The George Washington University
Washington, D.C.

MAE/CE 6207 – Theory of Elasticity

Spring 2014 – Main Campus

References: *Elasticity in Engineering Mechanics*, third edition, by A.P. Boresi, K.P. Chong, and J.D. Lee (Wiley, 2010), ISBN 9780470402559.
Elasticity, third edition, by J.R. Barber (Springer, 2010), ISBN 9789048138081.

Notes: *Elasticity* by G.C. Everstine

Instructor: Gordon C. Everstine, `http://gwu.geverstine.com`
gw(at)geverstine(dot)com, 301-977-0936

Schedule: Wednesdays, Jan. 15 – May 7, 6:10 p.m. – 8:40 p.m.
Mid-Term Exam: March 5
No class: March 12 (Spring Break), April 30 (designated Monday)
Final Exam: May 7

Description: Introduction to Cartesian tensors; deformation, stress, constitutive relations for linear elasticity; formulation of boundary value problems; variational principles; torsion and bending of prismatic rods; plane problems.

Objectives: To understand the basic equations of linear elasticity; to appreciate the variety of methods used to solve elasticity problems; to apply the fundamental equations by solving elementary elasticity problems.

Grading: Assignments 1/3, mid-term exam 1/3, final exam 1/3. All graded work must be completed in accordance with the GW Code of Academic Integrity (`http://www.gwu.edu/~ntegrity/code.html`). Students are encouraged to discuss the meaning of assignments and general approaches and strategies for handling those assignments, but it is not acceptable to share solutions.

Course Outline

1. Mathematical preliminaries; vectors; index notation; summation convention; volume; change of basis; orthogonal transformations; tensors; divergence theorem
2. Analysis of strain; deformation; general infinitesimal deformation; inhomogeneous deformations; infinitesimal strain tensor; compatibility; principal axes; finite deformation
3. Analysis of stress; body and surface tractions; stress tensor; equations of equilibrium; coordinate transformations; principal stresses; conservation of momentum and angular momentum
4. Equations of elasticity; Hooke's law; strain energy; material symmetry
5. Simplest problems of elastostatics; simple shear; simple tension; uniform compression; engineering elastic constants; stress and strain deviators; stable reference states
6. Boundary value problems in elastostatics; uniqueness
7. Torsion of circular and non-circular shafts; warping function; uniqueness and existence of warping function; harmonic functions; numerical analogue; stress function; torsion of elliptical cylinder; torsion of rectangular bars using warping and stress functions
8. Two-dimensional problems; plane strain; plane stress; stress compatibility equations; Airy stress function; biharmonic equation; bending of beams