CE130N – Mechanics of Structures

Instructor: Prof. Sanjay Govindjee, 779 Davis Hall. E-mail: s_g@berkeley.edu. Office Hours: M,Tu 2-3:30.

GSIs:

1. Paul Drazin, 504 Davis Hall. E-mail: pdrazin@gmail.com. Office Hours: Tu 12-2, F 10-12. Lab Monday 2-5.

2. Qi Tong, 504 Davis Hall. E-mail: freefall@berkeley.edu. Office Hours: M 3-5, Tu 10-12. Lab Tuesday 2-5.

3. Nicolas Peralta, 504 Davis Hall. E-mail: nicoper@berkeley.edu. Office Hours: Tu 3:30-5:30, W 10-12. Lab Thursday 2-5.

Lab: Mandatory M 2-5, T 2-5, Th 2-5 in 345 Davis Hall. If you do not already have access to the computer lab. Please follow the instructions on the department website. Note, there will be no labs the first week of the semester. Labs will begin January 26. You *must* go to your assigned lab section.

Web Page: Please see bCourses. bCourses will be used extensively for the course. You will find the course reader there, the syllabus, assignments, etc. A day by day calendar has been set up so that you can plan your semester.

Prerequisites: CE30/ME85 and (CE60 or E45).

Description: Elastic deformation analysis of bars, shafts, beams, and columns using energy and variational methods and their generalization to related areas of engineering science; stability analysis of structures; computer-aided mathematical techniques for solution of engineering problems and modular computer programming methods.

Textbook: The text for the course can be downloaded from bCourses:

Govindjee, S. (2015). *A First Course on Variational Methods in Structural Mechanics and Engineering.*

You will also want to have access to your CE30 textbook. If you no longer have this, I can recommend:

1. Govindjee, S. (2013). *Engineering Mechanics of Deformable Solids.* Oxford University Press, Oxford.

2. Gross, D., Hauger, W., Schröder, J., Wall, W.A. and Bonet, J. (2011). *Engineering Mechanics 2: Mechanics of Materials.* Springer-Verlag, Berlin.

The book by Gross et al. is free for Berkeley students and can be downloaded from the Engineering Library web site – look for electronic books, then Springer eBooks, then search.

Software: MATLAB is used extensively in the course so it is recommended that you have you have a copy on your own computer. You can obtain a free license from the campus; see `https://software.berkeley.edu/matlab`.

Conduct of Course: Homework will be assigned weekly and due the following the week. Assignments will be paper and pencil and computer-based. Lab assignments will mostly be required to be completed in the lab but some may extend over a longer period and be part of the weekly homeworks. Access to Matlab is essential.

There will be one midterm examination and a final exam. The midterm is scheduled for March 11. The final exam will be Tuesday, May 12, 2015 8-11am.

Course grade is based on: Homework 15%, Lab 15%, Midterm 30%, Final 40%.

Limited **collaboration** is permitted on homework assignments. You may discuss the homework with each other but may not show your written work or computer code to others. Similarly, the use of solution keys or solution sets of any type is expressly forbidden. All cases of misconduct on homework will be reported to the Student Conduct Office in addition to the assignment of a **zero** for the **entire** homework portion of the course grade. Misconduct on examinations will likewise be reported to the Student Conduct Office and result in a **failing grade** for the course.

Topic Outline:

1. Review of one dimensional models for basic elastic structural elements: tension-compression bars, torsion bars, beams
   (a) Differential equation representations
   (b) Static indeterminacy
2. One dimensional elements in two and three spatial dimensions
   (a) Direct assembly of truss systems, determinate and indeterminate systems
3. Energy methods
   (a) Review of conservation of energy, conservative forces, conservative systems
   (b) Potential energy of a system
   (c) Stationary potential energy and Castigliano's 1st Theorem
   (d) Trusses revisited using stationary potential energy
   (e) Approximate energy solutions: Ritz
   (f) Buckling and potential energy
4. Variational Methods
   (a) Method of virtual displacements
5. Multi-Dimensional Problems
   (a) Two dimensional mechanical systems: membranes
   (b) Applications to other fields: Darcy's flow and seepage
   (c) Applications to other fields: Pollution transport and advection-diffusion