Midterm Exam Outline

Math 206D: Finite Element Methods for PDEs
Professor: Paul J. Atzberger

- Weak formulation and approximation of partial differential equations (PDEs).
  - Hilbert spaces for given boundary conditions and constraints.
  - Establishing continuity and coercitivity of bilinear forms.
  - Well-possedness of variation problems.
  - Ritz-Galerkin approximation.
  - Lax-Milgram theorem.

- Ciarlet's formal definition of a finite element.
  - Polynomial shape spaces.
  - Conditions to determine shape function.
  - Common nodal variables.

- Finite element bases.
  - Lagrange triangular elements.
  - Hermite triangular elements.
  - Argyris triangular elements.
  - Quadrilateral elements.
  - Serendipity elements.

- Sobolev spaces.
  - Sobolev’s inequalities.
  - Averaged taylor polynomial.
  - Hilbert-Bramble theorem.

- Local and global estimates for FEM approximation.
  - Cea's theorem.
  - Bounds for polynomial interpolation.
  - Conforming vs non-conforming finite elements.
  - Convergence rates for the FEM bases above.