

MEC 536 Mechanics of Solids – Fall 2018

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

When sending emails, include MEC536 in the subject line.

Lectures: Tuesdays 2:30 – 5:20pm, Melville Library N3074

Office Hour: Monday and Thursday 1:30 – 3:00pm, Light Engineering 137

Recommended Text Book:

Mechanics of Solids and Material by Asaro and Lubarda, Cambridge Univ. Press.

Other Related Books:

Applied Mechanics of Solids by Bower, CRC Press

Continuum Mechanics by Mase, Schaum Outlines Series, McGraw-Hill

An Introduction to Continuum Mechanics by 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	–	30%
	Mid-Term Test (late October?)	–	30%
	Final Exam (12/18 at 11:15-1:45pm)	–	40%

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 MEC455/530 at Stony Brook) that cover the following subjects. *Make sure you have sufficient background to take the course.*

- *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).*

The course also uses computer software (Mathematica, Matlab, etc.) to solve equations.

Course Outline

1. Introduction (0.5 class) – *A & L (Ch. 1 & 2), Mase, Handout*
 - Vector, Tensor and Indicical Notation
2. Review of Stress and Strain (0.5 class) – *Mase, Handout*
 - Equilibrium, Compatibility, Constitutive Equations
 - Strain Energy
 - Principle of Virtual Work
3. Deformation (2.5 classes) – *A & L (Ch. 4), Mase*
 - Deformation Gradient Tensor
 - Finite Strain Tensors
 - Strain-Displacement Equations
4. Analysis of Stress (1.5 classes) – *A & L (Ch. 5), Mase*
 - Balance Law
 - Cauchy's Stress Tensor
 - Equilibrium and Equations of Motion
5. Constitutive Equation (2 classes) – *A & L (Ch. 7), Mase*
 - Finite Elasticity
 - Anisotropic Solids
6. Elastic Problems (2 classes) – *A & L (Ch. 8)*
 - Navier's Equation
 - Uniqueness, Minimum Potential Energy
 - Simple Linear Elastic Boundary Value Problems
7. Plasticity (2 classes) – *A & L (Ch. 26), Handout*
 - Mises and Tresca Yield Criteria
 - Limit theorem, Simple Boundary Value Problems
8. Fracture Mechanics (1 class) – *A & L (Ch. 17 & 19), – Handout*
 - Linear Elastic Crack Tip Field, Stress Intensity Factor
 - Energy Release Rate, J -integral, Fracture Toughness

Americans with Disabilities Act

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact Disability Support Services at (631) 632-6748 or <http://studentaffairs.stonybrook.edu/dss/>. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential. Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website: <http://www.sunysb.edu/ehs/fire/disabilities.shtml>

Statement on Academic Dishonesty

Academic dishonesty is an extremely serious offense and will not be tolerated in any form. Academic dishonesty in general is the presentation of intellectual work that is not originally yours. Examples include, *but are not limited to*, copying or plagiarizing class assignments including homework, reports, designs, and other submitted materials; copying or otherwise communicating answers on exams with other students; bringing unapproved aids, either in physical (written) or electronic form to an exam; obtaining copies of an exam prior to its administration, etc. Academic dishonesty violates both the ethical and moral standards of the Engineering profession and all infractions related to academic dishonesty will be prosecuted to the fullest via the CEAS CASA committee. For you, the honest student, academic dishonesty results in lower class curves, hence a depression in your GPA and class standing, while cheapening the degree you earn.