

**Department of Mechanical and Industrial Engineering
Northeastern University
ELASTICITY & PLASTICITY**

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

Web-Site: Blackboard: <https://blackboard.neu.edu>

Conference Hours: Monday 10-11, Wednesday 2-3, Thursday 10-11.

Text: I.H. Shames and F.A. Cozzarelli, *Elastic and Inelastic Stress Analysis*, Taylor & Francis Group, Philadelphia, PA, 1997, (reprinted from Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1992).

References on Reserve in Library:

- 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.
- J. Lubliner, *Plasticity Theory*, Macmillan, New York, 1990.
- G. E. Mase, *Theory and Problems of Continuum Mechanics*, Schaum's Outline Series, McGraw-Hill Book Company, 1970.
- H. Reismann and P.S. Pawlik, *Elasticity – Theory and Applications*, Robert E. Krieger Publishing Company, Inc., Malabar, Florida, 1991.
- M.H. Sadd, *Elasticity: Theory, Applications, and Numerics*, Elsevier Inc., 2005.
- S. Timoshenko and J.N. Goodier, *Theory of Elasticity*, Third Edition, McGraw-Hill Book Co., Inc., New York, 1970.

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%).

Responsibility: It is the student's responsibility to keep up with the course material. Although homework will not be collected, it is important that you keep up with it. Solutions will be posted on Monday morning for the previous week's assignments. Grades of Incomplete (I) are given only under unusual circumstances at the discretion of the instructor.

Exams: Mid-Term: Tuesday, October 9.
Mid-Term: Tuesday, November 13.
Final: To be announced.

Prerequisites: Mathematical Methods for Mechanical Engineers 1 or 2 (ME 6200 or ME 6201) is suggested, but not required.

TRACE: Participation in the Teacher Rating and Course Evaluation is expected of all students.

HW #	TOPICS	HOMEWORK
1	The Stress Vector and Stress Tensor. Equations of Equilibrium. (2.1, 2.2, 2.5)	2.12, 2.15
2	Indicial Notation. Coordinate Transformations. (1.1-1.13)	1.1, 1.3, 1.10, 1.16, 1.21
3	Stress at a Point. Principal Stresses. (2.3, 2.4, 2.6)	2.1, 2.3, 2.5, 2.6, 2.11, 2.18
4	Maximum Shear Stress. Three-Dimensional Mohr's Circles. Deviatoric Stress. (2.7-2.9)	2.20, 2.22, 2.24
STRAIN		
5	Deformation and Strain. Lagrangian and Eulerian Strain Measures. (3.1-3.2)	3.1, 3.2, 3.3, 3.6, 3.8, 3.11
6	Small Strains. Equations of Compatibility. (3.3-3.8)	3.15, 3.18, 3.20, 3.24, 3.28
STRESS-STRAIN RELATIONS: ELASTIC		
7	Behavior of Engineering Materials (4.1-4.5) Elastic Stress-Strain Relations for Anisotropic Materials (5.4)	4.1, 4.2, 4.3, SP7.1
8	Elastic Stress-Strain Relations Isotropic Materials (5.1-5.3, 5.5, 5.7)	5.3, 5.4, 5.8, 5.18
PLASTICITY		
9	Introduction to Plasticity. (4.6-4.8, 8.1, 8.2)	SP9.1, SP9.2, 4.8, 8.1, 8.3
10	Yield Criteria (Tresca and von Mises) (8.6-8.10)	8.12, 8.13, 8.14
11	Flow rules (Lévy-Mises, Prandtl-Reuss, and Hencky) (8.11-8.14)	SP11.1, SP11.2, SP11.3, 8.23
PROBLEM FORMULATIONS AND SOLUTIONS		
12	Spherical Symmetry (Elastic and Elastic-Plastic). (9.14)	SP12.1, SP12.2, 9.26 ¹
13	Problems with Cylindrical Symmetry.	SP13.1, SP13.2, SP13.3, SP13.4
14	Elastic Contact Stresses	SP14.1, SP14.2
15	Hardness, Elastic-Plastic Contacts	SP15.1, SP15.2
16	Plane Stress and Plane Strain Problems (12.1-12.4, 13.1-13.6) ²	SP16.1, 12.2, 12.5, 12.17
17	Thermal Stresses (5.6)	5.28, 5.31, SP17.1
18	Elasto-Plastic Pure Bending (10.1, 10.2, 10.11)	SP18.1, SP18.2, SP18.3
19	Elasto-Plastic Bending with Transverse Loads (10.12, 10.13, 10.15)	SP19.1, SP19.2
20	Elasto-Plastic Analysis of Shafts (Torsion) (11.1-11.4, 11.8, 11.9)	11.6, 11.21
21	Torsion of Non-Circular Cross-Sections (11.10-11.13)	SP21.1, SP21.2, SP21.3, SP21.4
VISCOELASTICITY		
22	Viscoelasticity (6.1-6.5)	SP22.1, SP22.2, SP22.3
23	Review	-----

¹ Only find the stress fields.

² The development is different from what we did in class. Read it if you wish.