ME 7210 (Formerly MTM G210) **Fall 2009**

Department of Mechanical and Industrial Engineering
Northeastern University
ELASTICITY & PLASTICITY
Course Registration Number (CRN) 13051

Instructor: Professor George Adams, 203 SN, 617-373-3826, FAX: 617-373-2921, adams@coe.neu.edu

Web-Site: http://blackboard.neu.edu

Conference Hours: Monday 4:00–5:00
Tuesday 3:00–4:00
Thursday 10:30–11:45

Texts:

- *Elasticity – Theory and Applications*, H. Reismann and P.S. Pawlik, Robert E. Krieger Publishing Company, Inc., Malabar, Florida, 1991 reprint of 1980 copyright.
- *Theory and Problems of Continuum Mechanics*, George E. Mase, Schaum's Outline Series, McGraw-Hill Book Company.

References:

- A.P. Boresi and K.P. Chong, *Elasticity in Engineering Mechanics*, Second Edition, John Wiley and Sons, Inc., New York, 2000.
- P.L. Gould, *Introduction to Linear Elasticity*, Second Edition, Springer-Verlag, New York, 1994.
- W. Johnson and P.B. Mellor, *Engineering Plasticity*, Van Nostrand Reinhold Company, Ltd., 1973.
- Lubliner, J., *Plasticity Theory*, Macmillan, New York, 1990.
- M.H. Sadd, *Elasticity: Theory, Applications, and Numerics*, Elsevier Inc., 2005.
- I.H. Shames and F.A. Cozzarelli, *Elastic and Inelastic Stress Analysis*, Taylor & Francis, 1997 (reprinted from Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1992).
- S. Timoshenko and J.N. Goodier, *Theory of Elasticity*, Third Edition, McGraw-Hill Book Co., Inc., New York, 1970.
- J.A. Williams, *Engineering Tribology*, Oxford University Press, Oxford, 1994.

Objectives: To thoroughly understand the concepts of stress, strain, and stress-strain relationships using indicial notation. To become familiar with problem formulations and solutions in elasticity, plasticity, and viscoelasticity. To prepare for future study in elasticity, plasticity, viscoelasticity, and continuum mechanics.

Grading: Two Mid-Term Exams (30% each) and a Final Exam (40%). It is the student's responsibility to obtain class notes for missed classes and to keep up with the course material. Grades of Incomplete (I) are given only under unusual circumstances at the discretion of the instructor.

Exams: Tuesday, October 20
Thursday, November 19
Final: Thursday, December 17

No classes on Thursday, September 10 (instructor away) and Thursday, November 26 (Thanksgiving).

Prerequisites: Admission to the Graduate School of Engineering.

CLASS	TOPICS	HOMEWORK
	STRESS	
1	The Stress Vector and Stress Tensor. Equations of Equilibrium. (2.1)	1,3
2	Indicial Notation. Coordinate Transformations. (1.1-1.9)	3, 4d, SP2.1, SP2.2
3	Stress at a Point. Principal Stresses. (2.2-2.5)	1.22, 2.2, 2.4, 2.17a,b, SP3.1, SP3.2, SP3.3
4	Maximum Shear Stress. Three-Dimensional Mohr's Circles. Deviatoric Stress. (2.6-2.9)	17c→h, 18, 24, 25, 30
	STRAIN	
5	Deformation and Strain. Lagrangian and Eulerian Strain Measures. (3.1-3.3)	2, 12a,b, 30, 31, 32, 33
6	Small Strains. Equations of Compatibility. (3.4-3.7)	37, 45, 46, SP6.1, SP6.2
	STRESS-STRAIN LAWS	
7	Stress-Strain Laws for Anisotropic and Isotropic Materials. (4.1-4.4)	----------
8	Stress-Strain Laws for Anisotropic and Isotropic	1, 2, 7, 10, SP8.1, SP8.2
	PROBLEM FORMULATIONS AND SOLUTIONS	
9	Problem Formulation and Solution with Spherical Symmetry and Cylindrical Symmetry. (5.0-5.2)	1, 3, 6, 8 SP9.1, SP9.2, SP9.3
10	Contact Stresses	SP10.1, SP10.2
11	Torsion (5.3)	SP11.1, SP11.2, SP11.3, SP11.4
12	Beam Theories (Euler-Bernoulli & Timoshenko). (6.3,6.4)	6.7, 6.8
13	Plane Stress and Plane Strain Problems. (5.6)	5.20, 5.27
14	Thermal Stresses	4.20, SP14.1
	PLASTICITY	
15	Introduction to Plasticity (4.4).	SP15.1, SP15.2
16	Yield Criteria (Tresca and von Mises)	SP16.1, SP16.2, 4.25, 4.28
17	Flow rules (Lévy-Mises, Prandtl-Reuss, and Hencky)	SP17.1, SP17.2, SP17.3
18	Hardness, Scaling Effects in Plasticity	SP18.1, SP18.2
19	Solution of Elasto-Plastic Bending Problems	SP19.1, SP19.2
20	Plastic Analysis of Beams	SP20.1, SP20.2
	VISCOELASTICITY	
21	Viscoelasticity	SP21.1, SP21.2
22	Viscoelasticity (cont'd)	SP22.1, SP22.2, SP22.3
23	Review and catch up	-------