Math 480: Special Topics: Numerical Solution of Differential Equations (Spring 2007)

Lectures:	MWF 9:30–10:20, CMU B006
Professor:	A. Greenbaum, C-434 Padelford, 543-1175
Office Hours:	MW 1:00–2:00
	Th 10:00–11:00
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Web Address:	http://www.math.washington.edu/~greenbau Course materials: Click on "Math 480".

Text: We will use course notes that can be downloaded from the course web page.

Some other good references (available in the Math Library) are: *Scientific Computing and Differential Equations* by Gene H. Golub and James M. Ortega; *Finite Difference Schemes and Partial Differential Equations* by John C. Strikwerda; *A First Course in the Numerical Analysis of Differential Equations* by Arieh Iserles.

Course Description: This course will cover the theory and practice of solving differential equations numerically. The emphasis will be on finite difference schemes for approximating the solutions to partial differential equations and on iterative methods for solving the systems of linear and nonlinear equations that arise from these difference methods. We also will cover the fast Fourier transform (FFT).

1. Introduction to Matlab (Ch. 1).
2. Numerical differentiation (Ch. 7).
3. Two-point boundary value problems: finite difference and finite element methods (Ch. 11).
4. Numerical solution of partial differential equations (Ch. 12).
   - **(a)** Parabolic, hyperbolic, and elliptic equations (e.g., the heat equation, the wave equation, and Poisson's equation).
   - **(b)** Separation of variables.
   - **(c)** Explicit methods and stability. The CFL condition.
   - **(d)** Implicit methods.
   - **(e)** Semidiscrete methods and the method of lines.
   - **(f)** Fast methods for Poisson's equation. The FFT.
5. Iterative methods for solving linear systems (Ch. 10, sec. 3).
   - **(a)** Simple iteration: Jacobi, Gauss-Seidel, and SOR methods.
   - **(b)** The conjugate gradient method.
   - **(c)** Iterative methods for nonsymmetric linear systems.

There will be homework assignments (with MATLAB programming), a midterm (tentatively scheduled for **Wed., May 2**), and a term project. The term project will consist of a written report

on a subject of your choosing related to numerical analysis and, especially, the numerical solution of differential equations. Students are encouraged to give oral presentations of their work as well, and some class time will be set aside for this toward the end of the term. There will *not* be a final exam.

Grading: Homework will count 45%, the midterm will count 25%, and the term project will count 30%. Late homework will be marked down by 10% of the total possible points for each day late; solutions to homework problems that have already been gone over in class will not be accepted.