ENCE 353: Introduction to Structural Analysis

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Notes from Class
Meet the Class: [2011]
Class Schedule, [2011]

GOALS

The class is an introduction to the basic tools of structural analysis and design. Design loads. Equilibrium of external and internal forces. Shear and moment diagrams in beams and frames. Truss analysis. Influence line diagrams. The slope-deflection method and method of consistent deformation. Matrix stiffness methods for beams, frames and trusses.

COURSE OUTLINE - FALL SEMESTER, 2011

The topics will be as follows:

- **Introduction** (3 classes)
  - Overview of structural analysis and structural design.
  - Quick review of statics, free body diagrams, equations of equilibrium.
  - Structural loads and structural design.

- **Statically Determinate Trusses** (5 classes)
  - Types and classification of trusses.
  - Method of joints, method of sections.
  - Compound trusses.

- **Statically Determinate Beams and Frames** (6 classes)
  - Internal forces: shear and bending moment diagram for a beam.
  - Shear and moment diagrams for a frame.
  - Qualitative drawing of deflection shape for a structure under applied loads.

- **Cables and Arches** (4 classes)
  - Behavior of cable and arch structures.

  - Cables subject to concentrated loads.
  - Cables subject to uniformly distributed loads.
  - Analysis of three-hinged arch structures.
  - Simplified analysis of suspension structures.

- **Influence Lines for Statically Determinate Structures** (4 classes)
  - Muller-Breslau Principle and general procedure for obtaining influence lines.
  - Qualitative influence lines for beams and frames.
  - Live-load patterns; determination of maximum response by influence lines.

- **Deflection of Structures** (6 classes)
  - Differential equations and moment area method.
  - Principle of virtual work.
  - Method of virtual work to determine deflections.

- **Method of Consistent Deformations (Force Method)** (6 classes)
  - General procedure.
  - Effects of support settlement (movement), temperature change, and fabrication errors.

- **Slope-Deflection Equations (Displacement Method)** (6 classes)
  - General procedure for displacement method.
  - Differences between the force and displacement methods.
  - Slope-deflection equations and sign conventions.
  - Analysis of simple structures with the slope-deflection equations.

There will be two midterm exams and one final exam (see details below).

COURSE PREREQUISITES

- A knowledge of engineering mathematics (e.g., calculus, linear algebra, differential equations).
- ENES220, MATH246 and permission of department.
- Restricted to students in the College of Engineering.

TIME AND LOCATION OF CLASS/OFFICE HOURS

- **Class.** M,W,F 9.00 am - 9.50 am,
  Room 2108, Chemical and Nuclear Engineering Building (i.e., Campus Building 090).
- **Office Hours.** Mark Austin. By appointment. For a quick response to your problems, send me e-mail.
- **Teaching Assistant.** Noah Blum (e-mail: blumn "at" umd.edu).

CLASS TEXT AND RESOURCES

- Hibbeler R.C., Structural Analysis, 8th Edition, Prentice-Hall, 2012.
- Lecture slides and support material will be posted on the class notes from class web page.

COURSE ASSESSMENT AND EXAM SCHEDULE

There will be two exams:

- Homework (20%): Short homeworks will be assigned approximately once every two weeks.
- Midterm 1 (20%): October XX,
  The exam will be open book and open notes.
- Midterm 2 (20%): November XX,
  The exam will be open book and open notes.
- Final (40%): December 19, 8 am - 10 am in our regular classroom.
  2 hrs long plus 5 minutes to read the paper.
  The exam will be open book and open notes. No computers.

Note.

- There will be no midterm or final make-up exams.
- Students may drop the lower midterm score if they do better in the final (i.e., the final exam can count for up to 60% of the overall grade).
- The boundary between a B grade and an A grade will be 80%.
  The boundary between D/F grades and a C grade will be 50%.
  No extra credit will be allowed.
- Accommodation for students with disabilities will be made.
- Homework must be completed on 8.5 x 11 inch engineering paper. Write on one side only.
  A 10% penalty will be applied to homework submissions that do not follow these guidelines.
- We encourage students to work together on solutions to the homework problems. However, each student must hand in their own homework and will be held accountable for understanding the concepts employed in the problem solutions.
- At the end of the semester, please participate in the evaluation of courses through CourseEvalUM. Your feedback is confidential and an important means of improving the course in future semesters.

Developed in August 2011 by Mark Austin