THE UNIVERSITY OF COLORADO BOULDER

ASEN 6519: Mathematical Foundations of Finite Element Analysis
Fall 2018

SYLLABUS

Instructor: Assistant Professor John Evans
Office: ECAE 159
E-Mail Address: john.a.evans@colorado.edu

Office Hours: Open Door Policy / By Appointment

Time: Tuesday/Thursday, 11:00 am – 12:15 pm

Location: KCEN N252

Web Page: Desire2Learn (learn.colorado.edu)

Course Objective:

To establish a fundamental understanding of the mathematical foundations of the finite element method.

Course Overview:

The finite element method is perhaps the most widely used technique in computer aided engineering. While many courses at the University of Colorado Boulder cover how to design and implement a finite element method for applications in structural mechanics, fluid mechanics, and electromagnetics, they typically do not review the mathematical machinery required to study the stability and convergence properties of a finite element method. This course serves to fill that

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Required Textbook:

An Introduction to the Mathematical Theory of Finite Elements, Oden and Reddy, Dover, 2011.

Reference and Supplemental Textbooks:

The Finite Element Method, Hughes, Dover, 2000.
The Finite Element Method for Elliptic Problems, Ciarlet, SIAM, 2002.
The Mathematical Theory of Finite Element Methods, Brenner and Scott, Springer, 2008.
Theory and Practice of Finite Elements, Ern and Guermond, Springer, 2004.

Outline of Course:

Part 1: Mathematical Preliminaries
   a) Sets, Measure Spaces, Vector Spaces, Normed Linear Spaces, and Inner Product Spaces
   b) Definition of a Banach Space and Major Results from Banach Space Theory
   c) Definition of a Hilbert Space and Major Results from Hilbert Space Theory
   d) Definition of a Sobolev Space and Major Results from Sobolev Space Theory

Part 2: Variational Formulation of Boundary Value Problems
   a) Variational Form of Poisson, Stokes, and Advection-Diffusion Equations
   b) Strong versus Weak Boundary Conditions
   c) The Lax-Milgram Theorem
   d) Existence, Uniqueness, and Stability
   e) Elliptic Regularity

Part 7: Weak Enforcement of Boundary and Interface Conditions
    a)

Literature Review Project:

A literature review project will be assigned approximately one month into the

rosters are provided to the instructor with the student's legal name. The instructor will gladly honor your request to address you by an alternate name or gender pronoun. Please advise the instructor of this preference early in the semester so that the instructor may make appropriate changes to his records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

Discrimination and Harassment:

The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (including sexual assault, exploitation, harassment, dating or domestic violence, and