Structural Engineering I

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This course is directed towards juniors in Civil and Enviromental Engineering who have taken introductory classes in statics (e.g., AA 210) and mechanics of materials (e.g., CEE 220). The goals of this class are:

- To provide the opportunity for students to review and master fundamental concepts of statics and mechanics of materials, and their application to civil engineering structures.
- To understand and apply direct stiffness analysis to structures.
- To better understand the application of structural analysis to structural engineering practice (e.g., automation, modeling decisions, solution checking).
- To prepare students for Structural Engineering II, CEE 380 and Advanced Structural Analysis, CEE 457.

Course Outline — Reading (Hibbeler)

I. Introduction — Sec. 1.1-1.2

- What do structural engineers do?
- Role of analysis in structural engineering

II. 1D Spring Systems — Instructor Notes

- structural types and idealization
- statics (methods, external and internal static determinacy)
- solution strategy — Sec. 13.1
- kinematic degrees of freedom (DOF)
- spring force-deformation relationships (element stiffness matrix)
- equations of equilibrium at joints (global stiffness matrix)
- calculation of joint displacements
- calculation of spring forces
- solution checking

III. 2D Trusses

- structural types and idealization — Sec. 3.1
- statics (methods, external and internal static determinacy) — Sec. 3.2-3.6
- solution strategy — Sec. 13.1-13.6
- kinematic degrees of freedom (DOF)
- truss member force-deformation relationships (element stiffness matrix)
- equations of equilibrium at joints (global stiffness matrix)
- calculation of joint displacements
- calculation of truss member forces
- solution checking
- imposed displacements

IV. 1D Beam Structures (no axial deformation)

- structural types and idealization — Sec. 2.1-2.5
- statics (methods, static determinacy) — Sec. 4.1-4.3
- review of elastic beam theory — Sec. 8.2-8.3
- solution strategy — Sec. 14.1-14.4
- kinematic degrees of freedom (DOF)
- beam member force-deformation relationships (element stiffness matrix)
- equations of equilibrium at joints (global stiffness matrix)
- calculation of joint displacements and rotations
- calculation of beam member forces and moments
- solution checking

V. 2D Frame Structures (with axial deformation) — Ch. 15

- structural types and idealization
- statics (methods, static determinacy) — Sec. 2.5, 4.4
- solution strategy — Sec. 15.1-15.4
- kinematic degrees of freedom (DOF)
- frame member force-deformation relationships (element stiffness matrix)
- equations of equilibrium at joints (global stiffness matrix)
- calculation of joint displacements and rotations
- calculation of frame member forces and moments
- solution checking
- approximate analysis — Ch. 7

VI. Practical Implementation

- automation — Instructor Notes
- solution checking
- effects of temperature (as time permits) — Sec. 13.8
- effects of initial misfit (as time permits)

Texts

- Hibbeler, R.C., *Structural Analysis*, 5th editon, Prentice Hall, 2002.
- Sack, R., *Matrix Structural Analysis*, PWS-Kent Publishing Company, Boston, Massachusetts (optional, another perspective), 2001.

Homework and In-Class Assignments

Homework and in-class assignments are important parts of this class. You are encouraged to consult with classmates while completing homework assignments to understand concepts and procedures, and to check the accuracy of your solutions.. However, unless specifically instructed, each student must complete and submit his/her own assignments himself/herself, including spreadsheet assignments.

A deduction of 10% will be applied for each school day that a homework assignment is late. No homework will be accepted after the solutions have been distributed.

In practice, it is important to communicate your ideas and designs clearly, because mis-communication can lead to faulty construction, lawsuits and injury. To receive full credit for your homework solutions, all homework solutions must be completed as follows:

- Attach copy of the problem statement to the front of assignment (you do not need to copy the assignment by hand).
- Hand-written portions of the homework assignments should be completed on engineering paper.
- The heading on each page should include your name, the date, an identification of the homework set and of the particular problem number. Right-hand corner should include page number and total number of pages.
- Document your solutions neatly such that another engineer (such as the grader) can understand your assumptions and procedures.
- Draw a box around your answer to each problem, so that the answers can be identified easily.

Grading

Homework and in-class assignments	30%
Midterm	30%
Final Exam	40%

Important Dates

Veteran's Day	Mon. Nov. 12
Thanksgiving	Thur.-Fri., Nov. 22-23
Last Day of Instruction	Friday, Dec. 7
Final Exam	Tuesday, December 11, 2:30-4:20 AM.