22.212 Strength of Materials
Spring 2013 Schedule *(updated 2/13/2013)*
Prof. Christopher Hansen (Perry Hall 223A)
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Week	Date	Lecture	Due	Associated Reading
1	1/23	**Lecture 1:** Review of statics concepts, normal stress/strain		1.1-1.2
	1/25	**Lecture 2:** Mechanical properties of materials, linear elastic stress/strain		1.3-1.6
2	1/28	**Lecture 3:** Shear stress/strain, allowable stresses, factor of safety	HW #1	1.7-1.9
	1/30	**Lecture 4:** Factor of safety, axial loads		2.1-2.2
	2/1	**Lecture 5:** Axial loads, change in length		2.3
3	2/4	**Lecture 6:** Non-uniform conditions	HW #2	2.4
	2/6	**Lecture 7:** Thermal effects		2.5
	2/8	**Lecture 8:** Saint-Venant's principle, stress concentrations	HW #3	2.10
4	2/11	**Lecture 9:** Torsion, angle of twist		3.1-3.3
	2/13	**Lecture 10:** Torsion, angle of twist		3.3-3.4
	2/15	**Exam #1: Covers lectures 1-9, chapters 1-3**		
5	2/19	**Lecture 12:** Non-uniform torsion, power transmission	HW #4	3.4, 3.7
	2/20	**Lecture 13:** Pure torsional stresses, strains		3.5-3.6
	2/22	**Lecture 14:** Statically indeterminate torsion problems shear forces, bending moments,		3.8, 4.1-4.4
6	2/25	**Lecture 15**: Relationships between loads, shear, and bending moments	HW #5	4.3-4.4
	2/27	**Lecture 16:** Shear and moment diagrams		4.5
	3/1	**Lecture 17:** Shear and moment diagrams	HW #6	4.5
7	3/4	**Lecture 18:** Review of centroids and moments of inertia		12.1-12.5
	3/6	**Lecture 19:** Review of centroids and moments of inertia		12.1-12.5
	3/8	**Lecture 20: (Snow day)**	HW #7	
8	3/18	**Lecture 21**: Normal stress in beams, pure bending		5.1-5.3

	3/20	**Lecture 22:** Curvature, strains in linear elastic beams		5.3-5.4
	3/22	**Lecture 23:** Curvature, strains in linear elastic beams	HW #8	5.5
9	3/25	**Lecture 24**: Design of beams		5.6
	3/27	**Lecture 25:** Shear stresses in beams	HW #9	5.8-5.9
	3/29	**Exam 2: Covers lectures 10-23, chapters**		
10	4/1	**Lecture 26:** Shear stresses in built-up beams		5.10-5.11
	4/3	**Lecture 27**: Analysis of plane stress		7.1-7.2
	4/5	**Lecture 28:** Stress transformations	HW #10	7.2
11	4/8	**Lecture 29**: Principal stresses		7.3
	4/10	**Lecture 30**: Mohr's Circle for plane stress		7.4
	4/12	**Lecture 31**: Hooke's Law for plane stress, triaxial stress	HW #11	7.5-7.6
12	4/15	**NO CLASS – PATRIOT'S DAY**		
	4/17	**Lecture 32**: Strain gage rosettes, strain transformation		7.5-7.6
	4/19	**Lecture 33**: Thin wall pressure vessels	HW #12	8.1-8.2
13	4/22	**Lecture 34**: Spherical, cylindrical pressure vessels		8.2-8.3
	4/24	**Lecture 35**: Deflection of beams – integration		9.1-9.4
	4/26	**Lecture 36**: Deflection of beams – superposition	HW #13	9.5
14	4/29	**Lecture 37**: Deflection of beams – moment area		9.6
	5/1	**Review for Final Exam**	HW #14	

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Catalog Description: Stress and deformation analysis of bodies subjected to uniaxial loading, thermal strain, torsion of circular cross-sections, shear flow in thin-walled sections, bending of beams, and combined loading. Application of equilibrium, compatibility, and load-deformation relations to solve statically determinate and indeterminate systems.

Textbook:

- Mechanics of Materials, by J.M. Gere and B.J. Goodno. 8th ed. (2012), 7th ed. (2008), 6th ed. (2003), or 5th ed. (2000). Publisher: Cengage Learning
- Optional resource: Schaum's Outline of Statics and Mechanics of Materials by W.A. Nash (1991).
- Class handouts
- Reference: Statics and Dynamics, Beer, McGraw-Hill (or other similar statics text)

Instructor: Prof. Christopher Hansen, Perry Hall 223A, 978.934.2932

Grading Assistants (GAs): The grading assistants are responsible for the grading of the lab reports. Please contact them in case of issues on their grading. The grader is Rafael Castro, with email address Rafael_Castro@student.uml.edu.

Schedule and Course Attendance: The course lectures are scheduled Monday, Wednesday, and Friday from 1-1:50pm. Lectures are not mandatory, but class participation is graded. Attendance and paying attention to the majority of the lectures is the only way to ensure a good grade in this course.

Office hours: Prof. Hansen has scheduled three office hours per week, which were decided by the class on the first day of lecture. These hours are Wednesdays 2-3pm and Fridays from 10:30am-12:30pm. If you are unable to meet with the instructor during these times, you must request an appointment via e-mail or phone, **with a 24-hour notice**.

Academic integrity:
All homework, exams, and projects are to represent students' own original work. Students are prohibited from infractions of academic integrity, which includes cheating, fabrication, plagiarism, facilitating dishonesty, or the dishonest use of instructional technology (e.g., using another person's clicker). **Infractions will not be tolerated and will be reported the department chair to initiate a formal process.** For more information, the university policy on academic integrity is available at: http://www.uml.edu/catalog/undergraduate/policies/academic_dishonesty.htm

Academic or External problems: If you experience **problems with the coursework or your classmates,** if you **anticipate being absent, or** if there are **external factors affecting your performance**, it is your responsibility to inform the instructor **as soon as possible**. I am willing to help, but I must know how I can assist and be given sufficient time to do so.

Grade Distribution:

Components	Grade Fraction
Class Participation	10%
Homework	20%
Service-Learning Project	10%
Exam 1	15%
Exam 2	15%
Final Exam	30%

The final numerical grade will be calculated with the above distribution. The letter grade will be attributed with respect to the whole class average grade (AVERAGE) and the standard deviation around that average (STD). A student having a numerical grade equal to the class average will be granted a B-.

Class Participation: Short-answer quizzes will be randomly assigned during class and use NXT clickers. The two worst grades of in-class quizzes are eliminated. Therefore, attendance is REQUIRED for the class participation grade. **Students who fail to bring their clicker to a lecture will receive a score of zero for the questions presented during that lecture and will be marked as absent unless they approach the instructor before leaving the classroom to indicate they were present**. **NO EXCEPTIONS**. Clicker malfunctions must be brought to the attention of the instructor as soon as possible so that the source of the malfunction can be promptly identified and corrected. Failure to abide by these rules may result in loss of participation and attendance points.

Homework: Homework will be assigned in class and be due at 1pm (start of lecture) on Friday (as indicated on the syllabus). Late homework will be docked by 20% for each day late, unless prior arrangements are made with the instructor.

Service-Learning Project:
This course contains a service-learning component. We will be partnered with the Lowell Transitional Living Center. The Center owns cots that are used during winter months, yet are often deformed or broken during use. Through a series of homework assignments, much of the project groundwork will be laid. These calculations will culminate in students grouping into teams of 3 to 4 students to design a solution to the problem. The solution will be documented and shared with the Center in order to implement a cost-effective solution. Further details will be announced mid-semester.

Exams: Exams #1 and #2 will be taken during the lecture hour. Make-up exams will not be given, and all exam conflicts must be discussed with the instructor at least 2 weeks prior to the exam.

Technology used in this class:
BlackBoard Learn Enhanced class:
This class has a web-enhanced component to it. Each student should check the course website on a regular basis in order to obtain an updated syllabus and lecture notes, as well as obtain links to the Echo360 Lecture Capture system. Instructors can be emailed through the BlackBoard Learn internal email system, which places no size limit on attachments.

Echo360 Lecture Capture:
The lectures will be captured using audiovisual recording equipment in the classroom. These clips are available almost immediately after the end of class. However, occasionally the recording becomes corrupted or is unavailable, so class attendance is recommended.

NXT Clickers by Turning Technologies:
The use of clickers will be integrated into the course on an almost daily basis. As discussed under "class participation", the participation grad will be based on the use of clickers. The class will use the NXT Clicker by Turning Technologies. Clickers must be registered via the web as follows (if not previously registered):
A. Go to webreg.turningtechnologies.com
B. Enter your First and Last names
C. Enter your EIGHT-DIGIT STUDENT ID in the 'User Id' field
D. Enter your email address
E. Enter your Device ID (found on back of unit BELOW BAR CODE)
F. Type the computer-generated security words (i.e., the "captcha") in the grey box
G. Click on 'Register Device'

Note that the new cost of the NXT clicker device is $53.50 new. However, there is currently a $10 buyback program for existing PRS devices (i.e., the prior clicker used). There's also a $15 rebate for the spring semester. Visit http://clickers.wiki.uml.edu/Student+Resources for details on the buyback and rebate programs. You will need to use the NXT clicker in the Applied Strengths course next year and so are encouraged to consider this a long-term investment and to *not* sell the device back each semester.

Prerequisites:

- Completion of Statics (22.211) with a passing grade
- Completion of Calculus II (92.132) with a passing grade

Objectives:

This course will provide an introduction to the mechanics of deformable, solid bodies subjected to static loading. It examines structural elements of practical interest, such as bars, shafts, beams, and thin-walled pressure vessels, in order to determine the stress and deformation of these elements when subjected to various types of loading. The course examines how stress and deformation, together with material properties, determine the adequacy of a mechanical component for its intended use in a specific design context. Emphasis is on understanding engineering fundamentals and applying them to engineering problems of practical interest.

Outcomes: Specific outcomes associated with this course are listed below. At the end of this course, a required on-line evaluation must be filled out by each student to assist us in assessing how well each of the following objectives were met.

Specific Outcomes: **A student will be able to...**	**Means to acquire**	**Means to assess, evaluate**	**ABET criteria**	**Program Goals**
Determine the stress at various locations along a beam and on a cross- section due to axial, torsional, and bending loads for statically determinate and indeterminate cases.	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Determine the deflection or angle of twist at various locations along a beam due to axial, torsional, and bending loads for statically determinate and indeterminate cases	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Determine the necessary geometry and material properties required to withstand a given set of axial, torsional, and bending loads for statically determinate and indeterminate cases.	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Describe the difference between material stiffness, torsional stiffness, and flexural stiffness, and relate this to optimization of beam and shaft design.	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Describe the general shape of the stress distribution on a cross-section due to axial, torsional, and bending loads and relate this to probable failure locations.	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Use linear superposition to obtain solutions to problems that have combined axial, bending and torsional loads.	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Use integration to solve problems of varying cross-section, material properties, or loads.	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Determine the stress at a specified location, in a specified orientation, and determine principal stresses and maximum shear stresses for that point.	Lectures, recitations, reading, and homework	Homework, direct questions in class, and exams	a, c, e	ii
Describe the assumptions/limitations of the analysis methods used. Model a real world structure using proper assumptions of joint type, loading condition, and rigid vs. deformable bodies.	Lectures, recitations, reading, homework, and design project	Homework, direct questions in class, exams, and project report/presentation	a, c, d, e, g, i, k	ii, iv, vi