

Engineering Mechanics / College of Engineering

EM 324 – Mechanics of Materials

Spring 2016 Syllabus

Instructor: *Benjamin Ahn; 2324 Howe Hall*

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Class: *Section 5: Hoover 1312; MWF 10:00 to 10:50 AM*

Course Information

Description

(3-0) Cr. 3 Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling.

Student Learning Outcomes/Objectives

By completion of the course, students should be able to

- Define each of the following mechanical properties – modulus of elasticity, ductility, yield strength, ultimate strength, and coefficient of thermal expansion – and describe how each property characterizes the material response of a linear elastic, homogeneous, isotropic material or structure.
- Properly apply section properties (first, second and polar moments of area, radius of gyration) for the purpose of stress and deformation analysis of beams, shafts, and/or columns.
- Calculate and illustrate the normal & shear stress components, normal & shear strains, and deformation of standard idealized elements such as shafts, beams, columns and thin-shell pressure vessels due to axial, torsional, and flexural loads, pressurization, and/or changes in temperature.
- Calculate and illustrate the magnitude and orientation of the principal stresses and maximum shear stresses at any point within a structural element.
- Calculate and illustrate the normal and shear stresses at any point on any plane within a structural element.
- Given strain gauge measurements, calculate and illustrate both normal & shear strains & stresses at that point.
- Calculate and illustrate normal and shear stress concentrations resulting from discontinuities in section geometry (holes, fillets, grooves).
- Understand the basic types of mechanical failure for ductile and brittle materials, and buckling of columns. Calculate the conditions which would

result in yielding, fracture, or elastic instability and the factor of safety relative to such failures.

Prerequisite or Co-requisite

- Credit in EM 274 – Statics of Engineering

Textbook

Mechanics of Materials; 9th Edition, by R.C. Hibbeler; Prentice-Hall, 2014

Topic Outline/Schedule

#	Week	Topic	Readings	Homework
1	1	M 1/11	Introduction; statics review	1.1 to 2
2		W 1/13	Normal & shear stresses	1: 8, 12, 15
3		F 1/15	Allowable stress design	1: 42, 53, 61
	2	M 1/18	No Class (ISU Holiday)	1: F19,F22,70
4		W 1/20	Deformation; normal & shear strain	
		F 1/22	In-class EXAM 0	2: 4, 5, 30
5	3	M 1/25	Mechanical properties of materials	3: 4, 8, 10
6		W 1/27	Determinate axial loading	3: 4, 8, 13
7		F 1/29	Indeterminate axial loading	4: 35, 42, S1
	4	M 2/01	In-class review for EXAM 1	
		W 2/03	No Class	
		W 2/03	NIGHT EXAM 1 (Topics 1 –7)	
8		F 2/05	Thermal effects	4: 68, 76, 83
9	5	M 2/08	Torsional shear stress & strain	5: 3, 8, 10
10		W 2/10	Power transmission	5: 31, 46, 151
11		F 2/12	Angle of twist (Determinate)	5: 62, 64, 69
12	6	M 2/15	Angle of twist (Indeterminate)	5: 80, 84, S2
13		W 2/17	Internal shear & moment equations	6: F3, 8, 21
14		F 2/19	Shear & moment diagrams	6: 5, 41, S3
15	7	M 2/22	Normal stress due to flexure	6: 48, 61, 64
16		W 2/24	Flexure stresses	6:68 7: 6, 8
17		F 2/26	Shear stress due to flexure	7: 10, 21, 72
18	8	M 2/29	Flexure induced forces (Shear flow)	7: 42, 44, 73
19		W 3/02	Thin-walled pressure vessels	8: 2, 12, 13
20		F 3/04	State of stress	8: 20, 21, 39

#	Week	Topic	Readings	Homework
		M 3/07	In-class review for EXAM 2	
21	9	W 3/09	Combined loading	8: 35, 76, 82
		W 3/09	NIGHT EXAM 2 (Topics 8-18)	
		F 3/11	No Class	
		March 14	Spring Break	
		March 18		
22		M 3/21	Combined loading in 3D	8: 56, 64, S4
23	10	W 3/23	Stress transformation	9: 5, 22, 28
24		F 3/25	Principal stresses; max shear	9: 16, 32 , 43
25		M 3/28	Mohr's circle for plane stress	9: 60, 65, 69
26	11	W 3/30	Mohr's circle & abs max shear	9: 79, 82, 88
27		F 4/01	Strain transformation	10: 2, 9, 16
28		M 4/04	Strain gages & Hooke's law	10: 40, 44, 48
29	12	W 4/06	Stress concentrations	4:91,5:120,6:156
30		F 4/08	Failure theories (static load)	10: 69, 79, 82
		M 4/11	In-class review for EXAM 3	
	13	W 4/13	No Class	
		W 4/13	NIGHT EXAM 3 (Topic 19-28)	
31		F 4/15	Deflection by integration	12: 4, 8, 16
32		M 4/18	Discontinuity function method	12: 40, 44, S5
33	14	W 4/20	Deflection by superposition	12: 86, 91, 96
34		F 4/22	Indeterminate beam deflection	12: 120,130,131
35		M 4/25	Buckling	13: 10, 31, 40
	15	W 4/27	Beam Deflection Wrap-up	
		F 4/29	In-class review for FINAL	
FINAL EXAM: (Topic 29-35) Date & Time to be determined by Registrar				

Grading Policy

Percentage	Description
52%	Exams 1 to 3; 20% each; lowest score at 12%
20%	Final Exam
5%	Review Exam on Principles of Statics for Internal Loads
10%	Homework through Pearson's Mastering Engineering
5%	Supplemental Homework with written submittal
8%	In-Class Assignments

Letter Grade	Percentage	Performance
A	90-100%	Excellent Work
A-	87-89.99%	Nearly Excellent Work
B+	84-86.99%	Very Good Work
B	80-83.99%	Good Work
B-	77-79.99%	Mostly Good Work
C+	74-76.99%	Above Average Work
C	70-73.99%	Average Work
C-	67-69.99%	Mostly Average Work
D+	64-66.99%	Below Average Work
D	60-63.99%	Poor Work
F	0 -59.99%	Failing Work

Academic Dishonesty

The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.

<http://www.dso.iastate.edu/ja/academic/misconduct.html>

Disability Accommodation

Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. If you have a disability and anticipate needing accommodations in this course, please contact (instructor name) to set up a meeting within the first two weeks of the semester or as soon as you become aware of your need. Before meeting with (instructor name), you will need to obtain a SAAR form with recommendations for accommodations from the Disability Resources Office, located in Room 1076 on the main floor of the Student Services Building. Their telephone number is 515-294-7220 or email disabilityresources@iastate.edu . Retroactive requests for accommodations will not be honored.

Dead Week

This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook

<http://www.provost.iastate.edu/resources/faculty-handbook> .

Harassment and Discrimination

Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email dso-sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

Religious Accommodation

If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.

Academic Issues

If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu.