MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 404: Applied Finite Element Analysis (4 units) Elective

Course Description: (2019-20 Catalog)
Finite element based solutions to engineering problems with an emphasis on elastostatic problems in structural mechanics. The power and pitfalls associated with the finite element method highlighted through practical modeling assignments. Introduces the use of commercial finite element codes. 3 lectures. 1 laboratory.

Prerequisite Courses:
ME 328 or CE 406 or [BMED 410 and (CE 207 or CE 208)]

Prerequisites by Topic:
Intermediate Stress Analysis

Textbook:
Text: Concepts and Applications of Finite Element Analysis, 4th edition, by Robert. D. Cook and David S. Malcus, 2002.

References:
Formulas for Stress and Strain, by R.J. Roark & W.C. Young
Advanced Mechanics of Materials, by W.B. Bickford
Advanced Mechanics of Materials, by R. D. Cook & W. C. Young

Course Coordinator/Instructor: Sthanu Mahadev, Professor of ME

Course Learning Outcomes:
The student will be able to:

1. Apply numerical solutions to elasticity and possibly heat transfer problems using the finite element method.
2. Describe Energy Theorems and their implementation in the finite element setting.
3. Evaluate approximations associated with the finite element method.
4. Apply convergence requirements and associated modeling techniques and methods.
5. Select appropriate elements and analysis types given a physical system.
6. Develop boundary conditions exploiting symmetry where appropriate.
7. Evaluate the validity of solutions based on fundamental engineering principals.

Relationship of Course to Mechanical Engineering Student Outcomes:
SO 1: Mastered (M)
SO 2:
SO 3: Mastered (M)
SO 4:
SO 5:

SO 6:
SO 7: Mastered (M)

Topics Covered:

- Elasticity review
- Bar elements
- Coordinate Transformations, beam elements
- Finite Element Formulation (stiffness matrix, shape functions)
- Finite Element Theory (Variations, Galerkin)
- Loads and Secondary Variables
- Symmetry
- Constraints
- Planar Elements
- Isoparametric formulation
- Modeling Errors, Accuracy
- Numerical Errors, Convergence
- Introduction to Other Elements – Solid, Plates, Shells
- Structural Dynamics
- Nonlinear Analysis

Laboratory Projects:

- Introduction to a commercial Finite Element program
- Truss Analysis
- Planar Elements
- System Modeling with Beams and Shells
- Structural Dynamics
- Modeling Contact
- Modeling project with subject chosen by the student

Class/Lab Schedule: Three 50 minute lectures/week and one 170 minute lab/week

Contribution of Course to Meeting the Professional Component:

(a) College-level mathematics and basic sciences:	0 credits
(b) Engineering Topics:	4 credits
(c) General Education:	0 credits
(d) Other:	0 credits

Prepared by: Sthanu Mahadev **Date:** July 07, 2020