

**ME111 — STRESS, STRAIN AND STRENGTH**  
Autumn Quarter 2000-2001

<b>Lectures</b>	MWF	2.15-3.05 p.m.	Building 530-127
<b>Problem Sessions</b>	Thursdays	7:00—8:30 p.m.	Location TBA
	Fridays	10:00—11:30 a.m.	Location TBA
<b>Web Address</b>	<a href="http://www.stanford.edu/class/me111">http://www.stanford.edu/class/me111</a>		

**Course Objectives**

To provide:

1. Better understanding of the important role that structural analysis plays in design.
2. Improved analytical skills for design, particularly in the area of evaluation of structural integrity.
3. Understanding of the mechanical conditions and mechanisms that cause failure of materials including yielding, fracture and fatigue.

Principal topics covered:

1. Properties of structural materials and stress-strain relationships
2. Static failure theories; plastic yielding and fracture under complex stress states
3. Fatigue failure of materials and life prediction methods, design margins
4. Buckling and structural stability.

**Instructor**

Peter M. Pinsky, Room 275, Durand, 3-9327, [Pinsky@stanford.edu](mailto:Pinsky@stanford.edu)

Office Hours Tu 2–4; Th 3-4

**TA Information**

All office hours will be Durand, Room 252 (important – after 5 pm enter Durand at second floor level at top of exterior stairs).

<u>Name</u>	<u>Office Hours (Durand 252)</u>	<u>Email address</u>
Ben Lipson	M 10 a.m.-12 p.m.; W 11:30-12:30	neato@stanford.edu
Nadia Navarro	M 1-2 p.m.; Tu 3-5 p.m.	nnavarro@stanford.edu
Mike Rosenbluth	M 7-9 p.m.; Tu 4-5 p.m.	miker@stanford.edu

**Prerequisite**

E14 (provides crucial background – students *must* have completed E14 – no exceptions allowed)

**Text**

*Fundamentals of Machine Component Design*, 3<sup>rd</sup> Ed., Robert Juvinall and Kurt Marshek, Wiley, 2000. Your E14 text will also be invaluable for reviewing background material.

**Grading**

Grades will be based on:	Homework assignments	25%
	Midterm exam (Nov. 1, in-class)	25%
	Final exam (Dec. 13, 12:15—3:15 p.m.)	50%

### ***Problem Sessions***

The purpose of the problem sessions is to illustrate the techniques and strategies for problem solving, to clarify any conceptual difficulties, and provide an opportunity for hands-on work with the course material. In general, the first 45 minutes will be devoted to the solution of example problems and to answer questions regarding the concepts presented in lecture. The remaining time will be a question and answer period.

### ***Homework Turn-in***

Homework will be given on Wednesdays and collected in class on the following Wednesday, one week later. Homework handed in after that time will fall under the "late homework" policy.

### ***Late Homework Policy***

Homework turned in after the due date will be "docked" 10% for one day late, 30% for two days late, and 50% for three or more. Homework will not be accepted after solution sets have been put on reserve in the library.

### ***Homework General Notes***

Work problems on standard 8½" x 11" paper (any convenient style) in PENCIL and staple the pages together in the upper left-hand corner; write your name and the homework Set No. on the upper right-hand corner of each piece; be neat and write legibly; and draw clear figures.

When performing calculations, be careful about units; be sure to record the units of all intermediate and final results. Do not record answers to more significant digits than warranted by the reliability of the data. The method used to solve a problem is very important. An answer placed on paper is not considered an acceptable solution without supporting calculations. Please make sure that you state all assumptions and present the formulation of your solution as clearly as possible.

Students are encouraged to use mathematical software such as **Mathcad** for computing homework solutions. If any software is used, the worksheets should be formatted and printed and these can be submitted for grading. Any students who would like an introduction to Mathcad for use in this class should speak with Professor Pinsky – who will be pleased to help.

### ***Graded Homework***

Graded homework will be returned in class. Those not picked up will be placed in the ME111 box on the second floor of Durand (Div. of Mechanics and Computation).

### ***Students with documented disabilities***

Students who have a disability, which may necessitate an academic accommodation or the use of auxiliary aids and services in a class, must initiate the request with the Disability Resource Center (DRC). The DRC will evaluate the request with required documentation, recommend appropriate accommodations, and prepare a verification letter dated in the current academic term in which the request is being made. Please contact the DRC as soon as possible; timely notice is needed to arrange for appropriate accommodations. The DRC is located at 123 Meyer Library (phone: 723-1066; TDD: 725-1067)

**ME111 Stress, Strain and Strength  
Autumn 2000-2001 Syllabus**

Week	Date	Class	Topic	Reading
1	Sept 27	1	Introduction; load analysis	2.1-2.2
	Sept 29	2	Load analysis continued; beam loading	2.3-2.6
2	Oct 2	3	Introduction to properties of engineering materials; uniaxial test demo	3.1-3.3
	Oct 4	4	Strength properties of engineering materials	3.4-3.13
	Oct 6	5	Stresses due to axial, shearing, torsional and bending loads	4.1-4.5
3	Oct 9	6	More on stresses in beams, analysis of curved beams	4.6-4.7
	Oct 11	7	Combined stresses; introduction to Mohr's circle for stress transformation	4.8-4.9
	Oct 13	8	Principal stresses; three-dimensional stress states	4.10-4.11
4	Oct 16	9	Analysis and design of pressure vessels	Lecture notes
	Oct 18	10	Stress concentrations; stress concentration factor	4.12-4.13
	Oct 20	11	Introduction to strains; beam deflections	5.1-5.8
5	Oct 23	12	Column buckling and column design	5.10-5.12
	Oct 25	13	Eccentric column loading; other types of buckling (plates and shells)	5.13-5.15
	Oct 27	14	Introduction to failure of materials; types of failures; factors of safety in design	6.1-6.2
6	Oct 30	15	Introduction to fracture; linear elastic fracture mechanics; stress intensity factor	6.1-6.4
	Nov 1	16	<i>Mid-term exam</i> (classes 1 – 13); 90 minutes; open text, notes and h/w.	
	Nov 3	17	Case studies in failure by fracture	6.1-6.4

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<b>Week</b>	<b>Date</b>	<b>Class</b>	<b>Topic</b>	<b>Reading</b>
7	Nov 6	18	Failure of brittle materials; maximum normal stress theory	6.5-6.6
	Nov 8	19	Case studies in brittle failure	
	Nov 10	20	Failure of ductile materials; plastic yielding; Tresca and von Mises criterion	6.7-6.8
8	Nov 13	21	Case studies in plastic yielding	
	Nov 15	22	Failure theories and design; safety factors against failure	6.10-6.12
	Nov 17	23	Case studies in static failure	
9	Nov 20	24	Basic concepts of fatigue failure; fatigue strength; fatigue life; endurance limit	8.1-8.3
	Nov 22	25	Fatigue strength under reversed loading	8.4-8.8
	Nov 24		<i>Thanksgiving recess</i>	
10	Nov 27	26	Fatigue strength under fluctuating loads	8.9
	Nov 29	27	Effects of stress concentrations	8.10-8.11
	Dec 1	28	Fatigue and randomly varying loads	8.12-8.15
11	Dec 4	29	Case studies in fatigue	
	Dec 6	30	Course review/course survey	
	Dec 8	31	Optional problem solving session	

**ME111 Questionnaire (2000)**

*Please turn in at next class*

Name: \_\_\_\_\_

Telephone number: \_\_\_\_\_

Year in school (circle one):    frosh.    soph.    jr.    sr.    other (specify)

E-mail address: \_\_\_\_\_

Major: \_\_\_\_\_

Select Problem Sessions in order of your preference (write 1 and 2 with 1 being first choice):

Thursday        7:00—8:30 p.m. \_\_\_\_\_

Friday         10:00—11:00 p.m. \_\_\_\_\_

Do you have any comments or suggestions concerning the scheduling of the problem sessions?

1.    Have you taken the following classes? (circle the appropriate answers):

E14	YES	NO	Concurrent with ME111
E15	YES	NO	Concurrent with ME111
E30	YES	NO	Concurrent with ME111
E40	YES	NO	Concurrent with ME111
E50	YES	NO	Concurrent with ME111
ME101	YES	NO	Concurrent with ME111
102	YES	NO	Concurrent with ME111
103	YES	NO	Concurrent with ME111
103	YES	NO	Concurrent with ME111
161	YES	NO	Concurrent with ME111

3.    What do you think that you will learn in ME111?

4.    What is your biggest concern about this class?

6.    List at least two failures of structures or products that you have experienced in your life.

7.    Are you able to make some of the office hours?