ME 3221 - Design and Manufacturing I: Engineering Materials and Manufacturing Processes

Spring 2009

First Day Class Information

Tom Chase

January 16, 2009

Course Web Site:
http://www.me.umn.edu/education/courses/me3221/

Lecture room: ME 108

Lecture times: MW 2:30 PM - 3:45 PM

Instructor: Tom Chase

Office: ME 305

Office Hours:

Mon: 4:40-5:30 PM
Tues: 4:40-5:30 PM
Wed: 8:00-8:50 AM

Phone: 612-625-0308

E-mail: trchase@me.umn.edu

Teaching Assistants:

Names & E-Mail Addresses

Daniel Habeck habec011@umn.edu
Jill Oertel sune0005@umn.edu
Stephen Sedler sedl0033@umn.edu
Aravind Srivatsa sriva041@umn.edu

Office Hours: MTWTh 12:20-1:10 PM, ME 5 (TA office hours begin on 1/26/09)

Discussion Sections:

Dates: 1/26/09 - 2/20/09

Rooms & Times:

DIS 016: 8:00-9:55 Tue, AkerH 211
DIS 017: 4:00-5:55 Tue, AkerH 313
DIS 018: 4:40-6:30 Wed, Phys 157

Note: *You must attend the discussion sections during the week of 2/16-2/20* for safety training for the labs. If you do not sign a safety training form provided at this discussion section, you will not be allowed to perform the labs!

Laboratories:

Dates: 2/23/09-4/30/09

Rooms: Different labs are held in different rooms. Please see the course calendar for the room number corresponding to each lab.

Times:

LAB 005: 8:00-9:55 Tues
LAB 006: 10:10-12:05 Tues
LAB 007: 12:20-2:15 Tues
LAB 008: 4:00-5:55 Tues
LAB 009: 10:10-12:05 Wed
LAB 011: 8:00-9:55 Thurs
LAB 012: 10:10-12:05 Thurs
LAB 013: 12:20-2:15 Thurs
LAB 014: 4:00-5:55 Thurs

Note: Several labs only have enough equipment to support 8-10 students in one lab. Therefore, enrollment is strictly limited to 10 for any one section, and you must attend the section for which you are registered.

Course Outline:

1. Deformable Body Mechanics
   (a) Review
      i. Loading Diagrams: Method of Sections
      ii. State of Stress at a Point: Mohr's Circle
      iii. Axial, Torsional & Bending Stresses
      iv. Deflection of Beams: Superposition
   (b) Energy Methods
   (c) Beam Buckling
2. Failure Theories
   (a) Static Strength
      i. The Maximum Shear Stress Theory
      ii. The Distortion Energy Theory
      iii. The Coulomb-Mohr Theory
      iv. The Modified Mohr Theory
   (b) Fatigue Failure
      i. Endurance Limits
      ii. Fatigue Diagrams
      iii. Combined States of Stress
      iv. Design for Finite Life
3. Manufacturing Processes
   (a) Machining
   (b) Polymer Processing
   (c) Bulk Deformation Processes
   (d) Sheet Metal Forming
   (e) Casting
   (f) Welding
4. Quality Assurance
   (a) Design of Experiments
   (b) Statistical Process Control

Basic Lab Safety: You will be using powerful production machines in labs: Machining I & II, NC Machining, Injection Molding & Rolling and Casting & Welding. For your safety, it is essential that you follow these basic guidelines:

- Wear safety glasses with side shields at all times in these labs. If you do not have safety glasses, you can purchase them at the University Bookstore in Coffman Memorial Union. *Be sure* to have safety glasses before the first lab meeting of the Machining I lab. We can not afford to risk your eyesight!
- If you wear a ring, a watch, a bracelet, or a necklace, remove them and put them in your pocket before turning on a machine tool.
- If you wear a necktie, take it off.
- Secure any loose-fitting clothing before turning on a machine.
- If you have long hair, tie it back before turning on a machine.
- Wear sturdy closed-toe shoes (preferably safety shoes).
- Never engage in horseplay near a machine tool.
- If you have any questions, please ask!
- Attend the safety training provided at the fourth discussion section.
  Note: The video on hand safety have dramatizations that are a bit "gory". Nevertheless, I feel that this is a valuable video, as I found that it really made me think twice about placing my hands near a running machine!

Required References:

Juvinall, R. C., and Marshek, K. M., *Fundamentals of Machine Component Design*, Fourth Edition (Third Edition acceptable), Wiley, 2005.

Kalpakjian, S., and Schmid, S. R., *Manufacturing Processes for Engineering Materials*, Fifth Edition (Fourth or Third Edition acceptable), Prentice-Hall, 2008.

(Texts, available from Williamson Hall Bookstore.)

Prerequisites: ME 2011, AEM 3031, MatS 2001 or equiv; upper division mechanical engineering major.

Grading: (Point allocations)

- Deformable body mechanics review quiz: 7%
- Weekly quizzes and homeworks: 45%
- Labs: 15%
- Comprehensive final exam: 33%

Weekly quizzes: Eleven quizzes, approximately 20 minutes in length, will be given at the end of class every Wednesday from 2/11 - 4/29 except for March 18 (Spring Break week). Please mark your calendars!

Your lowest quiz score will be discarded. All quizzes are open book, open notes. You can not share your textbooks or your notes with any other student.

Make-up quizzes must be scheduled with Tom Chase at least 2 days in advance of the quiz. Otherwise, a missed quiz will be counted as the discarded grade. (If more than one quiz is missed, the missed quizzes are scored at 0.)

All quizzes will be weighted equally (4.5% of the final point total). The homework counts as a portion of the quiz grade; please see the section on "Homework Policy" below.

Review quiz: A 50 minute quiz on the prerequisite material from the AEM 3031 Deformable Body Mechanics class (or equivalent) will be given on Wednesday, 2/04/09. This quiz score can not be dropped.

Final exam: Friday, May 15, 10:30 AM - 12:30 PM, ME 108. The final is open book, open notes.

Re-grades: You may submit a quiz for re-grading within one working week following its return date. Re-grade requests are not accepted after this time limit. The quiz must be re-submitted to the instructor with a written explanation of where you feel the original grading was inaccurate. The quiz will usually be re-graded in its entirety, and your grade may go down as well as up. Nevertheless, if we made a mistake in grading (and we occasionally do), we encourage you to re-submit your work for correction.

Homework policy: Homework assignments are designed to prepare you for the next quiz. Homework will be collected at the time of the quiz. Answers will be made available on the course web site. Typically, the final answer will be provided to all problems, but only an occasional problem will be worked out in its entirety.

Complete solutions will not be provided for all problems, as it leads to a false sense of understanding the course material. Doing the homework problems yourself is essential to developing the problem synthesis skills necessary for machine design and manufacturing planning.

You will have to solve all homework problems to develop sufficient understanding of the subject matter to complete the quizzes in a reasonable amount of time. The quizzes will be strictly timed. You should have no difficulty in completing the quizzes within the allotted time if you have done all the homework. Your mastery of the subject matter, as indicated by the time needed to complete a quiz problem, is a significant factor in the grading.

10% of each quiz score will be based on the attached homework. Homework will be checked for completeness but not graded. You will receive 10%, 7%, 4% or 0% based on its apparent completeness. Thus, if you don't turn in the homework, the highest possible quiz score is 90%.

Incompletes: The grade of "I" is awarded only in the case of exceptional and verifiable severe illness or tragedy. An "I" will not be awarded because you are doing poorly in the class. You must have completed all but a small portion of the course work for an "I" to be considered.

Policy on extra credit: You are not permitted to submit extra work in an attempt to raise your grade.

Conduct and discipline: Please see web page *www.it.umn.edu/students/policies* for the Institute of Technology's policy on conduct and discipline. You may work together on your homework and labs, but the work you turn in must be clearly recognizable as your own.

Please remember that you are *not* allowed to share textbooks or notes in quizzes or exams. Also, the usage of communication devices, including but not limited to cell phones, wireless network connections, and calculators with infrared communication capabilities, is prohibited during quizzes and exams.

Class attendance: While attendance will not be taken, attendance at all classes is expected. You will be held responsible for all material presented in lecture, labs and discussion sections. The instructor and the teaching assistants will not provide copies of notes for any missed lectures, labs or discussion sections.

Relationship to ME curriculum: ME 3221 blends two topics essential to designing and fabricating machines. The first topic addresses how to size parts for machines so that they will not fail. The second topic addresses most

common manufacturing processes used to fabricate both capital equipment and mass produced products. I have learned that a knowledge of these manufacturing processes is essential to designing machines.

ME 3222 is a direct follow-up to this class. The content of ME 3222 is coordinated with ME 3221: you can take ME 3221 either before or simultaneously with ME 3222. However, the failure theories used in ME 3221 are an essential prerequisite to the machine component selection portion of ME 3222, so you *can not* take ME 3222 before ME 3221.

This class is likely to be of interest and value to any mechanical engineering student interested in designing or manufacturing mechanical products.

Closing words: I first entered the field of mechanical engineering to learn how to design and manufacture machines. My interest has continued to grow ever since. I am enthusiastic about the topics of this class, as I still apply them regularly in my research and consulting. I will try to convey some of the most valuable techniques that I have learned during my experiences. I hope that you become excited about the content of this course too! Your suggestions for improving the class are always welcome.