Prerequisites: CE 340 (Structural Analysis)

Objectives:

1. To expand the student’s knowledge and understanding of the field of structural engineering, with particular emphasis placed upon idealizing and analyzing framed structures.
2. To present modern methods for calculating force distributions and displaced states of framed structures.
3. To develop skills in idealizing framed structures and in forming and solving equations required to complete analyses of these structures.
4. To develop skills in interpreting solutions from framed structure analyses.
5. To introduce computer-based applications for the analytical methods that have been presented.

Textbook: *Matrix Structural Analysis* by Aslam Kassimali

Instructor: Dan Linzell (dlinzell@ engr.psu.edu, 3-8609)
231L Sackett Building (Mailbox 216 Sackett)

Office Hours: T R 11:30 a.m. to 1:30 p.m. or by Appointment

Tentative Schedule:

| I. | Introduction, Definitions and Concepts | 2 Lectures |
| II. | The Flexibility Method | 1 Lecture |
| III. | Formation of the Global Analysis Equations – Plane Trusses | 5 Lectures |
| IV. | Formation of the Global Analysis Equations – Beams | 5 Lectures |
| V. | Formation of the Global Analysis Equations – Plane Frames | 4 Lectures |
| VI. | Other Topics and Structures | 9 Lectures |
| VII. | The Finite Element Method | 1 Lecture |

Grading:

| Midterm Exam (Mon. Oct. 23rd, 6:30-7:45 pm, 362 Willard) | 30 % |
| Final (Week of Dec. 18th, Date/Time TBA) | 30 % |
| Homework/Project | 40 % |
| | 100 % |
Tentative Outline:

NOTE - listed reading should be completed PRIOR to class lectures, students are encouraged to read other sections of text and references, supplemental handouts may be distributed in class.

I. Introduction, Definitions and Concepts (Ch.1, Ch. 2, Handouts)
   - History of Structural Analysis
   - Analysis Techniques
   - Types of Frames Structures
   - Structure Idealization/Model Development
   - Fundamental Analysis Relationships
   - Overview of Computer Programs
   - Review of Matrix Algebra

II. The Flexibility Method (App. B)
   - Indeterminacy
   - Method Overview

III. Formation of the Global Analysis Equations → Plane Trusses (Ch. 3)
   - Coordinate Systems
   - Degrees of Freedom
   - Member Stiffness → Local Coordinates
   - Coordinate Transformations
   - Member Stiffness → Global Coordinates
   - Assembly of Structure Stiffness → Direct Stiffness and Code Number Methods
   - Analysis Procedure

IV. Formation of the Global Analysis Equations → Beams (Ch. 5)
   - Member Stiffness → Local and Global Coordinates
   - Assembly of Structure Stiffness
   - Analysis Procedure
Tentative Outline (cont.):

V. Formation of the Global Analysis Equations → Plane Frames (Ch. 6)

- Member Stiffness → Local Coordinates
- Coordinate Transformations
- Member Stiffness → Global Coordinates
- Assembly of Structure Stiffness
- Analysis Procedure

VI. Other Topics and Structures (Ch. 7, Ch. 8, Class Notes)

- Member Releases
- "Secondary Effects" - Support Displacement, Temperature Change, Fabrication Errors
- Other Structures - Space Trusses, Grids, Space Frames
- Nonlinear Behavior and Analysis

VII. The Finite Element Method (Ch. 3, Ch. 9, Class Notes)

- Basic Concepts, Relationships
- Plane Stress Element
- Matrix Condensation
- Substructuring
- Connections and Joints
- Symmetry and Antisymmetry
Academic Integrity:
From the PSU web site (http://www.psu.edu/ufs/policies/):

49-20 Academic Integrity
Definition and expectations: Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University’s Code of Conduct states that all students should act with personal integrity, respect other students’ dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

To protect the rights and maintain the trust of honest students and support appropriate behavior, faculty and administrators should regularly communicate high standards of integrity and reinforce them by taking reasonable steps to anticipate and deter acts of dishonesty in all assignments (Senate Policy 44-40: Proctoring of Examinations). At the beginning of each course, it is the responsibility of the instructor to provide students with a statement clarifying the application of University and College academic integrity policies to that course.

Homework:
All text-based homework should be completed in a neat and orderly fashion on engineering paper and in pencil. This homework is typically assigned weekly. Homework incorporating computer analyses will be assigned intermittently throughout the semester. For these assignments, you should turn in your original input and relevant output files with your name and ID# at the top. Also submit a schematic of your model printed directly from program you used (probably STAAD/Pro), with node and element numbers, boundary conditions and applied loads clearly labeled.

Problems are to be submitted at the beginning of class typically one week after their assignment. Late homework can be submitted at the beginning of the class period immediately following the due date with a 10% penalty being assessed. Solutions to the assigned text homework problems will be available on the course ANGEL site after they are returned. Once graded homework is returned, you have 24 hrs. after receiving it to question the grades that were given. All questions and concerns must be submitted in writing.
Projects:

A project **MAY** be assigned that is to be completed by a team of two students during the semester. If a project is assigned, separate handouts will describe its specifics; however, its intent is to assist you with **developing skills** as a modeler of structural systems. You will utilize commercially available structural analysis computer programs (again, probably STAAD/Pro) to examine the response of certain types/themes of structures. You will be expected to: (1) select the structure (themes for the types of structures to be modeled will be provided on the project handouts); (2) obtain sufficient information related to its geometric and material properties; (3) develop and execute the models and interpret the results; and (4) compare the computer results to hand calculations that you developed or other publicly available data that helps verify the accuracy of your solution.

Exams:

**One mid-term and one final examination are scheduled as shown on pp. 1. **NO make-up exams will be given except as required by University policy. See me at least 24 hrs. prior to any anticipated absence. You have 24 hrs. after receiving a graded exam to question the grade that was given. All questions and concerns must be submitted in writing.

**IN ADDITION -** calculators will be **PROVIDED FOR YOU** during exams. They perform basic mathematic operations **ONLY** (addition, subtraction, multiplication, division) and operate using the standard sequence (**A+B=C, NON-HP** sequence). You will be assigned a calculator when you receive your exam and you MUST return it when you hand the exam in.