ENGN 0310 Solid Mechanics
Lectures: MWF 9:00 pm–9:50 pm at CIT Center 165
Section S03: Tues 12:00 pm–12:50 pm at BH 141
Section S04: Tues 4:00 pm–4:50 pm at BH 141
updated September 6, 2013

Teaching Staff:
Prof. Christian Franck (lectures; sections; labs; responsible for overall administration of the course)
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Prof. Jennifer Franck (lectures; sections)
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Faculty office hours:
Faculty Office Hours: Tuesday 1-3pm, in respective offices

The faculty member in charge of the current course material will hold office hours each week. Please check the online calendar for who is holding office hours, it will be the same person who holds section. Faculty are always available by appointment, even if they are not teaching the current material.

TAs & TA office hours:
Alireza Khorshidi (Head TA: Grading HW, Labs, Office Hours)
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Jonathan Estrada (Lab TA)
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Course secretary: Ms. Pat Capece, 7th floor, NE B&H

Course Description (from the course catalog). Mechanical behavior of materials and analysis of stress and deformation in engineering structures and continuous media. Topics include concepts of stress and strain; the elastic, plastic, and time-dependent
response of materials; principles of structural analysis and application to simple bar structures, beam theory, instability and buckling, torsion of shafts; general three-dimensional states of stress; Mohr’s circle; stress concentrations. Lectures, recitations, and laboratory. Prerequisite: ENGN 0030.

ENGN 0040 is not explicitly required but if you have taken 0040, it will help you a lot.

Purpose and goals (ABET). The student who successfully completes this course will

1. be proficient with basic concepts in continuum mechanics of solids, including measures of strain, internal force, stress and equilibrium in solids and structural elements; be able to characterize materials with elastic constitutive relations; be familiar with the use of yield and fracture criteria to design against failure in solids and components.

2. be able to use analytical techniques to predict deformation, internal force, failure and stability of simple solids and structural components.

3. be able to design and conduct experiments to measure strain, and infer stress states, in a structure or component

4. be able to apply principles of continuum mechanics to design a structure or component to achieve desired performance under realistic constraints, including: to function effectively in teams; to complete successfully the conceptual; embodiment and detail design process; to communicate design specifications through oral or written reports; and to manufacture and demonstrate a successful product.

Webpage. We will make extensive use of the course webpage, which is here (username and password are given out in class):

http://www.brown.edu/Departments/Engineering/Courses/en31

Textbook and schedule. Solid mechanics in engineering, by Raymond Parnes (Wiley). Required. We will assign problems from this book. Note that the level of mathematics in this book might seem a bit higher than what you are used to. Don’t panic! We will make sure you are sufficiently prepared to get through this course. Our course will be designed around this book, and we will follow the book according to the following approximate schedule:

- Chapter 1, introductory concepts: stress & strain: 9/4
• Chapter 2, internal forces & stress: 9/6-9/13
• Chapter 3, deformation & strain: 9/16–9/23
• Chapter 4, behavior of materials: 9/25–9/30
• Chapter 5, ‘mechanics-of-materials’ approach: 10/2
• Chapter 6, axial loadings: 10/4–10/11
• Chapter 7, torsion of circular cylindrical rods: 10/18–10/23
• Chapter 10, thin-wall pressure vessels: 10/25-10/28
• Chapter 8, bending beams: 10/30–11/11
• Chapter 9, fundamental solutions & superposition: 11/13–11/22
• Chapter 11, stability 11/25–11/2
• Chapter 14, energy theorems and the principle of virtual work 12/4–12/11

Laboratories. There will be 2 labs to be performed this semester. Each will require a separate report to be turned in after the completion of the laboratory component. The format and the guidelines of the report will be given with the assignment. Below is the rough schedule of the labs, although it is subject to change if we do not cover the necessary material in a timely manner. Lab reports will be turned in electronically (PDF format), no paper reports will be accepted.

Lab schedule:

1. Uniaxial Strain Field Measurements. This lab will focus on various methodologies to measure material strains to generate an overall material stress-strain curve. The lab demonstrates common engineering techniques to evaluate the mechanical properties of materials. You will learn how to use image processing and displacement tracking to calculate material strains. Introduced in lecture 9/30, due 10/9 at 5pm.

2. Soda Can Myth Buster. In this lab you will estimate the pressure inside a soda can and try to bust the myth that tapping on a soda can reduces the actual pressure inside the can after it’s been shaken. You will learn how to use strain gauges, an industrial uniaxial tension tester, and various signal processing tools. Introduced in lecture 10/28, due 11/6 at 5pm.
**Design project.** There will be a design project that introduces students to the powerful mechanics software, *ABAQUS*. The project will be at the end of the semester because it utilizes all the concepts and skills you have developed throughout the course. It will be introduced in class on 11/18. Part I (analytical) will be due on 11/27 at 12pm. Part II (computational) will be due on 12/11 at 5pm. More details will be given out in class.

**Homework.** Problem-solving is crucial for this class. It is to your benefit to do the homework since (1) it will help you on the exams, (2) there will be a problem on each exam which is very similar to a homework problem that has been assigned, (3) if you don’t do the homework, your grade will suffer, and (4) if you are on the borderline between A and B or B and C or C and NC, good homework might push you up. As the schedule allows we will assign problems on material before we cover it in class, so that you will have grappled with the material before it is covered in lecture. We will have weekly assignments due on Friday by 4 pm in a box in the secretarial bay outside Prof Christian Franck’s office (BH739). Late homework will not be accepted. To account for illness, family emergencies, and sports trips, we omit the lowest homework grade when computing the final grade. Please don’t bother to ask for an extension on your homework—any one homework set contributes very little to your grade. But they are extremely important for your understanding.

You are free to talk with anyone about the assigned problems. You can look at other books or the internet if you think it will help you. But please use good judgment—it is considered cheating to look at an internet site that collects homework solutions from textbooks and courses. There is evidence that students who simply copy solutions from sites like these perform more poorly than students who do not.

**Grading and Exams.** There will be two in-class midterm exams, one on October 16, worth 20% of the final grade, and November 15, also worth 20%. If you have any special needs, please make sure to inform Prof. Christian Franck well before the exam time (send him an email or meet with him in the first two weeks of class). Homework is worth 10% of the final grade. The lowest homework grade will not count toward the final grade. Labs are worth 10% (5% each), and the design project is worth 10%. Every student must contribute to every lab and the design project to get credit for the course. The final exam is cumulative and worth 30% of the grade.

**Plagiarism.** Plagiarism will not be tolerated. This includes, but is not limited to, copying other students’ work, solutions manuals, or internet sources, misrepresenting work as your own by not properly citing or referencing sources, or including your name on a lab report that you did not contribute to. More details on the Academic Code can be found here:

Any questions regarding this topic will happily be addressed by the course faculty and TAs.