THE UNIVERSITY OF TEXAS AT AUSTIN
Department of Aerospace Engineering and Engineering Mechanics

EM 319 MECHANICS OF SOLIDS
SPRING 2013 SYLLABUS

Unique Numbers: 13800, 13805, 13810, 13815

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

Lecture Time: MWF 11am – 12pm

Lecture Location: WEL 2.122

Nanshu’s Office Hour: MF 4pm – 5pm, WRW 305C

TAs:
Nathan Bechle, Nathan.bechle@utexas.edu, T 4pm – 5pm, WRW109
John Mersch, jmersch@utexas.edu, W 4pm – 5pm, WRW109
Kelin Chen, kelinchen@utexas.edu, Th 4pm – 5pm, WRW214
Chenglin Yang, stevenyang49@gmail.com, T 10am – 11am, WRW214
Shutao Qiao, shutao2011@gmail.com, W 10am – 11am, WRW 311

Web Page: Blackboard

Notes: Use virtual class (v01165) on Bb for everything: announcements, syllabus, lecture notes, HW and solutions, practice exams and solutions, grades, etc..

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.

### AEROSPACE ENGINEERING PROGRAM OUTCOMES

<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 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>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>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>j. Knowledge of contemporary issues.</td>
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<td>e. An ability to identify, formulate, and solve engineering problems.</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.

### AEROSPACE ENGINEERING PROGRAM CRITERIA

<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 x</td>
</tr>
<tr>
<td>b. Aerospace materials</td>
<td>h. Space Environment</td>
<td>n. Other Design Content</td>
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<tr>
<td>c. Structures</td>
<td>i. Attitude Determination and Control</td>
<td>o. Professionalism</td>
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EM 319 Course Syllabus, Spring 2013

Required 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 14  Welcome and introduction (Ch 1)
Jan 16  Normal stress (Ch 1)
Jan 18  Normal strain and mechanical properties of materials (Ch 1)
Jan 21  MLK Day
Jan 23  Shear stress and bearing stress (Ch 1)
Jan 25  Allowable stress and strain (Ch 1)
Jan 28  Axially loaded members (Ch 2)
Jan 30  Axially loaded members continued (Ch 2)
Feb 1   Statically indeterminate problems (Ch 2)
Feb 4   Statically indeterminate problems continued (Ch 2)
Feb 6   Misfit (Ch 2)
Feb 8   Prestrain (Ch 2)
Feb 11  Stresses on inclined surfaces (Ch 2)
Feb 13  No class (Nanshu is traveling)
Feb 15  Exam #1, in class, proctored by TA
Feb 18  Torsion of bars (Ch 3)
Feb 20  Non-uniform torsion and shafts (Ch 3)
Feb 22  Statically indeterminate torsion (Ch 3)
Feb 25  Statically indeterminate torsion continued (Ch 3)
Feb 27  Stress and strain in pure shear (Ch 3)
Mar 1  Pure shear and thin walled tubes (Ch 3)
Mar 4  Beams: shear force and bending moment diagrams (Ch 4)
Mar 6  Beams: shear force and bending moment diagrams continued (Ch 4)
Mar 8  Beams: shear force and bending moment diagrams continued (Ch 4)

Spring Break
Mar 18  Beam curvature (Ch 5)
Mar 20  Stress and strain in beams (Ch 5)
Mar 22  Normal stress in beams with flanges (Ch 5)
Mar 25  Shear stress in beams (Ch 5)
Mar 27  Shear stress in beams with flanges (Ch 5)
Mar 29  Shear flow (Ch 5)
Apr 1  Deflection of beams (Ch 9)
Apr 3  Deflections by integration (Ch 9)
Apr 5  Deflections by superposition (Ch 9)
Apr 8  Statically indeterminate beams (Ch 10)
Apr 10  Statically indeterminate beams using superposition (Ch 10) by Andrew
Apr 12  Compatibility (Ch 10)
Apr 15  Analysis of stress (Ch 7)
Apr 17  Stress transformation (Ch 7)
Apr 19  Mohr’s circle and principal stress (Ch 7)
Apr 22  Application of Mohr’s circle (Ch 7)
Apr 24  Hooke’s law for plane stress (Ch 7)
Apr 26  Pressure vessels (Ch 8)
Apr 29  Combined loadings (Ch 8)
May 1  Combined loadings continued (Ch 8)
May 3  Review for final exam

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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</thead>
<tbody>
<tr>
<td>13800</td>
<td>T 5:00 - 7:00</td>
<td>John Mersch</td>
<td>CPE 2.210</td>
</tr>
<tr>
<td>13805</td>
<td>W 5:00 - 7:00</td>
<td>Nathan Bechle</td>
<td>CPE 2.210</td>
</tr>
<tr>
<td>13810</td>
<td>T 7:00 - 9:00</td>
<td></td>
<td>CPE 2.210</td>
</tr>
<tr>
<td>13815</td>
<td>W 7:00 - 9:00</td>
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<td>CPE 2.210</td>
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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 in class.

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 finish 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 15, 2013 (Friday)  
11:00 am – 12:00 pm  
WEL 1.316
<table>
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<tr>
<th>Exam</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Exam #2</td>
<td>Mar 18, 2013 (Mon)</td>
<td>7:00 pm – 10:00 pm</td>
<td>UTC 2.112A</td>
</tr>
<tr>
<td>Exam #3</td>
<td>Apr 22, 2013 (Mon)</td>
<td>7:00 pm – 10:00 pm</td>
<td>UTC 2.112A</td>
</tr>
<tr>
<td>Final</td>
<td>May 14, 2013 (Tues)</td>
<td>9:00am – 12:00pm</td>
<td>TBD</td>
</tr>
</tbody>
</table>
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%

The plus-minus grading scheme will be used.

Tutoring information:
The Sanger Learning Center offers one-on-one tutoring sessions for EM 319. They help tackle difficult homework problems and review course concepts in a one-hour session with a specially trained tutor. All students are provided at least five free tutoring credits every semester. Check out http://www.utexas.edu/ugs/slc/support/one-on-one.

Important Dates:
Jan 14th, 2013, Tuesday Classes begin.
Jan 17th, 2013, Thursday Last day of the official add/drop period.
Jan 30th, 2013, Wednesday Last day to drop a class for a possible refund.
May 3th, 2013, 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: Jan 16, 2013