CE246
Strength of Materials
Spring 2013

Instructor:

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CREDITS:	(4+1+0) 4 ETCT 6
CLASS TIME:	Mon. 13:00-14:00; Th. 11:00-12:00
PRECEPT:	Th. 17:00-18:00
LECTURE HALL:	Mon. M3100; Th. M2230
OFFICE HOURS:	Wed. 11:00-12:00

COURSE (CATALOG) DESCRIPTION:
Stress and deformation. Uniaxial tension test, temperature effects in bars. Torsion of circular shafts. Simple bending of beams and associated deflections, shear stresses in beams. Combined stresses due to bending, torsion, shear and axial loads. Transformation of stress, principal stresses, and Mohr's circle. Introduction to energy principles. Failure criteria. Stability and buckling.

PREREQUISITES: CE245 Mechanics

COURSE OBJECTIVES:
This course is designed to introduce basic principles of statics for rigid and deformable bodies. The main objective is to help the students develop an intuition for equilibrium, properly constrained systems, and deformation under elementary loading conditions. In detail, the main objectives of this course are:

1. to be able to **calculate forces** on objects and in simple structures,
2. to be able to draw a **free-body-diagram** of a structure or part of a structure (this is actually a pre-requisite to calculating forces, and an essential skill to learn),
3. to be able to **calculate the stresses** in structural members and design them under applied force. To be able to calculate deflections of structural systems given the material properties, cross-sectional dimensions, loads, and boundary conditions.

Two further, secondary objectives can be added to these:
1. to understand how structures support loads,
2. to develop an organized approach to **problem-solving**. You will be introduced to a general strategy for problem-solving which will be applied to problems throughout the course.

TEXTBOOK:
Hibbeler, R.C., "Mechanics of Materials", 8th SI edition, Pearson Education

REFERENCE BOOKS:
Beer, F.P., Johnston, E.R., DeWolf, J.T., "Mechanics of Materials", 4th edition, McGraw Hill.
Popov, E.P., "***Engineering Mechanics of Solids***," Second Edition, Prentice Hall, 1998.

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DESIGN CONTENT:
This course introduces the basic principles of mechanics with implications and applications to design of structures. Estimated design content is 30%.

LABORATORY SESSIONS:
The lab sessions scheduled for this course are problem-solving sessions, not experimental labs, and will be run by the teaching assistants. In each lab session you will work through a series of problems on the material currently being covered in class, and some or all of these problems will be handed in to be marked. Some lab sessions may include a short test (approx. 20 minutes) on material from recent classes. **No advance notice will be given of these short tests.** The marks from these labs will be added up to an overall lab mark for the semester. Attendance at lab sessions is required. Attendance will be taken at random times during the semester, especially when the attendance level is minimal, both during the lectures as well as the lab sessions.

Class Policies:

Homework: **10%**
Quizzes **15%**
2 Midterms: **40%**
Final exam: **35%**

Contribution of the Course to Program Outcomes:
This course is intended to contribute to the following program outcomes:

✓	(a)	An ability to apply knowledge of mathematics, science and engineering
	(b)	An ability to design and conduct experiments, as well as to analyze and interpret data
✓	(c)	An ability to design a system, component, or process to meet desired needs
	(d)	An ability to function on multi-disciplinary teams
✓	(e)	An ability to identify, formulate and solve engineering problems
	(f)	An understanding of professional and ethical responsibility
	(g)	An ability to communicate effectively
	(h)	The broad education necessary to understand the impact of engineering solutions in a global and societal context
	(i)	A recognition of the need for, and ability to engage in life-long learning
	(j)	A knowledge of contemporary issues
✓	(k)	An ability to use the techniques, skills and modern engineering tools necessary for engineering practice

Course Assessment: Course will be assessed on the basis of the accomplishments regarding the course objectives and the contributions to the program outcomes. The evaluation will consist mainly of the responses from the students, who will provide their comments to various course related questions in the final week of the semester.

Classrom etiquette: Ask permission from the instructor if you need to leave the classroom during the lecture. Respect your fellow students by not talking to your friends during the lectures. Use the breaks between the lectures for that purpose. Do not enter the classroom in the middle of the lecture in order not to disrupt the attention of other students.

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COURSE OUTLINE:

Week	Topics	Reading Assignment	Homework Assignment	Content
1	Stress, strain, material properties	Chapters 1-3	HW1	Review of equilibrium principles. Concepts of stress and strain. Stress components in Cartesian coordinates. Normal and shear stresses. Safety factors and design. Deformation and strain. Normal and shear strains. Mechanical properties of materials. Constitutive relations. Hooke's Law.
2				
3			HW2	
4	Axially loaded bars	Chapter 4	HW3	Axial deformation. St. Venant's Principle. Statically determinate and indeterminate axial loading assemblies. Composite bars. Thermal stresses.
5	Torsion	Chapter 5	HW4	Torsional deformation of circular shafts. Torque and angle of twist. Statically determinate and indeterminate torsional loading assemblies. Composite shafts. Thin walled members. Design of shafts.
6	Stresses and deflections in beams	Chapters 6, 7, 12	**MIDTERM 1 March 25th 2013** HW5	Pure bending of beams. Second moments of area. Parallel axis theorem. Principal axes and moments of area. Flexure formula. Flexural stresses.
7			HW6	Biaxial bending. Eccentric axial load. Composite beams.
8			HW7	Derivation of the differential equations for flexural beam deflections. Boundary conditions. Deflection curve. Statically indeterminate beams.
9			HW8	Shear stresses in beams. Transverse shear and the shear formula. Limitations of the shear formula. Shear flow and shear center.
10			HW9 **HOLIDAY**	Design of beams.
11	Transformation of stress and strain	Chapters 9, 10	HW10	Transformation of stress and strain at a point. Stress transformation equations. Mohr's circle. Principal stresses and maximum in-plane shear stress. Combined loading.
12	Buckling of columns	Chapter 13	HW11 **MIDTERM 2 May 6th 2013**	Stability. Euler buckling load. Issues in column design.
13	Energy methods	Chapter 14	HW12	External work and strain energy. Principal of virtual work. Castigliano's theorem.