MEC 536 Mechanics of Solids – Fall 2011

Instructor: Toshio Nakamura (toshio.nakamura@sunysb.edu)

When sending emails, include MEC536 in the subject line.

Lectures: Thurs 3:50 – 6:40pm, Physics P122

Office Hour: Monday and Thursday 1:30 – 3:30pm, Light Engineering 137

Text Book:
Mechanics of Solids and Material by Asaro and Lubarda, Cambridge Univ. Press. OUT OF PRINT


Other Related Books:
Continuum Mechanics by Mase, Schaum Outlines Series, McGraw-Hill
An Introduction to Continuum Mechanics by J. N. Reddy, Cambridge
Elastic and Inelastic Stress Analysis by Shames and Cossarelli, Prentice-Hall
Introduction to the Mechanics of a Continuous Medium by Malvern, Prentice-Hall
Foundation of Solid Mechanics by Fung, Prentice-Hall
Deformation of Elastic Solids by Mal and Singh, Prentice-Hall (out of print)

Grading: Homework – 20%
Mid-Term Test (early Nov) – 35%
Final Exam (12/16 at 2:15-4:45pm) – 45%

Summary:
This course is designed to study the fundamentals of solid mechanics (e.g., stress, deformation) as well as to introduce various topics of the field (e.g., composites, plasticity and fracture mechanics). In Elasticity course (MEC541), 2D and 3D linear elastic problems will be solved with stress functions, displacement potentials and Laplace transform. There are also Plasticity (MEC543), Composites (MEC552) and Fracture Mechanics (MEC641) courses that cover the subjects more in-depth.

Required Background:
Two undergraduate courses in solid mechanics (equivalent to MEC363 and MEC455 at Stony Brook) that cover the following subjects.

- Basic understanding of stress and strain (e.g., formulations, Mohr’s circle).
- Linear stress-strain relation – Hooke’s law, Young’s modulus, Poisson’s ratio.
- Simple beam theory – bending moment, shear force of beams.
- Torsion of circular/ring cross-section.
- Plane stress and plane strain conditions – various stress & strain components.
- Strain energy and some energy based principles.
- Stress function (Airy & Torsional).
Course Outline

1. Introduction (1 week) – A & L (Ch. 1 & 2), Mase, Handout
   - Vector, Tensor and Indicial Notation

2. Review of Stress and Strain (1 week) – Mase, Handout
   - Equilibrium, Compatibility, Constitutive Equations
   - Strain Energy
   - Principle of Virtual Work

3. Deformation (1.5 weeks) – A & L (Ch. 4), Mase
   - Deformation Gradient Tensor
   - Finite Strain Tensors
   - Strain-Dispacement Equations

4. Analysis of Stress (1.5 weeks) – A & L (Ch. 5), Mase
   - Balance Law
   - Cauchy’s Stress Tensor
   - Equilibrium and Equations of Motion

5. Constitutive Equation (2 weeks) – A & L (Ch. 7), Mase
   - Elasticity
   - Anisotropic Solids

6. Elastic Problems (2 weeks) – A & L (Ch. 8)
   - Navier’s Equation
   - Uniqueness, Minimum Potential Energy
   - Simple Linear Elastic Boundary Value Problems

7. Plasticity (2 weeks) – A & L (Ch. 26), Handout
   - Mises and Tresca Yield Criteria
   - Limit theorem, Simple Boundary Value Problems

8. Fracture Mechanics A & L (Ch. 17 & 19), – Handout
   - Linear Elastic Crack Tip Field, Stress Intensity Factor
   - Energy Release Rate, J-integral, Fracture Toughness

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