CIVE 443/898: Advanced Structural Analysis

Spring Semester 2017
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:

1. To develop 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.

Recommended Textbook: Kassimali, Aslam. (2012). *Matrix Structural Analysis.* 2nd Edition, Cengage Learning, Stamford, CT. 640p. ISBN-13: 978-1111426200. (**Not required**)

Instructor: Richard L. Wood (rwood@unl.edu)
362K Whittier Research Facility, office: (402) 472-1916

Teaching Assistant: Yijun Liao (yijun.liao419@huskers.unl.edu)
362C Whittier Research Facility

Office Hours: Monday 12:30 PM – 2:00 PM (instructor, Whittier 362K)
Tuesday 1:00 PM – 2:30 PM (teaching assistant, Whittier 362S)
Thursday 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: Canvas 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 the site.

Grading:

Homework (approx. one per week, drop of the lowest assignment)	25%
Two Midterm Exams (TBD, announced minimally 1 week ahead)	40%
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 each assignment**. Any student is encouraged to inquire directly with the instructor at any time if they have a question on their performance.

Grading Scale: In this course, the following grade scale will be adopted.

Upper Bound (%)	Lower Bound (%)	Letter Grade Conversion
100.00	98.50	A+
98.49	93.00	A
92.99	90.00	A-
89.99	87.00	B+
86.99	83.00	B
82.99	80.00	B-
79.99	77.00	C+
76.99	73.00	C
72.99	70.00	C-
69.99	67.00	D+
66.99	63.00	D
62.99	60.00	D-
59.99	*below*	F

For pass/no pass enrollments, “pass” is defined as a grade equal to or greater than a C. A score of C- or lower equates to a “no pass.”

For audit enrollments, students with excessive absences will not be credited an “audit” grade on their transcripts.

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. Note homework not turned at the start of class or at the announced submission time will be indicated as late and will be deducted 25%.
2. As indicated on the schedule, there will be **two midterm exams and one 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 **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. Attendance, participation, and quizzes will be taken throughout the duration of the course. **Unexcused absences** and late arrivals will result in reduced scores.
7. 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).
8. 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.
9. **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.
10. **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. Points will be deducted if the format is not followed.

1. Each assignment is to be solved neatly on **engineering graph paper or plain white computer paper**. (Note legal pad or other lined paper is not accepted).
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 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.
6. Electronic homework submission guidelines are listed below. Note no paper copies will be accepted, unless otherwise explicitly stated.

Electronic Homework Submission:

All homework assignments will be **submitted electronically via email**. Electronic submission of the assignments must be submitted to the teaching assistant (yijun.liao419@huskers.unl.edu) and carbon-copied (cc'ed) to the instructor (rwood@unl.edu) by the due date and time. The email must have the subject line of

"**CIVE 443 – Homework *i* Electronic Submission**" – where *i* is replaced by the assignment number. For the first homework, this would be "CIVE 443 – Homework 1 Electronic Submission".

Inside the email, the homework will be attached as a **single collated pdf** of your last name (for example "Wood.pdf"). Note your scan should be professionally presentable, in color, and all your work must be shown as outlined. Verify and double check your pdf file before submission. Note no paper copies will be collected nor accepted.

Points will be deducted if your homework does not follow this criteria in format and submission, since additional delays are created in locating your email as well as renaming the files. PDF scanners are available in the library and/or the main civil office. If you have questions, please do not hesitate to contact the instructor.

Paperless Class Format:

No handouts other than any documents handed out on the first day will be provided to the students. This includes lecture notes, examples, and homework problem statements. Students are permitted to use digital devices for notetaking (i.e. tablets), but this is not required. It is the students' responsibility to ensure adequate material is available for lecture time.

Exceptions to this policy is exams and quizzes. These will be conducted in a

traditional paper format.

Class Announcements: Daily class announcements will be projected at the start of the course. This is to update students on the class time schedule, provide reminders for assessments, and clarifications. Daily announcements, as shown at the start of class, will not be routinely posted to the Canvas site.

For short notice announcements, emails will be sent to the students through the digital platform. It is the students' responsibility to ensure that their email address is valid and checked in a timely manner.

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
4. Flexibility Method *(as time permits)*
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 (subject to change):

Topic		Recommended References
I.	Introduction, Definitions and Concepts a. History of Structural Analysis b. Analysis Techniques and Structural Classifications c. Structure Idealization d. Fundamental Analysis Relationships e. 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	Chapter 2 Handouts
III.	Flexibility Method *(as time permits)* a. Indeterminacy b. Formulation of the Basic Equations c. Application to Plane Trusses	Appendix B
IV.	Analysis of Plane Truss Structures a. Coordinate Systems and Degrees of Freedom b. Member Stiffness and Local Coordinates c. Coordinate Transformations d. Member Stiffness and Global Coordinates e. Assembly of Structure Stiffness → Direct Stiffness and Code Number Methods f. Analysis Procedure	Chapter 3 Chapter 4
V.	Analysis of Beam Structures a. Member Stiffness: Local and Global Coordinates b. Assembly of Structure Stiffness c. Analysis Procedure	Chapter 5
VI.	Analysis of Plane Frame Structures 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 a. Member Releases - Hinges b. "Secondary Effects" – Support Displacement, Temperature Change, Member Misfit c. Shear effects (Timoshenko Beam Theory) d. Matrix Condensation e. Nonlinear Behavior and Analysis *(as time permits)* f. Connections and Joints *(as time permits)*	Chapter 7 Chapter 8 Chapter 9 Handouts