EM 319 MECHANICS OF SOLIDS
SPRING 2012 SYLLABUS

Unique Numbers: 13835, 13840

Instructor: Nanshu Lu, nanshulu@mail.utexas.edu, WRW 305C, 471-4208

Time: MWF 11am – 12pm

Location: WEL 2.304

Teaching Assistants: Andrew Barnes, barnesandrew@mail.utexas.edu, WRW 214
John Mersch, jmersch@utexas.edu, WRW 109

Web Page: Blackboard

Notes: Use virtual class on Bb for syllabus, lecture notes, practice exams and solutions (maintained by Nanshu).
Use class with unique numbers on Bb for HW, HW solutions and TA sessions (maintained by TA).

Catalog Description:
Internal forces and deformations in solids; stress and strain in elastic and plastic solids; application to simple engineering problems. Three lecture hours a week for one semester, with discussion hours if necessary.

Course Objectives:
Learn to perform stress, strain, and deformation analyses of simple structures subjected to tension, compression, torsion, bending and internal pressure. Learn to analyze failure under combined loading.

Prerequisites:
Engineering Mechanics 306, Mathematics 408D or 408M, and Physics 303K with a grade of at least C in each.

Knowledge, Skills, and Abilities Students Should Have Before Entering This Course:
The student should have a good command of the material covered in EM 306 Statics, particularly concepts of equilibrium, free-body diagrams, properties of areas such as centroids and second moments and shear force and bending moment diagrams for beams.
Knowledge, Skills, and Abilities Students Gain from this Course (Learning Outcomes):
Fundamental concepts of solid mechanics, including stress, strain, and displacement; analysis and design of simple structural members subjected to tension, compression, torsion, bending and internal pressure; elementary models of material deformation and failure behavior.

Impact on Subsequent Courses in Curriculum:
The course is an essential prerequisite for more advanced mechanics courses such as EM 339, ASE 221K, ASE 324L, CE 329, and ME 336, and ME 338.

Relationship of Course to Program Outcomes:
This course contributes to the following ABET Criterion 3 outcomes and those specific to the EAC accredited program.

<table>
<thead>
<tr>
<th>Outcome</th>
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<tbody>
<tr>
<td>a. An ability to apply knowledge of mathematics, science, and engineering.</td>
<td>x</td>
<td>g. An ability to communicate effectively.</td>
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<tr>
<td>b. An ability to design and conduct experiments, as well as to analyze and interpret data.</td>
<td></td>
<td>h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.</td>
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<tr>
<td>c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.</td>
<td>x</td>
<td>i. Recognition of the need for and an ability to engage in life-long learning.</td>
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<td>d. An ability to function on multidisciplinary teams.</td>
<td></td>
<td>j. Knowledge of contemporary issues.</td>
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<tr>
<td>e. An ability to identify, formulate, and solve engineering problems.</td>
<td>x</td>
<td>k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
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<td>f. An understanding of professional and ethical responsibility.</td>
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ABET Program Criteria Achieved:
Program criteria are unique to each degree program and are to be compiled from the program criteria given for each degree program and listed in table format below. The faculty should check which of the program criteria are achieved in the course.

<table>
<thead>
<tr>
<th>Criterion</th>
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<tbody>
<tr>
<td>a. Aerodynamics</td>
<td>g. Orbital Mechanics</td>
<td>m. Preliminary/Conceptual Design</td>
</tr>
<tr>
<td>b. Aerospace materials</td>
<td>h. Space Environment</td>
<td>n. Other Design Content</td>
</tr>
<tr>
<td>c. Structures</td>
<td>i. Attitude Determination and Control</td>
<td>o. Professionalism</td>
</tr>
<tr>
<td>e. Flight Mechanics</td>
<td>k. Space Structures</td>
<td>x</td>
</tr>
<tr>
<td>f. Stability and Control</td>
<td>l. Rocket Propulsion</td>
<td></td>
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Textbook:
Find it on Amazon:

Class Topics:
• General concepts of stress, strain, material behavior and some design considerations [Ch.1]
• Axially loaded members [Ch. 2]
• Torsion of circular bars and thin-walled tubes [Ch.3]
• Shear force and bending moment diagrams [Ch. 4]
• Stresses in beams [Ch. 5]
• Deflection of beams [Ch. 9]
• Statically indeterminate beams [Ch. 10]
• Analysis of stress and strain [Ch. 7]
• Pressure vessels and combined loadings [Ch. 8]

Class Outline and Schedule:
Jan 18 Welcome and introduction (Ch 1)
Jan 20 Normal stress (Ch 1)
Jan 23 Normal strain and mechanical properties of materials (Ch 1)
Jan 25 Shear stress and bearing stress (Ch 1)
Jan 27 Allowable stress and strain (Ch1)
Jan 30 Axially loaded members (Ch 2)
Feb 1 Axially loaded members continued (Ch 2)
Feb 3 Statically indeterminate problems (Ch 2)
Feb 6 Statically indeterminate problems continued (Ch2)
Feb 8 Misfit (Ch 2)
Feb 10 Prestrain (Ch 2)
Feb 13 Stresses on inclined surfaces (Ch2)
Feb 15 Torsion of bars (Ch 3)
Feb 17 Non-uniform torsion and shafts (Ch3)
Feb 20 Statically indeterminate torsion (Ch 3)
Feb 22 Statically indeterminate torsion continued (Ch 3)
Feb 24 Stress and strain in pure shear (Ch 3)
Feb 27 Pure shear and thin walled tubes (Ch 3)
Feb 29 Beams: shear force and bending moment diagrams (Ch 4)
Mar 2 Beams: shear force and bending moment diagrams continued (Ch 4)
Mar 5 Beams: shear force and bending moment diagrams continued (Ch 4)
Mar 7 Beam curvature (Ch 5)
Mar 9 Stress and strain in beams (Ch 5)

Spring Break
Mar 21  Normal stress in beams with flanges (Ch 5)
Mar 23  Shear stress in beams (Ch 5)
Mar 26  Shear stress in beams with flanges (Ch 5)
Mar 28  Shear flow (Ch 5)
Mar 30  Deflection of beams (Ch 9)
Apr  2  Deflections by integration (Ch 9)
Apr  4  Deflections by superposition (Ch 9)
Apr  6  Statically indeterminate beams (Ch 10)
Apr  9  Statically indeterminate beams using superposition (Ch 10) by Andrew
Apr 11  Compatibility (Ch 10)
Apr 13  Analysis of stress (Ch 7)
Apr 16  Stress transformation (Ch 7)
Apr 18  Mohr’s circle and principal stress (Ch 7)
Apr 20  Application of Mohr’s circle (Ch 7)
Apr 23  Hooke’s law for plane stress (Ch 7)
Apr 25  Pressure vessels (Ch 8)
Apr 27  Combined loadings (Ch 8)
Apr 30  Combined loadings continued (Ch 8)
May  2  Review for final exam
May  4  Flexible

**Class Format:**
Each week there will be three lectures (3 hours total) and one discussion session (2 hours). The instructor formally presents the topic covered in the course, and the discussion sessions will be led by one of the teaching assistants, emphasizing on problem-solving procedures. The time and locations are listed below.

<table>
<thead>
<tr>
<th>Unique Number</th>
<th>Time</th>
<th>TA</th>
<th>Classroom</th>
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<tbody>
<tr>
<td>13835</td>
<td>Tuesday 5:00 – 7:00pm</td>
<td>Andrew Barnes</td>
<td>CPE 2.210</td>
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<tr>
<td>13840</td>
<td>Wednesday 5:00 – 7:00pm</td>
<td>John Mersch</td>
<td>CPE 2.210</td>
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</table>

**Discussions**
- Discussions are regular classes and they must be treated accordingly.
- You must attend only the discussion session for which you are registered.
- Discussion sessions can be changed only through regular registration processes.
- Discussions are the best place to ask questions about homework problems.
- Every discussion session not on the week of a midterm will have a quiz.

**Attendance:**
Regular attendance is expected. No electronics allowed.
Design Assignments
There are no design assignments for this course.

Laboratory Assignments
There are no laboratory assignments for this course.

Computer:
There is no required use of any computer hardware or software for this course.

Homework Policy:
- About 15 representative homework problems will be assigned at the end of each session.
- It is your responsibility to do every homework problem.
- Homework will not be collected or graded.
- Some of the homework problems will appear in the weekly quizzes.
- Solving the homework problems and studying for quizzes is the best way to prepare for the midterm and final examinations

Examination:
- There will be weekly quiz at the beginning of each discussion session. Problems in the quiz will be similar to one or two of the homework problems assigned in the past week.
- Quizzes will be graded by the TA and returned one week later at the discussion sessions.
- The two lowest scores on the quizzes (that includes zero for absentia) will be dropped.
- There will be three midterm examinations and one final examination in addition to the weekly quizzes. All of them are closed books and notes.
- Practice exams will be posted on Bb one week before each exam and model solutions to the practice exams will be posted on Bb two days prior to each exam.
- Use of graphical calculators is allowed but the memory has to be cleaned prior to the exam.
- Be prepared to present your student ID before or during the exams.
- Make-up quizzes or exams will only be considered if there is time conflict with other classes or exams, severe medical conditions or family emergencies.
- The final exam will be comprehensive and mandatory and held at the officially scheduled time and location.

Exam #1   Feb 20, 2012 (Monday)   7:00pm – 10:00 pm   RLM 5.104
Exam #2   Mar 26, 2012 (Monday)   7:00 pm– 10:00 pm   ETC 2.108
Exam #3   Apr 23, 2012(Monday)    7:00 pm– 10:00 pm   ETC 2.108
Final     May 11, 2012 (Friday)   2:00pm-5:00 pm

Grading:
Weekly Quizzes (20% total)
3 Midterm Exams (15% each)
1 Final Exam (35%)
Grading Policy:
A: A cutoff around top 20%
B: A cutoff around top 50%
C: A cutoff around top 80%
D: A cutoff around top 90%

Office Hours:
- Nanshu Lu  Monday and Thursday  5pm~6pm  WRW 305C
  The day before each exam  8 pm~10:00pm on Skype (ID: nanshulu)
- John Mersch  Tuesday  1pm~3pm  WRW 109
- Andrew Barnes  Friday  9am~11am  WRW 214

Important Dates:
Jan 17th, 2012, Tuesday  Classes begin.
Jan 20th, 2012, Friday  Last day of the official add/drop period.
Feb 1st, 2011, Wednesday  Last day to drop a class for a possible refund.
May 4th, 2012, Friday  Last class day.

Special Notes:
The University of Texas at Austin provides upon request appropriate academic adjustments for
qualified students with disabilities. For more information, contact the Office of the Dean of
Students at 471-6259, 471-4641 TDD or the Cockrell School of Engineering Director of Students
with Disabilities at 471-4321.

Evaluation:
- Anonymous in-class surveys to evaluate the course, the instructor and the TAs.
- The Measurement and Evaluation Center forms for the Cockrell School of Engineering will
  be used during the last week of class to evaluate the course and the instructor.

Prepared by: Nanshu Lu

Last Modified: Feb 29, 2012