MECH 308: Finite Element Analysis

Catalog description: 3.0 units
Development of finite element formulation from fundamental governing engineering equations. Coverage includes areas ranging from elasticity, vibration, and heat transfer to acoustics and composites. 2.0 hours discussion, 2.0 hours activity.

Prerequisites: CIVL 311, MECH 306 (or faculty permission)
Recommended: MECH 210, PHYS 204C

Course objectives: For students to
1. Understand how and why the finite element technique works
2. Learn how the finite element method is implemented (both algorithmically and numerically) by developing simple finite element computer code
3. Develop finite element formulations of engineering problems from a variety of application areas including stress, heat transfer, and vibration analysis
4. Learn to use Nastran$^®$ (a commercial finite element program)
5. Understand how to use finite element analysis in design

Course outcomes: Students shall be able to
1. Develop finite element formulations of 1-degree-of-freedom problems and solve them
2. Write an Excel$^®$ spreadsheet to solve a finite element problem
3. Using Nastran$^®$ perform stress, thermal, and modal analysis
4. Compute the stiffness values of an 8-noded element

Topics covered
1. Introduction to the finite element analysis concept
2. Review of relevant topics in linear algebra
3. Development of finite element formulations of problems with 1-degree-of-freedom, using the direct method
4. Development of a 2-degree-of-freedom finite element formulation for an elasticity problem
5. Introduction to the Method of Weighted Residues and applying it to generate finite element formulations in heat transfer and fluid mechanics
6. Development of equations of motion for vibrating bodies and performance of modal analysis using Nastran$^®$

Class/Laboratory schedule
One hundred minutes of lecture and one hundred minutes of activity per week

Contribution of course to meet the professional component: none

Relationship of course to Mechanical Engineering Program Outcomes

This course contributes principally to Program Outcomes A and D. Students must achieve a grade of C or better in the portion of the course devoted to Nastran$^®$ to pass the course and satisfy Program Outcome D.