Finite Element Method (AME/CEES 5763)

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Class hours: 12:00 PM – 1:15 PM (Mondays & Wednesdays)

Lecture room: Carson 0205

Office hours: Attar Tues 8:00 -9:00 AM or by appointment; Gramoll MW 11:00-12:00 and 1:30-2:30

Course objectives: Physical phenomena in engineering and science are often described in terms of partial differential equations (PDEs). As these PDEs are often difficult or impossible to solve exactly, numerical methods are typically used to obtain an approximate solution to the equations. The finite element method is one example of the aforementioned numerical method. In this course students will learn the underlying theoretical concepts which the finite element method is based upon. In addition students will be instructed how to apply these concepts to a) develop their own finite element programs and b) use a particular commercial finite element code (ANSYS).

Course content: Some topics to be covered include:
1) Direct approach for discrete 1D bar
2) Development of strong forms (governing equations and boundary conditions)
3) Overview of other numerical methods for approximating solution of differential equations
4) Development of weak forms (required for finite element methods)
5) Function (trial and test) approximation
6) Numerical integration (Gauss quadrature)
7) Formulating finite element equations

With the exception of 1) and 3), each of the above will be discussed, when applicable, for both one-dimensional and multi-dimensional problems in multiple disciplines (mechanics, heat transfer, etc.)

Text book: A First Course in Finite Elements. Authors: Fish and Belytschko


Grading:
- Homework 30%
- Exams 30%
- Final Exam 20%
- Programming Projects 20%

Final grade scheme (approximate):
- A 90-100 %
- B 80-90 %
- C 70-80 %
- D 60-70 %
**Computer used and programming projects:** The course will use ANSYS as the commercial tool to solve various complex structural mechanics homework problems. Instructional lectures will be given on how to use ANSYS for Beams, Trusses and 2D/2D linear structures. ANSYS use will be needed for some homework and exam problems.

To reinforce theoretical learning, three programming projects will be completed by each student. Using FORTRAN, a basic FEM program will be completed for Truss, Beam and 2D Torsion type programs. Basic FORTRAN programming instruction will be given and no prior knowledge of FORTRAN is required or expected. However, all students are expected to know basic numerical methods, including how to program (any language) to solve for roots and simultaneous equations.

**Special considerations:** Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate the student's educational opportunities.

**Academic Misconduct:** Please refer to current University policies. http://integrity.ou.edu/