BAKER COLLEGE
STUDENT LEARNING OUTCOMES

ME 4710 Introduction to Finite Element Analysis (FEA)
3 Semester Hours

Student Learning Outcomes & Enabling Objectives

1. Explore Finite Element Method
   a. Explain Finite Element Analysis (FEA).
   b. Review a brief history of finite element method
   c. Distinguish discrete and continuum structures
   d. Illustrate various finite element types
   e. Describe the general steps used in FEA
   f. Examine typical applications of FEA
   g. Summarize the advantages of finite element method

2. Analyze spring, truss and beam structures
   a. Define the degrees of freedom at each node
   b. Derive interpolation and shape functions, and element stiffness matrices
   c. Examine local and global coordinate systems
   d. Derive transformation matrices and obtain global stiffness matrix for each element
   e. Apply direct stiffness method to construct the structural equations
   f. Apply boundary conditions and solve for displacements, member forces, stresses, and support reactions
   g. Construct shear and bending moment diagrams for beams

3. Evaluate the Behavior of Plane Frames
   a. Derive transformation matrices and obtain global stiffness matrix for a frame element
   b. Solve for displacements, member forces, stresses, and support reactions
   c. Construct shear and bending moment diagrams for frames

4. Analyze Plane Stress and Plane Strain Problems Using 2D Elements
   a. Distinguish plane stress and plane strain
   b. Derive the stiffness matrix for a constant strain triangular (CST) element
   c. Describe body and surface forces
   d. Derive the stiffness matrix for a rectangular element e
   e. Solve problems using CST and rectangular elements
   f. Examine the practical considerations in modeling

5. Apply FEA to Fluid Flow in Porous Media
    a. Describe the equations used for steady-state, incompressible, and inviscid fluid flow through and around pipes
    b. Determine 1D and 2D finite element fluid flow through porous media and around solid objects or through pipes

6. Analyze bars, trusses, and planes stress problems for thermal stresses due to temperature change
    a. Describe the thermal stress problem
    b. Derive thermal force matrices
    c. Solve for thermal stresses

7. Evaluate trusses, beams, frames, plane stress, and plane strain problems using the commercial FEA software, ANSYS
    a. Construct finite element models using ANSYS
    b. Solve problems and post process results
    c. Compare FEA results with available theoretical and experimental results

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These SLOs are not approved for experiential credit.

Effective: Fall 2017