

MEG 302 Materials Mechanics

UNLV Department of Mechanical Engineering

Spring Semester 2005, Version 1.0 (1/18/2005)

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Days/Time/Room: TR / 11:30 AM – 12:45 PM / CBC c128
Text: “Mechanics of Materials”, Beer, Johnston, & DeWolf, McGraw Hill, 2002
Roulo Website: <http://www.roulo.com/>
Course Website: <http://www.roulo.com/meg302/>

Course Objectives

The overall goal of this course is to learn how to design and analyze simple structures for predetermined strength and deformation requirements. Your learning objectives for the semester are to:

1. **Learn the Vocabulary.** It is important to read the text carefully. There are many new terms to learn and many subtle differences between the definitions of words. For example, you will learn about half a dozen new variations to the meaning of the word ‘stress’.
2. **Improve Your Skill at Drawing Free Body Diagrams.** Free body diagrams were used in your Statics class to model real physical problems with simplified sketches. This is a very important skill that is used to start and set up most Mechanics of Materials problems.
3. **Learn About Material Behavior.** All materials deform when loaded by mechanical forces or temperature changes. You should learn the basic principals of material behavior and some of the failure mechanisms of materials and structures. You should also learn the important properties of the most common materials used for engineering structures, machines and equipment.
4. **Learn How To Solve Mechanics Problems.** This is the largest part of the class. The solution procedure for most mechanics problems involves one or more of the following tasks:
 - A statics analysis of a component to find the internal reactions (forces & moments)
 - Determine stresses and strains in a component based on internal reactions
 - Find the deformation of the component
 - Compare calculated values of stress & deformation with known acceptable values
5. **Improve Your Engineering Design Skills.** A semester-long design project is also part of this course. All students will be part of a 3-4 member team working on the design of a realistic structure or mechanism. You will apply the analysis skills learned during the semester as part of the entire design project.

Prerequisites

The following UNLV courses (or their equivalent) are required as prerequisites: EGG 206 Engineering Mechanics I (Statics), MAT 182 Calculus II and PHY 180 Physics I.

Course Outline, Spring 2005 Version 1.0, Effective 1/18/2005

Dates	Ch	Sec	Topics	Homework Assignments & Due Dates
T 1/18 R 1/20	1 1	1-6 7-13	Intro: Concept of Stress, Normal Stress Components of Stress, Safety Factors	Send an e-mail to Eric Roulo with your e-mail address so he can create a class list.
T 1/25 R 1/27	2 2	1-8 9-10	Stress-Strain Diagram, Axial Deformation Statically Indeterminate Problems	Ch. 1: 2, 6, 9, 16, 21, 31, 38, 55
T 2/1 R 2/3	2 3	11-15 1-4	Poisson's Ratio, Shearing Strain Torsion: Stresses, Angle of Twist	Ch. 2: 6, 10, 16, 24, 35, 41, 50, 58, 65, 80
T 2/8 R 2/10	3 4	5-8 1-5	Statically Indeterminate Torsion, Power Bending: Stress & Deformation	Ch. 3: 6, 12, 20, 25, 35, 48, 56, 72, 81
T 2/15 R 2/17	 4	 6-12	EXAM 1: Chapters 1-3 Bending: Eccentric Axial Loading	Submit Design Project Title and Teams
T 2/22 R 2/24	5 5	1-2 3	Shear & Bending Moment Diagrams Load, Shear, & Moment Relationships	Ch.4: 2, 10, 22, 31, 45, 55, 118, 122
T 3/1 R 3/3	5 6	4 1-3	Design of Beams for Bending Shear Stresses in Beams	
T 3/8 R 3/10	6 6	4-6 7	Shear in Narrow Rectangular Beams Shear Stresses in Thin Walled Members	Ch. 5: 3, 16, 24, 27, 46, 57, 80, 87
T 3/15 R 3/17	7 7	1-3 4-6	Transformation of Plane Stress Mohr's Circle for Plane Stress	Ch. 6: 4, 9, 21, 31, 34, 45
T 3/22 R 3/24	 7	 7-9	EXAM 2: Chapters 4-6 Failure Criteria	
T 3/29 R 3/31	8 8	1-2	Principal Stresses in Beams & Shafts	
T 4/5 R 4/7	8 9	3-4 1-3	Stresses Under Combined Loading Equation of Elastic Curve	Ch. 7: 3, 15, 20, 32, 66, 75, 101, 117
T 4/12 R 4/14	9 9	4-5	Load-Deflection Relationship	Ch. 8: 3, 15, 40, 50, 57, 66
T 4/19 R 4/21	9 9	7-8	Statically Indeterminate Beams EXAM 3: Chapters 7-9	Ch. 9: 1, 10, 19, 27, 70, 79, 86
T 4/26 R 4/28	10 10	1-4 1-4	Euler's Column Formula Columns: Centric Loading	Project Presentations TBD Written design report due TBD
???			Final Exam	Ch. 10: 9, 11, 14, 20 (extra credit)

HOMEWORK ASSIGNMENT GUIDELINES:

Homework is due at the beginning of class on the dates on the outline. For example, homework # 1 is due on Thursday, January 27th. Homework assignments and due dates may change and will be announced in class. **Sloppy or unprofessional work will be returned ungraded. Late Homework Will Not Be Accepted** because solutions will be posted soon after the due date. Solutions will be posted on the MEG 302 Course Website.

Submit your assignments on 8.5" x 11" paper. Be sure to include your name at the top of the first page. Include the following information for each problem:

- Most of the problems will require a sketch of the problem along with one or more Free Body Diagrams showing the applied loads along with the external and internal reactions.
- Show all of your work. Make reference to equations in the book if you do not want to repeat them.
- Draw a box around your final answer or answers. You will not receive credit for a correct answer if you have not shown the work.

The homework counts as a significant percentage of your final grade so do not blow it off. Some of the problems may take several hours so manage your time accordingly. You are encouraged to help each other figure out the problems but do not copy each other's work.

It is **HIGHLY** encouraged that you purchase a computer math program such as MathCAD to do all your homework assignments on. The advantages of this are:

- 1) Mathcad keeps track of units
- 2) You can drag and drop the equations you need for each problem
- 3) It is much neater than your printing
- 4) You can reuse templates over and over again.

You should also consider investing in an HP calculator that has a built in equation library. One such model is the HP48 series of calculators. The HP49 does not come with an equation library the last time I checked.

The homework is assigned for three main reasons:

- To elaborate on material discussed in class and in the text
- To provide practice in solving mechanics problems
- To assess your understanding of the material

OFFICE HOURS

I do not have an office on campus, so office hours will vary on an as-needed basis. I encourage you to email me questions so I will be able to answer them and provide feedback to the entire class.

The best way to meet with me is to send e-mail to set up an appointment. I check my e-mail throughout the day and should respond quickly. I can be reached at:

Office Phone: 702 922 5028 (voice mail and fax)
E-mail: eroulo@roulo.com

GRADING

Your grade for the course will be based on weekly homework assignments, three in-class exams, a group design project and a comprehensive final exam which are weighted as shown below:

In-Class Exams (3)	Homework	Design Project	Final Exam
30 % (10 % each)	30 %	10 %	30 %

The letter grade cut-offs vary slightly from semester to semester. The table below shows an approximate correlation between final percentage grade and final letter grade.

88 - 100%	78 - 87%	73 - 77%	68 - 72%	58 - 67%	50 - 57%	< 50%
A	A- to B+	B	B- to C+	C	D	F

CHEATING

Copying each other's homework assignments is considered cheating. Any form of cheating on homework or an exam will result in a failing grade for the course. All of the assigned homework problems have answers in the back of the book. Use this information to check your work. **DO NOT PUT THE ANSWER FROM THE BACK OF THE BOOK AT THE END OF YOUR PROBLEM IF YOUR WORK DOES NOT SUPPORT THIS ANSWER OR YOU WILL GET ZERO POINTS FOR THE ENTIRE ASSIGNMENT.**

TIME MANAGEMENT

This will be a difficult class.

Plan to spend **6-10 hours per week** on homework assignments.

Plan to be completely stumped on some of the problems.

Plan your work periods at least **2 days before the due date.**

Plan to have questions after your first attempt at solving the homework problems.

Write your questions down when you think of them, **Ask** for help until you understand the problem.

DISABILITY RESOURCE CENTER

If you have a documented disability that may require assistance, you will need to contact the Disability Resource Center (DRC) for coordination in your academic accommodations. The DRC is located in the Reynolds Student Services Complex room 137. Their phone number is 895-0866.

Additional Resources

Engineers Edge

http://www.engineersedge.com/mechanics_material_menu.shtml

What is eFunda?

eFunda stands for engineering **F**undamentals. Its mission is to create an online destination for the engineering community, where working professionals can quickly find concise and reliable information to meet the majority of their daily reference needs.

http://www.efunda.com/formulae/formula_index.cfm

Material Properties (MATWEB)

<http://www.matweb.com/index.asp?ckck=1>

Source of Materials

<http://www.mcmaster.com/>

Unit Conversion

<http://www.digitaldutch.com/unitconverter/>

GROUP DESIGN PROJECT

Scope of Project: The design project provides you with an opportunity to apply the topics learned in class to any mechanics oriented design problem of interest to you and your teammates. You and your team will be responsible for:

- Identifying a design problem (A list of examples is available on the course website)
 - (e.g. wall mounted bookshelf for home)
- Defining a specific set of objectives and constraints for the problem (ex. Below)
 - The bookshelf must support 20 textbooks and 20 large 3-ring binders
 - The bookshelf must not sag in the middle by more than 0.125 inches
 - The bookshelf must be less than 14 inches deep
- Use a standard design procedure for defining a list of design criteria, alternative designs to be considered, design variables, scheduling, analysis, etc. You should have completed a project like this as part of your Introduction to Engineering Design Course. An outline of this procedure is posted on the class website.
- You will not be building or testing anything for this project. Your project must specify a recommended design with specific dimensions, materials, and costs outlined. You must also make it clear how you arrived at this final design and show why it is better than other alternatives under consideration.

Selection of Project: You may choose any project provided it is:

- acceptable to the instructor
- utilizes (at least) the principles covered in Chapters 1 through 8
- Includes a group of 2-5 students
- You may not select a project that is a copy of a problem in the textbook.

Design Project Deadlines:

Submit list of group members and project title by:

February 17, 2005

Send to eroulo@roulo.com, include all student e-mail addresses along with the title of the project.

Final written report due by:

TBD

Report: The written report will be graded on its mathematical correctness, grammar, spelling, style of writing, clarity, and brevity, as well as other criteria usually applied to a written report.