AE 6114 Fundamentals of Solid Mechanics

HOURS: 3-0-3

CATALOG DESCRIPTION (25 words or fewer):
Unified overview of fundamental aspects of solid mechanics, from nonlinear continuum mechanics to linear elasticity, including an introduction to energy methods and other special topics;

PREREQUISITES:
COE 3001

TEXTBOOKS:
Course notes

COURSE OBJECTIVES:
Develop understanding of introductory, graduate-level aspects of mechanics of solids within a unified framework to facilitate initiation to research activities in this and related fields.

LEARNING OUTCOMES:
Students will be able to:
1. Choose best formulation, e.g. linear vs. nonlinear, for problems in solid mechanics.
2. Formulate the equations corresponding to the boundary value problem in solid mechanics.
3. Utilize basic techniques for solving boundary value problems in solid mechanics.

GRADING:
Homework: 20%
Midterm Exams (2):40%
Final Exam: 40%

LEARNING ACCOMMODATIONS:
If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the ADAPTS office (http://www.adapts.gatech.edu).

TOPICAL OUTLINE:

Topic	Lecture Hours
I. Course Overview and Background	**1**
II. Preliminary Mathematical Concepts	**4**
A. Cartesian tensors: definition and algebraic operations	1
B. Summation convention, Kronecker delta, and permutation symbol	0.5
C. Change of basis	1
D. Eigenvalues and eigenvectors of second order tensors	1
E. Properties of second order tensors	0.5
III. Finite Kinematics	**10**
A. Body and its configurations	0.5
B. Deformation mapping	0.5
C. Eulerian and Lagrangian formulations	0.5
D. Kinematics of local deformations	1.5
E. Infinitesimal change in length, area, and volume	2
F. Other measures of deformation	2
G. Linearization of measures of deformation	1
H. Infinitesimal deformations	2
IV. Balance Laws	**5**
A. Conservation of mass	0.5
B. Balance of linear momentum	0.5
C. Cauchy's stress principle	0.5
D. Cauchy's stress tensor	0.5
E. Balance of angular momentum	1
F. Material form of balance laws	1
G. Linearization of balance laws	1
V. Linear Elasticity	**11**
A. Generalized Hooke's Law	1
B. Symmetries of elasticity tensor	1
C. Boundary value problem in elastostatics	1
D. Principle of superposition	1
E. Two-dimensional problems in elasticity	2
F. Problems in polar coordinates	1
G. Airy stress potential for plane problems	1
H. Sample problems	3
VI. Energy principles	**7**
A. External and deformation power	0.5
B. Deformation power identity theorem	1
C. Internal energy	0.5
D. Principle of minimum potential energy	1
E. Rayleigh-Ritz method	1
F. Introduction to finite element method	1
G. Sample problems	2
VII. Special topics	**7**
A. One-dimensional elastic wave propagation	3
B. Nonlinear constitutive models	2
C. Peridynamics	2
Tests/Exams/Reviews	**3**
Total	**45**