EM394H/CAM394H ADVANCED THEORY OF FINITE ELEMENT METHODS
Spring 05, # 12675/ # 63840 , MWF 8:00-9:00, WRW 413

The class will focus on Galerkin methods (predominantly finite and some boundary elements) and linear boundary-value problems only. We shall begin with a short review of abstract variational problems (Babuśka's Thm, Thm., Babuśka - Brezzi theory for mixed problems, indefinite problems and asymptotic convergence), and converge quickly to a detailed study of energy Sobolev spaces - H^1, $H(curl)$ and $H(div)$, including fractional spaces and state-of-the-art results for boundary spaces including $H^{-\frac{1}{2}}(curl, \Gamma)$ and $H^{-\frac{1}{2}}(div, \Gamma)$. The presentation will be set in polyhedral (Lipschitz) domains.

The presented convergence analysis will cover h, p and hp methods. Projection-based interpolation will be presented, and compared with classical (Lagrange, Hermite) interpolations and other quasi-local interpolation techniques.

Applications will include classical elliptic problems, elasticity, Stokes problem, Helmholtz and Maxwell equations, Time permitting, singularly perturbed problems (convection dominated diffusion, elastic thin wall structures) will be discussed as well.

Text books:

1. William McLean, *Strongly Elliptic Systems and Boundary Integral Equations*, Cambridge University Press, 2000 (required, a number of copies have been reserved at Coop),

2. J. T. Oden, L. Demkowicz, *Applied Functional Analysis*, CRC Press, 1996

3. Ch. Schwab, *p and hp-Finite Element Methods*, Clarendon Press, Oxford 1998.

The class will be conducted in a seminar style. No exams (including final) will be given. Instead, problems with varying difficulty, ranging from "hard theory", through practice exercises, to assignments involving numerical experiments , will be assigned in the class on a continuous basis. Each problem will be worth a number of points (5-20). The final grade will be determined by the number of collected points.

Final score range	grade
100 and above	A+
80 - 100	A
60 - 80	B
40 - 60	C
20 - 40	D
00 - 20	F

Discussion session; one hour, once a week, to be determined.

Instructor: Dr. Leszek Demkowicz, ACES 6.326, Office hours: immediately after the class.