CIVE 443/898: Advanced Structural Analysis

Spring Semester 2016
University of Nebraska-Lincoln
MW 2:30 PM – 3:45 PM
Nebraska Hall W131

Prerequisites: CIVE 341 (Introduction to Structural Engineering) or similar.

Learning Targets: This course will enable students to:

1. To develop a skills to idealize, formulate, and analyze determinate and indeterminate structures (beams, trusses, and frames) using classical and matrix structural analysis methods.
2. To present modern methods to determine the force distribution and deformed shapes of structures.
3. To develop skills in interpreting and predicting solutions from structural analysis.
4. To introduce computer-based applications for the analytical methods as presented.

Student Outcomes: This course will enable students and prospective graduates to minimally achieve the following educational outcomes (defined within ABET 2014):

(a) An ability to apply knowledge of mathematics, science, and engineering.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Textbook: Kassimali, Aslam. (2012). *Matrix Structural Analysis.* 2nd Edition, Cengage Learning, Stamford, CT. 640p. ISBN-13: 978-1111426200

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Office Hours: Monday 12:30 PM – 2:00 PM (instructor, Whittier 362K)
Tuesday 1:00 PM – 2:30 PM (teaching assistant, Whittier 362S)
Friday 1:00 PM – 2:30 PM (teaching assistant, Whittier 362S)
other times are available by appointment

Email Policy: In each email, use "CIVE 443" as part of the subject line. This will ensure that your email is filtered appropriately and responded in a timely manner. Emails may be sent to either the instructor or teaching assistant.

Course Documents: Blackboard will be used to distribute course material (notes, assignments, reference documents, etc.). It is essential for students to have access to download the appropriate material and verify your e-mail address on blackboard site.

Grading:

Homework (approx. one per week, drop of the lowest assignment)	25%
Exam 1 (date TBD, announced minimally 1 week ahead of time)	20%
Exam 2 (date TBD, announced minimally 1 week ahead of time)	20%
Final Exam	30%
Attendance, Quizzes, and Participation	5%

At the conclusion of the semester, the **final grades** may be curved if the class average is less than 70% and/or the highest grade is less than 100%. Throughout the semester, the **mean and the standard deviation will be provided to estimate performance on a particular assignment**. Any student is encouraged to inquire directly with the instructor at any time if they have a question on their performance.

Notes:

1. All homework assignments are due at the **start of class** on the due date assigned, unless otherwise noted. Late work will only be accepted within two days of the due date, in the absence of **prior approval** for extraneous circumstances. Late work will be deducted 25% per calendar day.
2. As indicated on the schedule, there will be **two exams and the final exam**. The subject matter for each exam will be announced in class at least one week before.
3. If a student **misses an exam**, the instructor must be notified as soon as possible. For compelling (and documented) reasons, the instructor reserves the right to provide a make-up exam, change the weight of other exams, or assign a term project in determining the course grade.
4. Discussion regarding exam grades will be performed within **two days of returning the exams**. Any unclaimed exams will be discarded two weeks after it has been returned to the class.
5. The instructor may choose to use to **unannounced quizzes** at the start or end of class. These quizzes are implemented such that students stay current with the class material. Quizzes are typically closed book and notes.
6. Select assignments may require the use of **MATLAB**. MATLAB is provided to the UNL community free of charge for on-campus or VPN use. For details on procuring a license, visit: http://procurement.unl.edu/matlab-licenses. Assignments done in MATLAB must adhere to the same format as described below and all developed files should have appropriate comments (% syntax).
7. Select assignments will also require the use of a **structural analysis software**. A trial version limited to academic usage will be provided to the students to install on their personal computers.
8. **Active learning strategies** will be used in class that allow students to participate in class polls, quizzes, and discussions. This will be done as a

classroom experiment and will invoke the use of color coded flashcards initially. All students will be given a single flashcard, if lost it is the student's responsibility to replace it.

9. **Class evaluations** will be performed online in Lincoln and on paper in Omaha. To encourage participation of the evaluations for continuous class improvement, an extra credit score of 0.5% will be applied to the final grade for completion of the class evaluation. Details on the documentation for online submission will be provided towards the end of the semester, while attendance noted in the Omaha classroom.

Homework/Assignment Format:

Homework preparation and submission guidelines are established to create professional quality detail.

1. Each assignment is to be solved neatly on **engineering graph paper**.
2. Each problem must have a problem statement, problem sketch, diagrams, solution steps, equations used (with variables and then substituted values), and a final answer. The final answer must be **boxed** and include appropriate **units** and **sign conventions**.
3. Use of a **straight edge** is compulsory for sketches, figures, and tables.
4. **All of your work must be shown**. The solution steps are just as important as the final answer and any solution which does not contain the previous steps will receive deduction in points.
5. Multiple pages should be **stapled** or bound.

Academic Dishonesty:

You are encouraged to work together on your assignments, but copying will not be tolerated. For all computer generated work, be sure you work on separate computer terminals and do not turn identical assignments. Scores will be minimally reduced for all suspected parties. Any student who commits this or other acts of misconduct may be subject to further disciplinary action by the University. The regulations in the "Code of Conduct" concerning **academic honesty will be strictly enforced** in this class.

Tentative Schedule:

1. Introduction, Definitions and Concepts
2. Review of Classical Methods
3. Linear Algebra and MATLAB Introduction
4. The Flexibility Method
5. Formation of the Global Analysis Equations – Plane Trusses
6. Formation of the Global Analysis Equations – Beams
7. Formation of the Global Analysis Equations – Plane Frames
8. Other Topics and Structures

Tentative Course Outline:

	Topic	Reference
I.	Introduction, Definitions and Concepts a. History of Structural Analysis b. Analysis Techniques c. Types of Frames Structures d. Structure Idealization e. Fundamental Analysis Relationships f. Review of select classical methods i. Moment Area ii. Slope Deflection iii. Moment Distribution Method	Chapter 1 Handouts
II.	Linear Algebra and MATLAB Introduction a. Linear Algebra: Matrix Operations b. Overview of Computer Programs (MATLAB) *(as time permits)*	Chapter 2 Handouts
III.	The Flexibility Method a. Indeterminacy b. Formulation of the Basic Equations c. Application to Plane Trusses	Appendix B
IV.	Formation of the Global Analysis Equations for Plane Trusses a. Coordinate Systems b. Degrees of Freedom c. Member Stiffness and Local Coordinates d. Coordinate Transformations e. Member Stiffness and Global Coordinates f. Assembly of Structure Stiffness → Direct Stiffness and Code Number Methods g. Analysis Procedure h. Application within Computer Programs	Chapter 3 Chapter 4
V.	Formation of the Global Analysis Equations for Beams a. Member Stiffness: Local and Global Coordinates b. Assembly of Structure Stiffness c. Analysis Procedure	Chapter 5
VI.	Formation of the Global Analysis Equations for Plane Frames a. Member Stiffness: Local Coordinates b. Coordinate Transformations c. Member Stiffness: Global Coordinates d. Assembly of Structure Stiffness e. Analysis Procedure	Chapter 6

VII.	Other Topics and Structures *(as time permits)* a. Member Releases b. "Secondary Effects" – Support Displacement, Temperature Change, Member Misfit c. Nonlinear Behavior and Analysis d. Shear effects (Timoshenko Beam Theory)	Chapter 7 Chapter 8 Handouts
VIII.	The Finite Element Method *(as time permits)* a. Basic Concepts, Relationships b. Plane Stress Element c. Matrix Condensation d. Connections and Joints e. Symmetry and Antisymmetry	Chapter 3 Chapter 9 Handouts