University Of California, Berkeley
Department of Mechanical Engineering

ME 284-Nonlinear Theory of Elasticity (3 Units)

Graduate Course

Syllabus

CATALOG DESCRIPTION

Fundamentals of the nonlinear theory of elasticity. Material symmetry. Exact solutions in elastostatics. Internal constraints. Useful strain-energy functions. Uniqueness. Compatibility conditions. Volterra dislocations. The Eshelby tensor. Small deformations superposed on finite deformations. Waves in pre-stressed solids. Stability. Bifurcations and buckling. Acceleration waves. Entropic elasticity.

COURSE PREREQUISITES

ME 185 or consent of instructor.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL :

None (reading assigned by instructor)

COURSE OBJECTIVES:

To provide students with a working knowledge of elasticity.

DESIRED COURSE OUTCOMES:

Ability to embark on modern research in the field.

TOPICS COVERED:

1. Introduction: The nonlinear and linear field theories.
2. Review of relevant continuum mechanics.
3. Mathematical idealizations of an elastic material. Experiments, Cauchy and Green elasticity. Thermodynamical aspects.
4. Invariance requirements.
5. Material symmetry: Isotropy and anisotropy.
6. The initial-boundary-value problem. Some exact solutions.
7. Internally constrained materials: Incompressibility, inextensibility.
8. Useful strain-energy functions. Solutions and applications.
9. Universal relations of use in experimental verification. Controllable deformations. Ericksen's theorem.

10. Compatibility conditions.

11. Volterra dislocations.

12. The Eshelby tensor.

13. Small deformations superposed on large deformations. Waves in prestressed solids.

14. Stability criteria and their implications for constitutive equations. Material instabilities.

15. Bifurcations and buckling.

16. Acceleration waves.

17. Thermoelasticity. Entropic elasticity of rubber and polymers.

CLASS/LABORATORY SCHEDULE

3 hours of lecture per week, 0-1 hour of discussion per week.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES:

40% Homework; 50% Course Project; 10% Class participation

PERSON(S) WHO PREPARED THIS DESCRIPTION

Professor James Casey, 15 January 2016

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): NONLIN ELASTICITY
TIE CODE: LECT
GRADING: Letter and/or Pass Not Pass
SEMESTER OFFERED: Fall or Spring
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTORS: Staff
DURATION OF COURSE: 14 weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: None