

CIVE 443/843: Advanced Structural Analysis

Fall Semester 2018

University of Nebraska-Lincoln

MW 1:30 PM – 2:45 PM

Scott Engineering Center (SEC) N101

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 2017):

- (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. **Note the textbook is NOT required.**

Alternative Textbook Access:

The materials required for this course are included in a Cengage Unlimited subscription, which can also be used across all courses where Cengage products are assigned at no additional cost. Students can subscribe to Cengage Unlimited at the bookstore, or online at Cengage Unlimited. For details, please access: <https://www.cengage.com/unlimited>

Instructor:

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

Teaching Assistant:

Daniel P. Watson (daniel.watson@huskers.unl.edu); 362C Whittier

Office Hours:

Tuesday 12:30 PM – 2:00 PM (teaching assistant, Whittier 362S)

Wednesday 11:30 AM – 1:00 PM (instructor, Whittier 362K)

Thursday 2:30 PM – 4:00 PM (teaching assistant, SEC N104)

other times are available by appointment

Email Policy: In each email, use “**CIVE 443/843**” 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 at UNL (<http://canvas.unl.edu>) 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 Breakdown:

| | |
|---|-----|
| 1. Homework (approx. one per week, drop of lowest assignment) | 25% |
| 2. Midterm #1 (announced minimally 1 week ahead) | 20% |
| 3. Midterm #2 (announced minimally 1 week ahead) | 20% |
| 4. Final Exam | 30% |
| 5. Attendance, Conduct, Participation, and Quizzes | 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.

Alternative Grading Scheme: To account for improved performance throughout the duration of the course, final grades will be weighted alternatively for the benefit of the student. Note this grading scheme is not displayed in the Canvas gradebook. Note the maximum of all grading schemes will be taken for the benefit of the student for the final grade.

Option 1: (reduced midterm #1)

| | |
|---|------------|
| 1. Homework (approx. one per week, drop of lowest assignment) | 25% |
| 2. Midterm #1 (announced minimally 1 week ahead) | 10% |
| 3. Midterm #2 (announced minimally 1 week ahead) | 30% |
| 4. Final Exam | 30% |
| 5. Attendance, Conduct, Participation, and Quizzes | 5% |

Option 2: (increased weight on final exam)

| | |
|---|------------|
| 1. Homework (approx. one per week, drop of lowest assignment) | 25% |
| 2. Midterm #1 (announced minimally 1 week ahead) | 10% |
| 3. Midterm #2 (announced minimally 1 week ahead) | 10% |
| 4. Final Exam | 50% |
| 5. Attendance, Conduct, Participation, and Quizzes | 5% |

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 | <i>below</i> | F |

**Non-Letter
Grade Policies:**

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.” Additionally for pass/no pass enrollments, homework submissions are encouraged, but not explicitly required.

For audit enrollments, students with excessive absences will not be credited an “audit” grade on their transcripts. Excessive unexcused absence count is defined as greater than five classes.

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. Turnitin will be the **anti-plagiarism software** used within the Canvas platform. Submitting a Turnitin-enabled assignment is almost identical to submitting a regular Canvas assignment. When a paper is submitted through Turnitin, it is compared against three vast databases. An "Originality Report" is generated which will show which elements of a student's paper matches content from Turnitin's databases. The three primary sources are 1) current and archived web, 2) student papers, and 3) content partnerships.
3. 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.
4. 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.
5. **All exams will be closed-book and closed-notes**. One single-sided 8.5 x 11 inches sheet of notes or an “equation sheet” are permitted for each exam. Equation sheets from previous exams (unedited) will be permitted in subsequent exams. No examples or complete sentences are permitted. If you

are typing your equation sheet, be mindful of the variables, subscripts, etc. The equation sheet must be of your own effort (no sharing). No electronic devices of any kind, other than a calculator, will be permitted for an exam or quiz. Bags must be placed on the floor adjacent to your chair and not on the table.

6. Disputes regarding grades must be performed within **two days of returning the exams**. For exam or grades disputes, a **written document** must be turned into the instructor by the deadline.
7. Any **unclaimed exams** will be discarded two weeks after they have been returned to the class.
8. 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.
9. Attendance, participation, class attention, and quizzes will be assessed/taken throughout the duration of the course. **Unexcused absences** and late arrivals will result in reduced points allocated for “*Attendance, Conduct, Participation, Quizzes*”.
10. 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).
11. 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.
12. **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.
13. **Class evaluations** will be performed online at both Lincoln and Omaha campuses. 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.

**Peer
Instruction:**

This course will utilize peer instruction to create an active learning classroom environment. Specific to this year, the effectiveness of peer instruction in civil engineering courses will be formally assessed. This includes both videotaping of several lessons and an end-of-the semester assessment to evaluate your opinions of the value of peer instruction. There is no risk to you in either of these activities, but your participation is voluntary. Additional details are provided in a separate handout and you are encouraged to directly contact the instructor if you have any concerns.

**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. Start each problem on a **new blank page**.
4. Use of a **straight edge** is compulsory for sketches, figures, and tables.
5. **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.
6. If a paper submission is required, multiple pages should be **stapled** or bound.
7. 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 through the Canvas platform**. Only electronic submission of the assignments will be accepted, unless otherwise disclosed on the assignment. Your file upload must be a single or collated pdf file. Note multiple files will not be considered for credit.

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**. It is your responsibility to guarantee the quality and contents of the pdf. Note no paper copies will be collected nor accepted.

Points will be deducted if your homework does not follow this criterion in format and submission. Scanners are free for students to use at the university library system as well as at any PrintIT (Wepa) Kiosk (for more information on these services, please refer to: <http://libraries.unl.edu/photocopy> and <https://its.unl.edu/services/wepa>). 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 class 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 submit 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. This is in alignment with the Academic Honesty Policy (see Student Code of Conduct, Section B. Conduct – Rules and Regulations, 1. Acts of Academic Dishonesty). The regulations in the "Code of Conduct" concerning **academic honesty will be strictly enforced** in this class.

Student Code of Conduct:

Students are expected to be familiar with the Student Code of Conduct. A link is available here: <https://studentconduct.unl.edu/student-code-conduct>. If you have any questions or concerns – inquire with the instructor before submission.

Acts of Academic Dishonesty:

Students violating the Code of Conduct will be imposed a sanction, depending on the severity of the offense. Example sanctions may include:

- 1) Reduced grade on assignment, paper, quiz, or exam
- 2) Zero on assignment, paper, quiz, or exam
- 3) Grade of F on transcript for the course
- 4) Other

If a sanction is imposed, an electronic “Academic Integrity Report Form” must be submitted to the Office of Student Conduct and Community Standards and the Department Chair(s). Note this required by the UNL Office of the Executive Vice Chancellor. A link to this form is available here:

https://studentconduct.unl.edu/forms/Academic%20Integrity%20Report%20Form_Fillable.pdf

Accommodations for Students with Disabilities Policy:

Students with disabilities are encouraged to contact me (the instructor or teaching assistant) for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide individualized accommodations to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 232 Canfield Administration, (402) 472-3787 voice or TTY.

Tentative Schedule:

1. Introduction, Definitions and Concepts
2. Review of Classical Methods
3. Linear Algebra

4. Formation of the Global Analysis Equations – Plane Trusses
5. Formation of the Global Analysis Equations – Beams
6. Formation of the Global Analysis Equations – Plane Frames
7. Advanced Topics and Structures

Tentative Course Outline (subject to change):

| Topic | | Recommended References |
|--------------|---|---|
| I. | Introduction, Definitions and Concepts <ol style="list-style-type: none"> a. History of Structural Analysis b. Analysis Techniques and Structural Classifications c. Structure Idealization d. Fundamental Analysis Relationships e. Review of select classical methods <ol style="list-style-type: none"> i. Moment Area ii. Slope Deflection iii. Moment Distribution Method | Chapter 1 Handouts |
| II. | Linear Algebra <ol style="list-style-type: none"> a. Linear Algebra: Matrix Operations | Chapter 2 Handouts |
| III. | Analysis of Plane Truss Structures <ol style="list-style-type: none"> 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 |
| IV. | Analysis of Beam Structures <ol style="list-style-type: none"> a. Member Stiffness: Local and Global Coordinates b. Assembly of Structure Stiffness c. Analysis Procedure | Chapter 5 |
| V. | Analysis of Plane Frame Structures <ol style="list-style-type: none"> a. Member Stiffness: Local Coordinates b. Coordinate Transformations c. Member Stiffness: Global Coordinates d. Assembly of Structure Stiffness e. Analysis Procedure | Chapter 6 |
| VI. | Advanced Topics and Structures <ol style="list-style-type: none"> a. Member Releases - Hinges b. “Secondary Effects” – Support Displacement, Temperature Change, Member Misfit c. Shear effects (Timoshenko Beam Theory) d. Matrix Condensation | Chapter 7 Chapter 8 Chapter 9 Handouts |