
FINAL : A cumulative in-class final will be held in December.

Required Texts:

Recommended Texts: Reference texts: We will be using a variety of sources for this graduate course. The selections below are some of the classics in the field; there are several newer texts and papers as well which you could look at.
- Finite difference schemes and partial differential equations by J.C. Strikwerda, 2nd. Edition, SIAM. - Numerical analysis of spectral methods: Theory and Applications by D. Gottlieb and S.A. Orszag, CBMS-NSF Regional Conference Series in Applied Mathematics, SIAM.
- Numerical solution of partial differential equations by the finite element method by C. Johnson,
Dover.
- Numerical mathematics by A. Quarteroni, R. Sacco and F. Saleri, Springer.

Materials/Supplies:

Prerequisite/Corequisite: Prerequisites: A solid undergraduate PDE course, and an undergraduate course in numerical analysis will be a good foundation. Ideally you should have some experience in coding in MATLAB.

Notes: Learning Objectives: This course is intended as a graduate-level introduction to standard numerical methods for solving PDE. At the end of this course, you should be able to
- Recognize when a PDE requires a numerical solution as opposed to an analytic one;
- Understand the conceptual basis for finite difference, finite element and spectral methods;
- Analyze the consistency, stability and convergence of these methods in a range of settings;
- Evaluate which of a variety of algorithms is appropriate for a given situation;
- Implement these numerical methods for simple test cases, and also for more complex models.

Academic Honesty: All work that you turn in must be your own effort. Any group work will be mentioned as such. While it is a good strategy to study with others, any assignments you turn in must reflect your own work. Please make sure to cite all resources and references you use.

Policies: Class notes: I do not post notes online. However, feel free to set up a rotating note-taking arrangement, and/or latex the notes, and/or post them online. On-line communication: I attempt to reply to email in a timely fashion, but the average response time is 48 hours.
THE INSTRUCTOR RESERVES THE RIGHT TO CHANGE ANY OF THE ABOVE INFORMATION. Students should be aware that they have certain rights to

confidentiality concerning the return of course papers and the posting of marks. Please pay careful attention to the options discussed in class at the beginning of the semester.