3.032 Mechanical Behavior of Materials

Fall 2007

I. TEACHING TEAM

Instructors

Prof. Krystyn J. Van Vliet

Prof. John B. Vander Sande

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II. WHAT AM I LEARNING?

A. Lectures

Week	Day	Date	L#	Topic	Reading in Course Reader (see TOC)
1	W	09.05.07	1	Introduction	
	F	09.07.07	2	Force distributions	Hibbler 1; 10-15; B/L 1-21 & AppD
2	M	09.10.07	3	Deformation under force	B/L 10.1 439-447 & ApE
	W	09.12.07	4	Stress distributions in materials	B/J 4 271-301
	F	09.14.07	5	Strain and stress	B/L 2.1 69-77; B/L 6.1 250-254
3	M	09.17.07	6	Pressure vessels	B/L 221-227
		09.18.07		LAB 1	
	W	09.19.07	7	Stress transformations	B/L 5.1-5.4
		09.20.07		LAB 1	
	F	09.21.07	8	Stress transformations: 2D - 3D	B/L 5.1-5.4
4	M	09.24.07		STUDENT HOLIDAY	
	W	09.26.07	9	Stress transformations: 3D	
	F	09.29.07	10	Elasticity	Nye
5	M	10.01.07	11	Continuum linear elasticity	A/J 3 27-35; M/C 2.8
	W	10.03.07	12	Linear elasticity	M/C 2.8
	F	10.05.07		QUIZ 1	
6	M	10.08.07		MIT HOLIDAY	
	T	10.09.07		MIT HOLIDAY	

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	W	10.10.07	13	Linear elasticity	A/J 3 36-44; 58-60
	F	10.12.07	14	Superelasticity	H 21 372-375
7	M	10.15.07	15	Nonlinear elasticity	H 11 182-185
	T	10.16.07		LAB 2	
	W	10.17.07	16	Viscoelasticity	H 15 247-251
	R	10.18.07		LAB 2	
	F	10.19.07	17	Rubber elasticity	M/C 2.12 102-107
8	M	10.22.07	18	Continuum plasticity	H 6 80-93
	W	10.24.07	19	Plasticity in crystals	Call 8.3 238-243, M/C 4.2 206-207
	F	10.26.07	20	Plasticity in crystals	H9 139-147; 158-166
9	M	10.29.07	21	Plasticity in amorphous materials	M/C 8.4.2 420-425
	W	10.31.07	22	Controlling plasticity onset	H 12 188-202; Call 8.9 250-256
	F	11.02.07	23	Controlling plasticity onset	Call 11.10 455-460
10	M	11.05.07	24	Plasticity at surfaces	H 4 62-67
	T	11.06.07		LAB 3	H3 39-49
	W	11.07.07	25	EGs of engineering elastoplastic defmn mechs	
	R	11.08.07		LAB 3	
	F	11.09.07		**QUIZ 2**	
11	M	11.12.07	26	VETERANS' DAY	
	W	11.14.07	27	Time-dependent plasticity	M/C 13 541-546
	F	11.16.07	28	Time-dependent plasticity	

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12	M	11.19.07	29	Creep deformation mechanisms	M/C 13 553-570
	W	11.21.07	30	Designing against creep	
	R	11.22.07		THANKSGIVING HOLIDAY	
	F	11.23.07		THANKSGIVING HOLIDAY	
13	M	11.26.07	31	Continuum fracture	H 14 227-233; 240-241
	W	11.28.07	32	Continuum fracture	
	F	11.30.07	33	Fracture in crystals	M/C 8 381-384; 400-412
14	M	12.03.07	34	Fracture in crystals	
	T	12.04.07		LAB 4	
	W	12.05.07	35	Fracture in amorphous materials	
	R	12.06.07		LAB 4	
	F	12.07.07	36	Fatigue	M/C 14 592-596; 602-615
15	M	12.10.07	37	Fatigue	M/C 14 592-596; 602-615
	W	12.12.07	38	Fatigue	
	R	12.13.07		Reading Day	
	F	12.14.07		Reading Day	
	M	12.17.07		**EXAM WEEK (QUIZ 3 THIS WEEK)**	

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B. Laboratory Experiments

Labs are conducted in groups and written up individually. The first recitation will outline the lab activities and schedule in detail. In short, you will attend lab 9am-1pm on EITHER Tuesday or Thursday of a given lab week, as indicated on the 3.032 calendar. You will attend recitation on the day (T or R) that you do not have lab that week.

Everyone goes to recitation this Thursday, 10am in 3-442.

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http://commons.wikimedia.org/wiki/Image:CocaCola_C2.jpg

Fig. 2 in Bragg, Lawrence, and Nye, J. F. "A Dynamical Model of a Crystal Structure." *Proceedings of the Royal Society of London, Series A, 190 (September 1947): 474-481.*

Fig. 1b in Tweedie, Catherine A., and Van Vliet, Krystyn J. "On the indentation recovery and fleeting hardness of polymers." *Journal of Materials Research* 21 (December 2006): 3029-3036.

Any diagram of a tensile testing machine, such as http://www.biomed.metu.edu.tr/courses/term_papers/mechanical-characterisation_sonat_files/image004.jpg

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III. WHERE CAN I GO TO READ AND LEARN MORE?

Textbooks

Required:

3.032 Course Reader, *Mechanical Behavior of Materials*
Available at CopyTech 3-011 ($63)

Recommended Supplementary*:

Hosford, *Mechanical Behavior of Materials*

**Note:* There are many texts that treat various aspects of mechanical behavior. However, these texts tend to treat *either* the mechanics or the materials perspectives well, rather than integrating the two. Your lecture notes provide this integration, and the Course Reader provides sufficient background material and worked examples from the "best" textbook for a specific topic. The Hosford text is recommended and heavily cited in the Course Reader, but is missing key material covered in the first third of the class.

MIT Server Website

Bookmark the class website, here you will find
the assigned problem sets and laboratory materials, as well as resources such as material property databases, practice material for quizzes, and scientific and general-audience articles that include content related to our class topics.

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IV. HOW IS MY UNDERSTANDING EVALUATED?

Grading

1. Breakdown:

Quizzes (3)	15% each (Fri 10/5; Fri 11/9; TBA on week of 12/17)
Problem sets (7)	25% total
Labs (4)	30% total

2. Academic Honesty: We encourage you to work together on problem sets and lab analysis/discussion. However, all work turned in must be your own product, as it stands on the submission due date. What is cheating?

- Duplication of others' problem set solutions, figures summarizing lab data, or quiz responses is cheating.
- Failure to cite sources of ideas and/or facts in your problem sets and laboratory written assignments is cheating.
- Falsifying excuses for late / missing assignments or lab participation is cheating.
- Backdating / alteration of submitted documents and false claims that electronic files have been submitted by the due date are cheating.

A student who cheats will receive a formal letter in his/her file at the Office of Student Discipline and may be reported to the Council on Discipline. You do not need to cheat to succeed in this class!

3. Who is grading?: Prof. Van Vliet will grade the three quizzes noted above. TA David Fischer will grade problem sets, but students should see Prof. Van Vliet regarding requests for re-grading. Prof. Vander Sande will grade all pre-lab quizzes and laboratory assignments, and will handle un/excused absences related to the labs.

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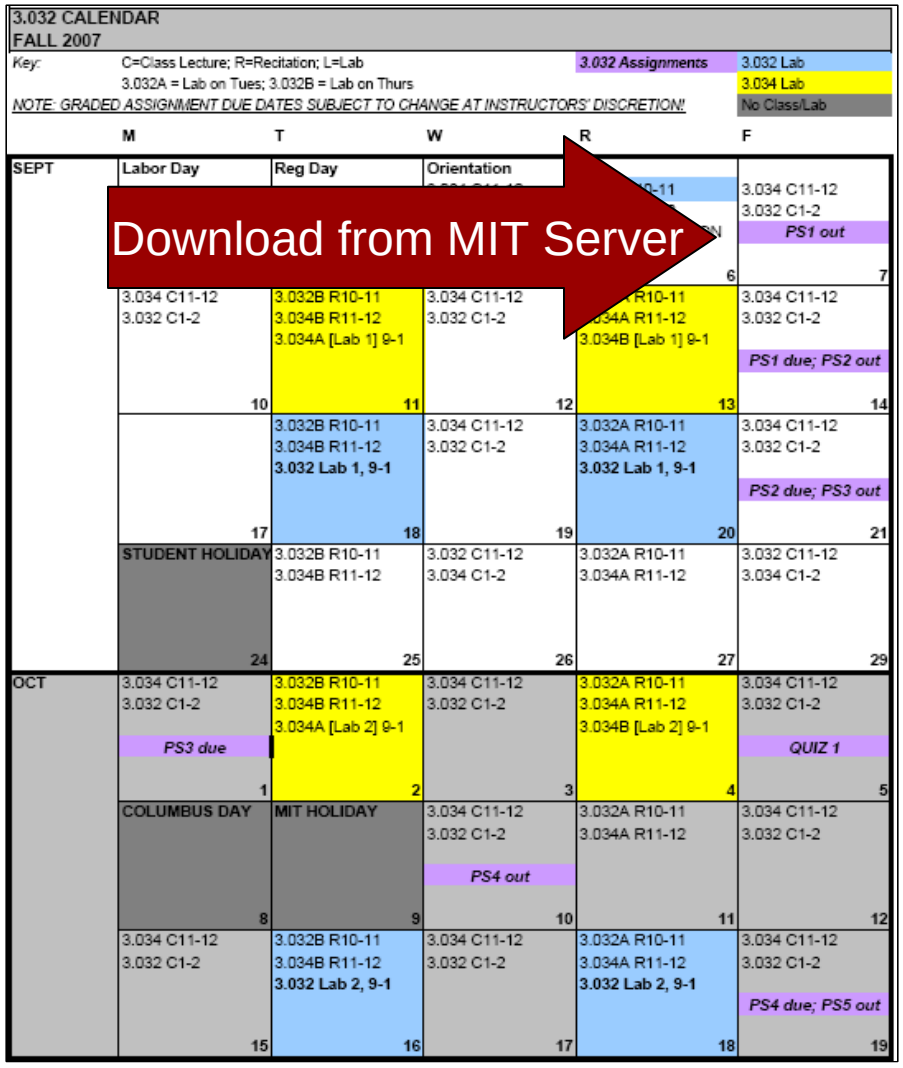

3.032 CALENDAR
FALL 2007

Key: C=Class Lecture; R=Recitation; L=Lab
3.032A = Lab on Tues; 3.032B = Lab on Thurs
NOTE: GRADED ASSIGNMENT DUE DATES SUBJECT TO CHANGE AT INSTRUCTORS' DISCRETION!

3.032 Assignments | 3.032 Lab | 3.034 Lab | No Class/Lab

	M	T	W	R	F
SEPT	Labor Day	Reg Day	Orientation		
	3.034 C11-12 3.032 C1-2	3.032B R10-11 3.034B R11-12 3.034A [Lab 1] 9-1	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 3.034B [Lab 1] 9-1	3.034 C11-12 3.032 C1-2 *PS1 out*
	10	11	12	13	14
	3.034 C11-12 3.032 C1-2	3.032B R10-11 3.034B R11-12 **3.032 Lab 1, 9-1**	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 **3.032 Lab 1, 9-1**	3.034 C11-12 3.032 C1-2 *PS2 due; PS3 out*
	17	18	19	20	21
	STUDENT HOLIDAY	3.032B R10-11 3.034B R11-12	3.032 C11-12 3.034 C1-2	3.032A R10-11 3.034A R11-12	3.032 C11-12 3.034 C1-2
	24	25	26	27	29
OCT	3.034 C11-12 3.032 C1-2 *PS3 due*	3.032B R10-11 3.034B R11-12 3.034A [Lab 2] 9-1	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 3.034B [Lab 2] 9-1	3.034 C11-12 3.032 C1-2 *QUIZ 1*
	1	2	3	4	5
	COLUMBUS DAY	MIT HOLIDAY	3.034 C11-12 3.032 C1-2 *PS4 out*	3.032A R10-11 3.034A R11-12	3.034 C11-12 3.032 C1-2
	8	9	10	11	12
	3.034 C11-12 3.032 C1-2	3.032B R10-11 3.034B R11-12 **3.032 Lab 2, 9-1**	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 **3.032 Lab 2, 9-1**	3.034 C11-12 3.032 C1-2 *PS4 due; PS5 out*
	15	16	17	18	19

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	3.034 C11-12 3.032 C1-2	3.032B R10-11 3.034B R11-12 3.032A [Lab 2] 9-1 NO LAB (3.14)	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 3.032A [Lab 2] 9-1 NO LAB (3.14)	3.034 C11-12 3.032 C1-2 *PS5 due*
	22	23	24	25	26
NOV	3.034 C11-12 3.032 C1-2	3.032B R10-11 3.034B R11-12 3.034A [Lab 3] 9-1	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 3.034B [Lab 3] 9-1	3.034 C11-12 3.032 C1-2
	29	30	31	1	2
	3.034 C11-12 3.032 C1-2	3.032B R10-11 3.034B R11-12 **3.032 Lab 3, 9-1**	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 **3.032 Lab 3, 9-1**	3.034 C11-12 3.032 C1-2 *QUIZ 2*
	5	6	7	8	9
	VETERANS' DAY HOLIDAY	3.032B R10-11 3.034B R11-12 3.034A [Lab 4] 9-1 *PS6 out*	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 3.034B [Lab 4] 9-1	3.034 C11-12 3.032 C1-2
	12	13	14	15	16
	3.034 C11-12 3.032 C1-2	3.032A&B R10-11 3.034A&B R10-12	3.034 C11-12 3.032 C1-2 *PS6 due*	THANKSGIVING	MIT HOLIDAY
	19	20	21	22	23
DEC	3.034 C11-12 3.032 C1-2 *PS7 out*	3.032B R10-11 3.034B R11-12 NO LAB (3.14)	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 NO LAB (3.14)	3.034 C11-12 3.032 C1-2
	26	27	28	29	30
	3.034 C11-12 3.032 C1-2	3.032B R10-11 3.034B R11-12 **3.032 Lab 4, 9-1**	3.034 C11-12 3.032 C1-2	3.032A R10-11 3.034A R11-12 **3.032 Lab 4, 9-1**	3.034 C11-12 3.032 C1-2 *PS7 due* *LAST DUE DATE*
	3	4	5	6	7
	3.034 C11-12 3.032 C1-2		3.034 C11-12 3.032 C1-2 **LAST CLASS DAY**	READING DAY	READING DAY
	10	11	12	13	14
	EXAM WEEK	EXAM WEEK	EXAM WEEK	EXAM WEEK	EXAM WEEK
	17	18	19	20	21

Force distributions in structures → mechanical behavior of materials

MN bridge span, prior to Summer 2007 collapse

Microfilaments of a biological cell, prior to cell division

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http://www.biology.arizona.edu/Cell_bio/tutorials/cytoskeleton/graphics/microfilament.gif

http://rruff.geo.arizona.edu/OLA/files/SXD/graphite_files/image004.jpg

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Interatomic covalent bonding of graphite, prior to fracture