UNIVERSITY AT BUFFALO
School of Engineering and Applied Sciences

EAS 209 Mechanics of Solids

Spring, 2015

Lecture classes:	EAS209A-LEC on MWF: 3:00-3:50 PM, Hoch 114 EAS209C-LEC on MWF: 9:00-9:50 AM, NSC 228 EAS209D-LEC on MWF: 12:00-12:50 PM, NSC 228
Recitations or labs:	EAS209A1-REC on Tue 5:00-5:50 PM, Cooke 121 EAS209A2-REC on Mon 4:00-4:50 PM, Park 440 EAS209C1-REC on Mon 5:00-5:50 PM, Clemen 119 EAS209C2-REC on Tue 3:30-4:20 PM, Clemen 322 EAS209D1-REC on Fri 3:00-3:50 PM, Clemen 119 EAS209D2-REC on Wed 4:00-4:50 PM, Clemen 119
Instructor:	Siamak Epackachi, 206 Ketter Hall (M/W/F) (716)866-0584, siamakep@buffalo.edu
Instructor office hours:	Fri: 4:00-6:00 PM at 206 Ketter Hall
Teaching assistant:	Ayed Yamin (ayedyami@buffalo.edu) Seoyoung Heo (sheo4@buffalo.edu)
TA office hours:	Ayed Yamin M/W: 1:00-3:00 PM at 202 Ketter Hall Seoyoung Heo Tu/Th: 11:00 AM-01:00 PM at 202 Ketter Hall
Prerequisite(s):	EAS 207
Course web site:	UBLearns
Text:	*Mechanics of Materials* by Beer, Johnston, DeWolf, and Mazurek 7th Edition, McGraw Hill, 2014

Catalog Description: Studies the mechanical behavior of solid bodies under various types of loading. Topics include stresses and strain, stress-strain relationships, plane stress and plane strain; shear and bending moments in beams, stresses in beams; deflection of beams, torsion of shafts, buckling of columns, energy methods, and failure criteria.

Course Objectives: 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: Upon successful completion of the course, students will be able to:

Course Learning Outcomes	SO	Assessment Tools
1. Apply basic understanding of stress-strain behavior of engineering materials to solution of engineering problems	a, e, g	Homework & Exam
2. Analyze members subjected to axial loading, shear, torsion, bending to determine the state of stress and resulting deformation	a, e, g	Homework & Exam
3. Design simple members to withstand prescribed loads based on strength and serviceability considerations	a, c, e, g	Homework & Exam
4. Apply the concepts of equilibrium and compatibility to analyze statically indeterminate members	a, e, g	Homework & Exam
5. Calculate principal stresses and strains and transform states of stress/strain to different orientations	a, e, g	Homework & Exam
6. Draw shear-force and bending-moment diagrams for beams	a, e, g	Homework & Exam
7. Calculate beam deflections	a, e, g	Homework & Exam
8. Calculate the critical buckling load for columns	a, e, g	Homework & Exam

Contribution of EAS 209 towards fulfillment of Student Outcomes (SO):

(a) An ability to 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) An ability to 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 Student Outcomes (Course Assessment Matrix):

a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
3		1		3		1				

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

Course Requirements: There will be weekly homework assignments, two (2) midterm tests and a final. While attendance is not mandatory, students are expected to approach this course as they would any professional responsibility. Students are also expected to use professional style in all communications, including email, with the instructor and teaching assistants. Email must include the use of correct salutations and closings (including clear identification of the author) and be grammatically correct.

Homework Assignments: Homework assignments will be due every Monday and will typically consist of 3 problems. Homework will be due in class and will not be accepted by fax or email. Late homework (no more than 24 hours late) will receive a 20% late penalty and must be submitted directly to the instructor.

Each homework assignment is a professional, original document prepared by you; treat it as such. You should be proud of the way it looks while knowing that the calculations that you have prepared are as accurate as possible. Remember that 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. Students are expected to do all homework **individually** although general discussion of concepts amongst peers is encouraged. Use of on-line help sites that provide the solution is strictly forbidden. In practice, there is no solution manual; you must get used to solving the problems on your own.

Assignments **must** be done 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 must be drawn roughly to scale using a straight edge. Final answers must be **boxed** and must include **units** where applicable and be given using the appropriate number of **significant figures**.

Weekly homework will be graded out of 10 points. Problems will be graded for neatness and your ability to explain your approach, organize the solution, and review the results.

Homework **must** follow the following format:

Problem Statement: (givens, what you want to find)
Solution: (analysis leading to result)

Sloppy work, even if technically correct, is unprofessional and will lose points. Homework solutions will be posted on-line to help you review and understand your mistakes.

All homework grades will be posted on UBLearns. Students are responsible for checking the accuracy of their grades on UBLearns. Please notify the instructor if your grade is missing or wrong; the graded assignment must be produced to get credit for it. Graded homework will be returned during the lecture period. After class, graded homework will be placed in a box labeled "EAS209" and can be picked up from the TA during office hours. Homework that is not collected will be disposed of after one week. All homework assignments will be used in calculating the final grade, with the same weight assigned to each assignment. Individual arrangements will be made with students who have documented, legitimate

absences which prevent them from submitting their homework on time such as an illness requiring a doctor's visit, an automobile accident, a family emergency, jury duty, participation in a sanctioned university activity.

Recitation policy: Two 50-min recitations will be offered every week. During the first week, recitations will be used to review statics. Starting with the second week of the semester the recitations will be used to reinforce the topics covered during the lectures. Every week homework problem(s) will be assigned for the recitation. You must attempt to solve the problem(s) before coming to recitation. During recitation, the instructor will show in detail how to solve the problem(s), and help you reach the correct answer. The problem(s) will be collected at the end of recitation for extra credit. Attendance is not mandatory but it is strongly recommended as it will help you succeed in the course.

Exams: Every Monday, a quiz is taken from the topics presented in the class during the week. The first and second midterms will be scheduled on a Wednesday and Monday evenings, respectively. See lecture schedule for tentative dates. They will be 120 minutes long each. The final will be 3-hours long. 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 to the instructor, prior to the exam date. In cases of emergency, the instructor should be notified as soon as possible. Students with a legitimate absence will be given a make-up exam.

Important dates: Last day add/drop: Monday, February 02
Last day to resign: Friday April 17 (after second midterm)

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

Mid semester exams	30% (15% each)
Homework	10%
Final	40%
Quiz	20%
Class participation	5% BONUS
Recitation	5% BONUS

Exact cutoffs for specific grades will depend on the level of difficulty of exams. These cutoffs will be determined once the final exam has been graded. However, the cutoffs will not exceed the following:

Composite score	Guaranteed grade
90%	A
80%	B
68%	C
58 %	D

Grade 'I' will be strictly limited to the circumstances for which the incomplete is intended; namely, satisfactory work to date and legitimate inability to complete the work within the semester. See UB policy (http://undergrad-catalog.buffalo.edu/policies/grading/explanation.shtml).

Academic Integrity: The University at Buffalo takes very seriously its commitment to principles of academic integrity. Please review the UB policies regarding academic integrity regularly (http://academicintegrity.buffalo.edu/policies/index.php).

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." For additional information about the procedures in place within the CSEE department, see the academic integrity section of the departmental website (http://www.csee.buffalo.edu/undergraduate/current-students/academic-integrity/).

Accessibility Resources: If you require classroom or testing accommodations due to a disability, please contact Accessibility Resources, located at 25 Capen Hall. Accessibility Resources can be reached by phone at (716) 645-2608 or by email at stu-accessibility@buffalo.edu. Please inform me as soon as possible about your needs so that we can coordinate your accommodations. For additional information, see http://www.buffalo.edu/accessibility/index.php.

Classroom "etiquette": To provide an environment that is professional and conducive to learning, it is important that all students observe the following classroom etiquette (modified from http://undergrad-catalog.buffalo.edu/policies/course/obstruction.shtml).

- 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 book bags 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

Lecture	Content	Assigned Reading
Jan 26	Introduction	1.9-1.10 Problem Solution / Numerical Accuracy
Jan 28	1- Concept of Stress	1.1-1.8, 1.13 Normal Stress / Shear Stress / Bolted Connections, Design Considerations
Jan 30		1.11 -1.12 Stresses on Oblique Plane / Gen. State of Stress
Feb 2	2 – Stress Strain	2.1-2.7 Mechanical Properties
Feb 4		2.8 Deformation Under Axial Loading
Feb 6		2.9 Statically Indeterminate Problems
Feb 9		2.10 Problems Involving Temperature Changes
Feb 11		2.11-2.15 Generalized Hooke's Law / Shear Strain
Feb 13		2.18 Stress Concentrations, 2.19 Plastic Deformations, 2.20 Residual Stresses
Feb 16	3 - Torsion	3.1-3.4 Stresses in Elastic Range
Feb 18		3.5 Angle of Twist in Elastic Range 3.7 Design Transmission Shafts
Feb 20		3.6 Statically Indeterminate Shafts
Feb 23		3.13 Thin-Walled Hollow Shafts
EXAM 1 covering Chapters 1, 2, and 3 will be held on Wednesday February 25 (7:30-9:30 pm) No class on Wednesday February 25		
Feb 27	4-Pure Bending	4.1-4.5 Pure Bending
Mar 2		4.1-4.5 Pure Bending Examples
Mar 4		4.6 Composite Sections
Mar 6		4.8-4.10 Inelastic Bending
Mar 9		4.12 Eccentric Axial Loading
Mar 11		4.13-4.14 Unsymmetric Bending
Mar 13	5-Analysis and Design of Beams for Bending	5.1-5.3 Review Shear and BM diagrams
Mar 23		5.4 Design of Beams for Bending
Mar 25	6-Shear Stresses in Beams	6.1-6.4 Shearing Stresses in Beams
Mar 27		6.6-6.7 Shearing Stresses in Thin-Walled Members
EXAM 2 covering Chapters 4, 5 and 6 will be held on Monday March 30 (7:30-9:30 pm) No class period on Monday March 30		
Apr 1	7-Transformation of	7.1-7.3 Transformation of Plane Stress

Apr 3	Stress and Strain	7.4 Mohr's Circle
Apr 6		7.5-7.7 General State of Stress, Yield Criteria
Apr 8		7.9 Pressure Vessels
Apr 10		7.10-7.13 Transformation of Plane Strain
Apr 13	8 –Principal Stresses Under a Given Load	8.2 Principal Stresses in a Beam
Apr 15		8.4 Combined Loading
Apr 17	9-Deflection of Beams	9.1-9.4 Beam Deflection / Elastic Curve
Apr 20		9.6 Statically Determinate Beams / Singularity Functions
Apr 22		9.5 Statically Indeterminate Beams
Apr 24		9.7-9.8 Method of Superposition
Apr 27		Beam Deflection Comparison of Methods
Apr 29	10-Columns	10.1-10.4 Euler's Formula/End Conditions
May 1		10.6 Design under Centric Load
May 4	11- Energy Methods	11.1-11.4 Strain Energy
May 6	**Final Review**	
May 8	**Final Review**	