Math/AMath 595: Finite Element Methods
(Winter 2001)

Lectures:	MW 3:30–4:50, room 121 RAI
Professor:	Anne Greenbaum, C-434 Padelford, 543-1175
Office Hours:	MW after class – 6:00, or by appointment or drop in.
e-mail:	greenbau@math.washington.edu
Web Address:	http://www.math.washington.edu/~greenbau
	Course materials: Click on "Math/AMath 595".

Text: *Numerical solution of partial differential equations by the finite element method*, by Claes Johnson, Cambridge University Press, 1987. (available at Professional Copy 'n' Print, 4200 University Way NE)

Reserve list: The following books are on reserve in the Mathematics Research Library or are available in the Engineering Library.

1. *The Mathematical Theory of Finite Element Methods* by Susanne C. Brenner and L. Ridgway Scott (1994).
2. *The Finite Element Method for Elliptic Problems* by Philippe G. Ciarlet (1978).
3. *An Analysis of the Finite Element Method* by Gilbert Strang and George J. Fix (1973).

The course will cover:

1. Introduction to FEM for elliptic problems: Variational formulation of a one-dimensional model problem; generating a finite element approximation with piecewise linear functions; an error estimate for the model problem; the Hilbert spaces $L_2(\Omega)$, $H^1(\Omega)$, and $H_0^1(\Omega)$; natural and essential boundary conditions.
2. Abstract formulation of the finite element method for elliptic problems: Generating a finite element approximation in two and more dimensions; new problems encountered; regularity requirements; some finite element spaces; error analysis for elliptic problems; the energy norm and the $L_2(\Omega)$-norm.
3. Some applications to elliptic problems.
4. Direct and iterative methods for solving the systems of linear equations arising from finite element approximations: Gaussian elimination; operation counts; band matrices; the frontal method; nested dissection; the conjugate gradient method; condition number of the stiffness matrix; preconditioning; multigrid methods.
5. FEM for parabolic and hyperbolic problems: semi-discretization in space; adaptive methods in space and time.

There will be weekly homework assignments (with some programming) and a course project. The project may involve using the finite element method to solve a problem of your choice, reading and reporting on a paper concerning aspects of the finite element method beyond those covered in class, etc.