UNIVERSITY AT BUFFALO
School of Engineering and Applied Sciences
DRAFT – (Final Course outline will be posted on 8/30/13)
EAS 209 Mechanics of Solids
Fall, 2013

Lecture classes: MWF: 3 – 3:50 PM, Knox 109

Recitations or labs: **A**: TBA **B**: TBA

Instructor: Prof. S. Thevanayagam, 244 Ketter Hall
645-4376, theva@buffalo.edu
Office hours: M/W/F: 4:00 – 5:00 PM

Teaching assistant(s): Graduate Teaching Assistants: TBA

Prerequisite(s): EAS 207
Course web site: UBLearns

Text: *Mechanics of Materials* by Beer, Johnston, DeWolf, and Mazurek 6th Edition, McGraw Hill, 2011 (EAS209 – SUNY Buffalo)

Course description: This course studies the mechanical behavior of solid bodies under various types of loading, and the resulting deformations. Topics include stresses and strain, stress-strain relationships, plane stress and plane strain; shear force and bending moment diagrams in beams, stresses in beams; deflection of beams, torsion of shafts and buckling of columns.

Course Goals: In this course we will build on the knowledge gained in Statics (EAS207) to determine the internal forces in structures due to applied external loads. We will then see how these internal forces are distributed in terms of stresses. The emphasis of this course will be on understanding how solid bodies deform when subjected to these internal forces, and thus a key objective is to understand the mechanical behavior of materials. Emphasis will be on understanding basic concepts and applying them to solve engineering problems. Systematic problem solving methods will be stressed where student must first plan the solution and at the end, review the solution for reasonableness. The concepts learned in this course are important in future engineering studies and in practice because many of the equations in engineering design codes are based on fundamental concepts that will be covered in this course.

Course Learning Outcomes: At the successful completion of the course, students will be able to:

1) Explain basic stress-strain behavior of engineering materials
2) Analyze members subjected to axial loading, shear, torsion, bending and combined loads to determine the internal stress and deformation
3) Design members to withstand prescribed loads based on strength and serviceability considerations
4) Apply the concepts of equilibrium and compatibility to solve statically indeterminate problems
5) Calculate principal stresses and strains and transform states of stress/strain to different orientations
6) Draw shear-force and bending-moment diagrams for beams.
7) Calculate beam deflections

8) Calculate the critical buckling load for columns

Contribution of EAS 209 towards fulfillment of ABET Student Outcomes 3(a-k):

(a) Apply knowledge of mathematics, science, and engineering

EAS 209 is an engineering problem solving course that builds upon the students' background in mathematics and physics to form a linkage between abstract concepts and physical problems common to engineering practice.

(c) An ability to design a system, component, or process to meet a desire need within realistic constraints

Design of simple structural elements is introduced. Students consider safety and serviceability.

(e) An ability to identify, formulate, and solve engineering problems

The problems demonstrated in class and the homework assignments encourage students to apply their engineering knowledge and judgment to the meaningful solution of the problem. These exercises develop the students' confidence so they will be competent to make the next transition, from problem solving to design.

(g) Communicate effectively

Because engineers frequently communicate via engineering calculations, a premium is placed on the quality, order, neatness, and correctness of the solution of problems performed as part of EAS 209. The students are continually reminded that the quality of their engineering calculations is a statement of their regard for their profession.

Relationship of Course to ABET Student Outcomes (Course Assessment Matrix):

Course Outcomes	**ABET Student Outcomes**										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	2						2				
2	3				3		1				
3	3		2		3		1				
4	3				3		1				
5	3				3		1				
6	3				2		1				
7	3				3		1				
8	3				2		1				

Contribution Level: Substantial = 3, Moderate = 2, and Limited = 1

Assessment Tools: Homework will be assigned weekly and will typically consist of 4-5 problems. Homework will be due every Wednesday. Additional (optional) practice problems will also be assigned. A number of these will be available through CONNECT (McGraw-Hill's web-based assignment and assessment platform). Homework will

be due in class and will not be accepted by fax or email. **NO** late homework will be accepted.

Assignments **must** be done neatly on **engineering** paper, in pencil, and written on one side of the paper. A cover sheet should accompany each assignment. Pages must be **stapled** together. Figures should be drawn roughly to scale using a straight edge. Final answers must be **boxed** and should include **units** where applicable and be given using the appropriate number of **significant figures**.

Homework **must** follow this format:

Given: (statement of problem)
Find: (what are you after)
Solution: (analysis leading to result; present your work neatly, show appropriate diagrams)
The answer must be **boxed.**

It is expected that each student will do all homework **individually**, although general discussion of concepts amongst peers is encouraged.

Homework solutions will be posted in a glass cabinet on the 1st floor of Ketter Hall.

There will be two (2) tests throughout the semester, in addition to the final. The tests will be scheduled on a Monday evening. See lecture schedule for tentative dates.

Grading Policy: Final course grade shall be determined as follows:

Mid semester exams	50% (25% each)
Homework	10%
Final	40%

Weekly homework will be graded out of 4 points.

All homework submissions are expected to be neat, thorough and logically organized. When you perform engineering calculations you must explain your work such that an uninformed reader can follow how and why each step was performed. Practicing engineers must maintain very high standards in the quality of their work because all engineering calculations must be independently checked during the design review process. Sloppy work, even if technically correct, is unprofessional and will lose points.

Consequently, the points will be distributed as follows:

The basis for grading will be as follows:
4 = correct format, correct solution & answer
3 = correct format, some errors
2 = correct format, many errors
1 = incorrect format, little effort
0 = no effort

Other policies: All tests should be taken at the announced time and place. Missed exams will be assigned a grade of zero unless an acceptable excuse is provided and approved by the instructor, prior to the exam date.

Important dates: Last day to drop: See UB Academic Calendar

Last day to add: See UB Academic Calendar

Last day to resign: See UB Academic Calendar

Academic integrity: Please review the UB policies on academic integrity in the Rules and Regulations (www.student-affairs.buffalo.edu/judicial/art3a.shtml) and in the University catalog (undergrad-catalog.buffalo.edu/integrit.html). They will be strictly enforced.

As an engineer, you have special ethical obligations. As per the NSPE Code of Ethics, "engineers shall avoid deceptive acts" and "shall conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession."

UB Engineering Code of Ethic:

- Act with honesty, integrity and fairness
- Show respect for others
- Accept responsibility
- Give credit where credit is due
- Serve the larger community
- Take pride in being a part of UB Engineering

Classroom "etiquette"

- Attend classes and pay attention.
- Come to class on time. If you must enter a class late, do so quietly and do not disrupt the class by walking between the class and the instructor. Do not leave class unless it is an absolute necessity.
- Do not talk with other classmates while the instructor or another student is speaking. If you have a question or a comment, please raise your hand, rather than starting a conversation about it with your neighbor.
- Turn off the electronics: cell phones, pagers, laptops, and beeper watches.
- Avoid audible and visible signs of restlessness. These are both rude and disruptive to the rest of the class.
- Focus on class material during class time. Sleeping, talking to others, doing work for another class, reading the newspaper, checking email, and exploring the internet are unacceptable and can be disruptive.
- Do not pack bookbags or backpacks to leave until the instructor has dismissed class.

How to pass and do well in this course:

1. **Read appropriate section from text and/or course notes BEFORE class**
2. Come regularly to class and recitations and pay attention.
3. Take good notes, and ask questions if you do not understand the material.
4. Before you attempt to solve your homework problems, reread the appropriate section from the text and your notes; try to understand the concepts and solved problems.
5. Do ALL the assigned homework.
6. Use all resources available for additional assistance if you need it (e.g. recitation, office hours)
7. Start preparing for each exam at least one week before, allowing time to work out practice exams

Tentative Lecture Schedule

(if a Lecture falls on a holiday, that lecture will be held on the next scheduled class date)

Lecture	Content	Assigned Reading
Aug 26	Introduction	1.9-1.10 Problem Solution / Numerical Accuracy
Aug 28	1- Concept of Stress	1.1-1.8 Review of FBD / Normal Stress / Shear Stress / Bolted Connections
Aug 30		1.11 -1.13 Stresses on Oblique Plane / Gen. State of Stress / Design Considerations
Sept. 4	2 – Stress Strain	2.1-2.7 Mechanical Properties
Sept 6		2.8 Deformation Under Axial Loading
Sept 9		2.9 Statically Indeterminate Problems
Sept 11		2.10 Problems Involving Temperature Changes
Sept 13		2.11-2.15 Generalized Hooke's Law / Shear Strain
Sept 16		2.18 Stress Concentrations, 2.19 Plastic Deformations, 2.20 Residual Stresses
Sept. 18	3 - Torsion	3.1-3.4 Stresses in Elastic Range
Sept. 20		3.5 Angle of Twist in Elastic Range 3.7 Design Transmission Shafts
Sept. 23		3.6 Statically Indeterminate Shafts
Sept. 25		3.13 Thin-Walled Hollow Shafts
EXAM 1 covering Chapters 1, 2, and 3 will be held on Fri Oct. 4 (tentative) The class period on Fri Oct. 4 will be review		
Sept. 27	4-Pure Bending	4.1-4.5 Pure Bending
Sept.30		4.6 Composite Sections
Oct. 2		4.8-4.10 Inelastic Bending
Oct. 7		4.12 Eccentric Axial Loading
Oct 9		4.13-4.14 Unsymmetric Bending
Oct. 11	5-Analysis and Design of Beams for Bending	5.1-5.3 Shear and BM diagrams
Oct 14		5.4 Design of Beams for Bending
Oct 16		5.5 Using Singularity Functions
Oct 18	6-Shear Stresses in Beams	6.1-6.4 Shearing Stresses in Beams
Oct 21		6.6-6.7 Shearing Stresses in Thin-Walled Members
EXAM 2 covering Chapters 4, 5 and 6 will be held on Monday October 28 (tentative) The class period on Monday October 28 will be review		

Oct 23	7-Transformation of Stress and Strain	7.1-7.3 Transformation of Plane Stress
Oct 25		7.4 Mohr's Circle
Oct 30		7.5-7.6 General State of Stress
Nov 1		7.9 Pressure Vessels
Nov 4		7.10-7.13 Transformation of Plane Strain
Nov 6	8 –Principal Stresses Under a Given Load	8.2 Principal Stresses in a Beam 8.4 Combined Loading
Nov 8		
Nov 11	9-Deflection of Beams	9.1-9.4 Beam Deflection / Elastic Curve
Nov 13		9.6 Statically Determinate Beams / Singularity Functions
Nov 15		9.5 Statically Indeterminate Beams
Nov 18		9.7-9.8 Method of Superposition
Nov 20		9.9-9.10 Moment-Area Theorems
Nov 22	10-Columns	10.1-10.4 Euler's Formula/End Conditions
Nov 25		10.6 Design under Centric Load
Nov 27		10.5, 10.7 Eccentric Loading
Dec 2-6	**FINAL REVIEW**	Appropriate topics from above.

Final Exam will be held on the date and time scheduled by the University.
Midsemester exam dates and times will be announced via ublearns. Keep the tentative dates open until date/time is announced. Midsemester exams will take place likely in the evening.