ME 302 Materials Mechanics

UNLV Department of Mechanical Engineering

(Course Information as of 8/29/06)
Check Course Website for updates and supplemental information)

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Days/Time/Room: TR / 11:30 AM – 12:45 PM / MPE 232
Text: "Mechanics of Materials", Beer, Johnston, & DeWolf, McGraw Hill, 2002
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(Responsible for grading homework assignments)

STARTING FALL 2006

The Mechanical and Civil Engineering Departments will be offering their own versions of Mechanics of Materials. ME students should sign up for ME 302 and ME302L. CEE students should sign up for CEE 370 and CEE 370L.

CEE 370 Engineering Mechanics of Deformable Bodies

UNLV Department of Civil and Environmental Engineering

Professor: Aly Said, Ph.D.
E-Mail: asaid@egr.unlv.edu

Days/Time/Room: TR / 11:30 AM – 12:45 PM / CBC C-120
Text: "Mechanics of Materials", Beer, Johnston, & DeWolf, McGraw Hill, 2002

ME 302 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, Fall 2006 Version 1.0, Effective 6/21/06

Dates	Ch	Sec	Topics	Homework Due Dates	Proposed Lab Plan
T 8/29 R 8/31	1 1	1-6 7-13	Normal Stress Comp. of Stress, Safety	Send an e-mail to Dr. O'Toole so he can create a class list.	No Lab
T 9/5 R 9/7	2 2	1-8 9-10	Stress-Strain curves, Static Indeterminacy	Ch. 1: 6, 12, 17, 26, 36, 40, 47, 52	1: Safety & Statistics
T 9/12 R 9/14	2 3	11-15 1-4	Poisson's Ratio Torsion:, Angle of Twist	Ch. 2: 5, 13, 18, 27, 37, 44, 51, 66, 72, 81	2: Strain Gage Bonding
T 9/19 R 9/21	3 4	5-8 1-5	Statically Ind., Power Bending: Stress	Ch. 3: 2, 14, 28, 42, 50, 59, 68, 75, 82	2: Strain Gage Bonding
T9/26 R 9/28	 4	 6-12	**EXAM 1: Chapters 1-3** Eccentric Axial Loading	**Project Title**	3: Tensile Testing
T 10/3 R 10/5	5 5	1-2 3	Shear/Bending Diagrams Load, Shear, & Moments	Ch.4: 7, 12, 18, 35, 46, 51, 103, 105	3: Tensile Testing
T 10/10 R 10/12	5 6	4 1-3	Beams for Bending Shear in Beams		4: Torsion
T 10/17 R 10/19	6 6	4-6 7	Shear in Narrow Beams Thin Walled Members	Ch. 5: 10, 20, 25, 27, 45, 46, 60, 68, 73	5: Beam Bending
T 10/24 R 10/26	7 7	1-3 4-6	Plane Stress Mohr's Circle	Ch. 6: 1, 14, 17, 23, 34, 37, 45, 64, 71	5: Beam Bending
T 10/31 R 11/2	 7	 7-9	**EXAM 2: Chapters 4-6** Failure Criteria		Projects
T 11/7 R 11/9	8 8	1-2 3	Principal Stresses Combined Loading	Ch. 7: 3, 11, 25, 32, 71, 92, 102, 104, 116	Projects
T 11/14 R 11/16	8 9	3-4 1-3	Combined Loading Beam Deflection	Ch. 8: 1, 9, 19, 27, 31, 37, 49, 55	Projects
T 11/21 R 11/23	9	4-5	Load-Deflection **Thanksgiving**	**No Class**	Projects
T 11/28 R 11/30	9	7-8	Indeterminate Beams **EXAM 3: Chapters 7-9**	Ch. 9: 5, 16, 21, 25, 65, 73, 79, 84	6: Column Buckling
T 12/5 R 12/7	10 10	1-4 1-4	Column Buckling Column Buckling	**Design Project Report Due**	Course Evaluations
R 12/14			**Final Exam 10:10 AM**	Ch. 10: 4, 12, 15, 23	

HOMEWORK ASSIGNMENT GUIDELINES:

Homework is due at the beginning of class on the dates highlighted in bold on the outline. For example, homework # 1 is due on Thursday, September 7. 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. A password will be provided in class to allow access to the HW solutions.

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.

Each problem will be graded on a scale from 0-10. 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.

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 encourage you to come ask questions about the coursework. I am usually on campus from about 9:30 AM to 5:30 PM. I am often called out of my office for meetings or to assist people in one of the labs. My walk-in office hours set aside for this class will be announced during the second week of 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: **895 - 3885**
E-mail: **bj@me.unlv.edu**

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
45 % (15 % each)	15 %	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 **e**ngineering **Funda**mentals. 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: September 28, 2006

Send to bj@me.unlv.edu, include all student e-mail addresses along with the title of the project.

Final written report due by: Friday December 8, 2006

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. Send final report to bj@me.unlv.edu, as an attached MS WORD file. If you are not using MS WORD, see instructor. Hard copies of reports will NOT be accepted. All figures, drawings, equations, etc. must be imported into the report document. You can scan handwritten equations or use Equation Editor, MathType, MathCad, or a similar tool for equations.

DESIGN PROCESS

The following outline is a brief overview of the design process. You should be familiar with the design process from the required "Introduction to Engineering Design" course. The presentation and report for your project should include:

- Identify Need
  - A customer usually approaches an engineer or engineering team with a problem. Your group must act as the customer initially by selecting a problem (approved by the instructor).
- Problem Definition
  - Try to come up with a specific definition of the problem
  - Consult with the customer before proceeding, make sure your definition matches the need
- Search for Information
  - Gather information from as many sources as possible
    - Library books
    - Library technical journals
    - Professional organizations
    - Internet (WWW)
  - Also examine existing products
- Criteria and Constraints (All projects will have different design criteria and constraints. The following is a partial list of possible criteria and constraints.)
  - Cost
  - Reliability
  - Weight
  - Ease of operation
  - Ease of Maintenance
  - Appearance
  - Strength
  - Compatibility
  - Safety Features
  - Noise Level
  - Effectiveness
  - Durability
  - Feasibility
  - Acceptance
- Alternative Solutions (You must consider a minimum of 3 different solutions to your design problem.)
  - Initial brainstorming session should be very informal
  - Write down every idea mentioned
  - Everyone must feel comfortable stating their ideas
  - There will be many bad ideas that can be eliminated later
- Analysis (You must include some analysis covered in this class: axial loading, torsion, bending, combined loads, buckling, beam deflections, …)
  - Use your engineering knowledge to evaluate the alternatives based on your design criteria
- Decision Making
  - Use the results of your analysis to compare all the alternatives using a systematic process
- Specifications
  - Write a thorough description of your design
  - Include detailed drawings if needed
- Communication
  - Selling your idea
  - Written reports
  - Oral presentations
  - Visual aids

Design Project Ideas

Trampoline	Spent Nuclear Fuel Rack	Slide
Steel Bridge	Mr. Flexy Snowboard	Water Couch
Neat Note Book	Interstate Median	Pliers
Weight Lifting Bar	Compact Folding Stadium Seat	Monkey Bars
Traffic Signal	Roll Cage for a Dune Buggy	Spring Board
PVC Sprinkler System	Residential Piping System	Wheelchair
Portable Basketball Hoop	Space Saving Hammock	Car Port
House Patio Cover	Durable Bag for carrying Lathes	Bus Stop Bench
Work Bench	Adjustable Folding Table	TV Stand
Foot Bridge	Automatic Adjustable Pencil	Freeway Sign
TV Tray	Automatic Adjustable ladder	Stop Sign
High Chair	Automatic Adjustable Cane	Trebuchet
Computer Stand	Fishing Pole	Gazebo
Book Shelf	RC Car Stand	Swing Set
3 Leg Table	RC Car Chassis	Diving Board
Chair (Stool)	Guitar	Retaining Wall
Staircase Design	Airport Wind Guard	Bicycle Frame
Pandora's Safe	4x4 Tow Winch	Car Jack
Computer Desk	Rope Bridge	Glasses
Computer Chair	Indestructible Pita	Bike Rack
Automobile Seat	Children's Playhouse	Small Porch
Aquarium Base	Artificial Limb	Engine Hoist
Pull Trailer (for a car)	Closet Shelving System	