ENG ME 580/MS 580 Theory of Elasticity

2008-2009 Catalog Data:
ENG ME 580/MS 580 Theory of Elasticity Prereq: ENG ME 309 or equivalent. An introduction to the general theory of solid deformation; small deformation emphasized. Topics include: Cartesian tensors, indicial notation. Introduction to continuum mechanics: deformation of continuous media, deformation gradient, strain definitions. Stress, Cauchy's postulate, Cauchy and Piola-Kirchhoff stress tensors. Balance laws. Constitutive equations, strain energy and Green's postulate. Linear Elasticity: two-dimensional problems, Airy stress function, in-plane loading of strips, St. Venant's principle, complex variable methods, Goursat-Muskhelishvili representation, stress concentrations around holes and cracks. Three-dimensional problems, Kelvin's solution, the Boussinesq problem, Hertzian contact, Eshelby's energy-momentum tensor. 4 cr.

Class/Lab Schedule: 4 lecture hours per week

Status in the Curriculum: Elective

Textbook(s) and/or Other Required Material: None

Coordinator: Paul Barbone, Associate Professor, Mechanical Engineering

Prerequisites by topic:
1. Exposure to a continuum field theory at the advanced undergraduate level.
2. Elementary exposure to concepts of stress and strain.

Goals:
Students will master concepts of stress and strain tensors, know how to formulate a well posed elasticity problem, and learn several methods for its solution.

Course Learning Outcomes:

As an outcome of completing this course, students will:
- i. Become proficient with indicial notation and master manipulation of Cartesian vector and tensor equations.
- ii. Understand basic tensorial strain and stress measures.
- iii. Know how to formulate a well posed elasticity boundary value problem.
- iv. Learn several methods to solve elasticity boundary value problems, including some or all of the following: superposition, Green's functions, separation of variables, transform methods, dimensional analysis, complex variable methods, integral equations, variational methods.
- v. Follow the historical development of the subject from Navier's time to the present.

Course Learning Outcomes mapped to Program Outcomes:

Program:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Course:	i-v				iii-v				v	iv	iv	iv		
Emphasis:	5	1	1	1	5	1	1	1	4	4	5	5	1	1

Topics (time spent in weeks):

1. Field Equations (4)
2. Elementary 3D Solutions of Linear Elasticity (2)
3. Plane Problems (4)
4. Advanced Problems (2)
5. Inverse Elasticity Problems: as time permits

Contribution of Course to Meeting the Professional Component:

Engineering topics: 100%

Status of Continuous Improvement Review of this Course:

Prepared by: Paul Barbone **Date**: June 9, 2009