Ae/AM/CE/ME 102c Mechanics of Structures and Solids 2007-'08

Instructor: G. "Ravi" Ravichandran 109 Firestone x4525
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Lectures: Tu, Th 9:00-10:25 AM, 306 Firestone

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URL: http://www.its.caltech.edu/~ae102
Refer to this homepage for information and updates related to the course.

Textbook: There is no required textbook. Reference books are on reserve in the SFL.

Homework: Homework will be assigned every week and due the following week in class, except during exam weeks. Homework assignments will be due in a week (before the class starts). Late homeworks will not be accepted, except in special cases such as a doctor-documented illness. Students may discuss homework problems with each other, but ultimately solving and writing should be done by students on their own. For example, you should not include in your solution a step someone mentioned that you don't fully understand. Use of packages such as Matlab and Mathematica is permitted and encouraged. There will be a project assigned after the mid-term.

Exams: There will be a mid-term exam (5/1/08) and a final exam (6/5/08)
(All exams will be in-class, closed book, and closed class notes)

Grading: The weighting for the final grade will be as follows:
Homework: 30%, Mid-term Exam: 15%, Term Project: 15%, Final Exam: 40%

TOPICS

1. Stress waves
   - One dimensional wave propagation: uniaxial stress and uniaxial strain
   - Reflection and refraction of waves
   - Surface waves (Rayleigh)
   - Wave guides; Dispersion

2. Composites
   - Homogenization; Effective properties
   - Eshelby's inclusion problem
   - Anisotropic elasticity
   - Laminate theory
   - Boundary value problems

3. Viscoelasticity
   - Creep compliance; Time-dependence
   - Maxwell, Voigt, Voigt-Kelvin element

- Time-temperature superposition and shifting
- Sinusoidal deformations
- Boundary value problems

4. Atomistic models of crystalline solids
   - Bravais lattice; Pair potentials
   - Atomisticc-Continuum linkage (Cauchy-Born hypothesis)
   - Embedded atom method

5. Finite Elasticity
   -Elasticity of rubbery polymers
   -Constitutive models
   -Boundary value problems

6. Micromechanics of Plasticity
   -Dislocations
   -Peierls-Nabarro model
   -Crystallographic slip: Schmid criterion, Taylor's hypothesis
   -Polycrystals
   -Thin films

Reference Books (on reserve in SFL)

S. P. Timoshenko and J. N. Goodier, "Theory of Elasticity," McGraw-Hill

Y. C. Fung, "Foundations of Solid Mechanics," Prentice Hall

I. S. Sokolnikoff, "Mathematical Theory of Elasticity," McGraw-Hill

H. Kolsky, "Stress Waves in Solids," Dover

K. F. Graff, "Wave Motion in Elastic Solids," OSU Press

R. M. Christensen, "Theory of Viscoelasticity; an Introduction," Academic Press

D. R. Bland, "The Theory of Linear Viscoelasticity," Pergamon Press

D. Hull, "An Introduction to Composite Materials," Cambridge University Press

R. M. Christensen, "Mechanics of Composite Materials," Krieger

S. Nemat-Nasser and M. Hori, "Micromechanics: Overall Properties of Heterogeneous Materials," North-Holland

R. Phillips, "Crystals, Defects and Microstructures: Modeling Across Scales," Cambridge University Press

M. Born and K. Huang, "Dynamical Theory of Crystal Lattices," Oxford University Press

L. R. G. Treolar, "The Physics of Rubber Elasticity," Oxford University Press

R. W. Ogden, **"**Non-linear Elastic Deformations," Halstead Press

T. Mura, "Micromechanics of Defects in Solids," Kluwer Publishers

A. S. Khan and S. Huang, "Continuum Theory of Plasticity," Wiley-Interscience