University of Nebraska-Lincoln
CIVE 842: Structural Dynamics
Fall Semester 2020

Course Syllabus

<u>**Basic Course Information**</u>

Instructor: Christine E. Wittich, Ph.D.
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University of Nebraska-Lincoln
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Office Hours: Office hours will be available in-person and via Zoom. When both in-person and Zoom options are offered simultaneously, students will be assisted in the order in which they arrive regardless of whether they join via Zoom or in person.

Monday	3:00 – 4:15 PM	PKI 250 and Zoom
Thursday	3:45 – 5:15 PM	NH W347 and Zoom

Recommendations for Zoom Office Hours: Students are strongly recommended to utilize Zoom office hours. To fully engage in office hours, it is recommended to utilize a webcam and microphone. Should a student not have access to a computer with built-in webcam and/or microphone, smartphone apps are available that enable a smartphone to act as a webcam and/or microphone for a computer (via wifi or usb). Based on the instructor's experience, DroidCam or similar apps would suffice. DroidCam is available for both Apple and Android. Zoom office hours will have a waiting room enabled to allow each student a private space. Students will be permitted to enter in the order in which they arrive. The Zoom Meeting ID and link are as follow: ID (941 0443 7906) or click https://unl.zoom.us/j/94104437906

IMPORTANT - Requirements for In-Person Office Hours: Social distancing must be maintained. Therefore, students must sign up for in-person office hours prior to attending. Students may sign up for a 15-minute appointment using Canvas Calendar. If a time slot is unavailable, it indicates that the room is at capacity and no additional students are permitted to enter. If more than 15 minutes is required, students may sign-up for additional time slots; however, students should not request multiple consecutive time slots until they are in the room and can verify that they need more time. In addition, students should not sign-up for in-person office hours more than 24 hours in advance. The intention is to offer equal office hour opportunities to all students. White boards and document cameras are available during in-person office hours for real-time collaboration while maintaining social distancing.

*Peter Kiewit Institute (PKI) is located on Scott Campus in Omaha, NE.

Other times available by appointment

Course Description: Concepts of Newtonian and Lagrangian mechanics for dynamical systems. Free and forced vibration of linear single-degree-of-freedom systems and multiple degree-of-freedom systems. Harmonic, periodic, pulse, arbitrary, and earthquake response. Numerical evaluation of dynamic response and linear response spectrum concepts. Introduction to non-linear system response. Dynamic response of continuous beams.

Prerequisites: Official: CIVE 341: Introduction to Structural Engineering (or graduate standing)

Recommended Exposure: Rigid Body Dynamics (Undergraduate)
Differential Equations
Linear Algebra or Matrix Structural Analysis
Computer Programming (MATLAB)

Class Meetings: M/W   4:30 PM – 5:45 PM   City Campus: SEC 111
Scott Campus: PKI 160

Students are permitted to join via Zoom. Please inform the instructor.
Meeting ID: 981 4367 4196, Passcode: 842

Textbook (Required): Chopra, Anil K. (2017). Dynamics of Structures, 5th Edition, Pearson, Stamford, CT. ISBN-13: 9780134555140. *Hard copy not needed.

Additional references will be provided as needed throughout the semester. These references will be posted to the course Canvas site.

Course Objectives

Learning Objectives:

1. **Derive** the equation(s) of motion and **explain** the relevant variables that govern the response of single and multiple degree-of-freedom systems.

2. **Identify** and **describe** the fundamental dynamic parameters of a system and their influence on the dynamic response.

3. **Select** the most appropriate method and **solve** equation(s) of motion for a single or multiple degree-of-freedom system subject to free, harmonic, periodic, or random (earthquake) vibrations.

4. **Identify** and qualitatively **describe** the impact of assumptions and limitations of various solution methods for the dynamic response of structures.

5. **Describe** the construction of response and design spectra for earthquakes; and, qualitatively **describe** the impact of relevant parameters on their shapes.

Fit Within CIVE Graduate Program:

- Although not required, this course is one of the basic core computational/analysis courses for graduate students within the Structural Engineering track.

- This course is listed as a relevant elective for graduate students in the Geotechnical and Materials Engineering track.
- This course is a prerequisite for (with tentative offerings):
    - CIVE 945: Structural Analysis and Design for Dynamic Loads
    - CIVE 948: Blast-Resistant Structural Design

Course Policies

Email Policy: [CIVE 842] should be placed at the beginning of all email subjects for communication regarding this course. This will ensure proper filtering and a timely response.

Please use your UNL email addresses or Canvas accounts for communication regarding this course. This is to ensure that it is not caught in a spam filter (this often occurs with students using Yahoo email from a cell phone).

Grading Policy:

Quizzes (4 in total, non-cumulative*)	60%
Weekly Homework Assignments (approx. 10, lowest dropped)	30%
Participation and Engagement	10%

*While the quizzes will not be cumulative, the material naturally builds upon itself and students are encouraged to ensure mastery of preliminary topics.

The **minimum** percentage required for the final letter grade will be:

$100\% > \textbf{A+} \geq 96.7\%$ $96.7\% > \textbf{A} \geq 93.3\%$ $93.3\% > \textbf{A-} \geq 90\%$
$90\% > \textbf{B+} \geq 86.7\%$ $86.7\% > \textbf{B} \geq 83.3\%$ $83.3\% > \textbf{B-} \geq 80\%$
$80\% > \textbf{C+} \geq 76.7\%$ $76.7\% > \textbf{C} \geq 73.3\%$ $73.3\% > \textbf{C-} \geq 70\%$
$70\% > \textbf{D+} \geq 66.7\%$ $66.7\% > \textbf{D} \geq 63.3\%$ $63.3\% > \textbf{D-} \geq 60\%$
$60\% > \textbf{F}$

At the conclusion of the semester, the final grades **may** be curved at the discretion of the instructor. Any student is encouraged to inquire directly with the instructor at any time if they have a question on their performance.

Pass/No-Pass Policy: 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." Note that all engineering classes at UNL will follow the UNL registrar and college guidelines concerning pass/no pass policies, which may also be called credit/no credit policies.

For more detail on Pass/No Pass policies, please visit the office of the registrar webpage at https://registrar.unl.edu/academic-standards/grade-information/

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

Grading Inquiries: Discussion and questions regarding grades of any quiz or assignment must be submitted in writing **to the instructor** within 2 days (48 hours) of the grade posting to the Canvas site (email submission is sufficient). This is done to ensure fair and consistent grading for all students.

Course Website: This course will utilize **UNL Canvas** (http://canvas.unl.edu) to distribute and submit course materials including note packets for lectures, homework assignments, and course announcements. All enrolled students are automatically added to this course's Canvas site. It is the student's responsibility to verify that they have access to this site and to immediately notify the instructor otherwise. The instructor will send a notification when new material has been posted to this site; however, it is the student's responsibility to ensure Canvas notifications are received (e.g. via email) or checked regularly.

Students are highly recommended to download the Canvas Student app on their smartphones to receive notifications, as well.

Homework:

1. Each homework submission must be of **professional quality**. If a homework is solved by hand, engineering paper must be used and a straight edge must be used for sketches, figures/tables, and boxing answers. If a homework is solved digitally (via Microsoft Excel, Mathcad, or by hand on a tablet), standard white letter size paper may be used in place of engineering paper.

2. Each problem must begin on a new blank page. Problems are differentiated by number.

3. All handwritten work must be neat and legible. It is the student's responsibility to ensure this. If the work is illegible, the applicable portion(s) of a problem will not receive credit.

4. All homework submissions must be presented in a **clear and logical fashion** including a problem statement, labeled sketch/diagram (if applicable), annotated solution steps (including a brief text statement describing the step and any referenced equations in variable form followed by substitutions), and a boxed final answer indicating units and sign conventions, if necessary. **All work must be shown, and all steps must be explained in words** in order to receive credit.

5. All homework assignments are to be **submitted online** via the Canvas site. No paper submissions will be accepted. For assignments completed by hand, scanned copies are to be uploaded. Scanners are free for students to use on either UNL's or UNO's campus. However, a student may use a smart-phone app for convenient pdf scanning (e.g. CamScanner, Google Drive Scan, etc.). Regardless of the scanning platform, the student must ensure that the final pdf scan is letter-size (not cropped to the written area), legible (not missing lightly-written words), and a single multi-page pdf (not multiple individual pages).

6. **Late Submissions**: Late work will be reduced by 25% of the total available points, with the percentage increasing by another 25% for each additional 24 hours past due. This includes weekends and holidays. This is done because student submissions will be graded as quickly as possible so that students can receive feedback.

Software: Select homework assignments will require the use of MATLAB. MATLAB is freely available to all UNL students on campus computers as well as on personal computers through VPN (virtual private networks). For installation instructions, please visit http://itprocurement.unl.edu/matlab.

Quizzes:

1. Four quizzes will be given via Canvas throughout the semester. These quizzes will be non-cumulative, however the material naturally builds upon itself.

2. Quizzes are tentatively scheduled for Fridays (refer to tentative course outline in this document). Quizzes will be available on Canvas for 24 hours to accommodate student schedules. The instructor will be available on Zoom for questions at times to be announced.

3. Quizzes will be open-book and open-notes. However, students may NOT use online forums or discuss the quiz with anyone except the instructor and teaching assistants.

4. If a student intends to miss a quiz, it is the student's responsibility to inform the instructor as soon as possible. Make-up quizzes will only be accommodated for extenuating circumstances.

Digital Notetaking: Printed copies of note packets will NOT be distributed to students. It is the student's responsibility to print notes ahead of each lecture and laboratory, if desired. Digital notetaking is permitted (e.g. via tablet or laptop); however, students should be advised that notes in this course may involve mathematical or Greek characters, which makes notetaking on standard keyboards difficult without stylus support. Digital notetaking by any student shall not interfere with the ability of any other student to participate in class (e.g. loud typing).

Course Evaluations: Course evaluations are a critical component for the continuous improvement of course material, instructor development, and teaching methods. Throughout the semester, **anonymous surveys will be requested via Canvas,** which are intended to gather student feedback on material, assignments, and teaching methods. Information gathered from these surveys will be used to engage student learning as well as modify the course as the semester progresses and for future iterations of this course. To encourage participation, **Canvas will automatically give full credit** upon completion of each survey to the Attendance, Participation, and Quizzes portion of the final grade.

Final, official course evaluations will be distributed digitally by the university in December**. It is essential that all students complete this evaluation fully and honestly.**

Attendance: Attendance will not be taken in this class, nor will it be formally assessed. However, participation and engagement with course materials is required. Participation and engagement will be assessed through in-class assignments, peer instruction, and small group discussions during lectures.

Class Recording: The instructors invite all of the students to actively creating and contributing to a positive, productive, and respectful classroom culture. Each student contributes to an environment that shapes the learning process. Any work and/or communication that each student is privy to as a member of this course should be treated as the intellectual property of the speaker/creator and is not to be shared outside the context of this course.

Students may not make or distribute screen captures, audio/video recordings of, or live stream, any class-related activity, including lectures and presentations, without express prior written consent from the instructors or an approved accommodation from Services for Students with Disabilities. If a student has a disability such that you need to record or tape class-related activities, you should contact Services for Students with Disabilities. If a student has an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform. Failure to follow this policy on recording or distributing class-related activities may subject you to discipline under the Student Code of Conduct.

Academic Integrity: Academic integrity is of the utmost importance at Nebraska. Be sure you understand the expectations of you and your academic work. View the complete list of academic dishonesty violations in the Student Code of Conduct, specifically Article III: Proscribed Conduct, Section B "Conduct – Rules and Regulations, 1. Acts of Academic Dishonesty." For more information, please visit https://studentconduct.unl.edu.

Students in this course are encouraged to work together on in-class and homework assignments, but identical assignments will not be accepted. All explanations must be written in each student's own words. For all computer-generated work (e.g. MATLAB codes), be sure that your assignment is uniquely generated. Shared computer codes are easily identifiable and will not be accepted.

Student Disabilities: This class should be an accessible and welcoming experience for all students. Reasonable accommodations are provided for students who are registered with the Office of Services for Students with Disabilities (SSD) on City Campus or the Accessibility Services Center on Scott Campus and who make their request sufficiently in advance (a minimum of 1 week notice is required for any accommodation, though further notice is preferred).

Mental Health: UNL and UNO offer a variety of options to students to aid them in dealing with stress and adversity. CAPS is a multidisciplinary team of psychologists and counselors that works collaboratively with Nebraska students to help them explore their feelings and thoughts and learn helpful ways to improve their mental, psychological and emotional well-being when issues arise. For more information, contact UNL CAPS https://caps.unl.edu/. 402-472-7450 or UNO CAMPS at 402-554-2409.

At UNL, Big Red Resilience & Well-Being (BRRWB) provides one-on-one well-being coaching to any student who wants to enhance their well-being. Trained well-being coaches help students create and be grateful for positive experiences, practice resilience and self-compassion, and find support as they need it. BRRWB can be reached by calling 402-472-8770. At UNO, the Wellness Center provides a variety of wellness resources. The UNO Wellness Center can be reached by calling 402-554-2539.

Face Coverings: As of July 17, 2020 and until further notice, all University of Nebraska–Lincoln (UNL) faculty, staff, students, and visitors (including contractors, service providers, and others) are required to use a facial covering at all times when indoors except under specific conditions outlined in https://covid19.unl.edu/face-covering-policy. This statement is meant to clarify classroom policies for face coverings:

To protect the health and well-being of the University and wider community, UNL has implemented a policy requiring all people, including students, faculty, and staff, to wear a face covering that covers the mouth and nose while on campus. The classroom is a community, and as a community, we seek to maintain the health and safety of all members by wearing face coverings when in the classroom. Failure to comply with this policy is interpreted as a disruption of the classroom and may be a violation of UNL's Student Code of Conduct (https://studentconduct.unl.edu/student-code-conduct).

Individuals who have health or medical reasons for not wearing face coverings should work with the Office of Services for Students with Disabilities (for students) or the Office of Faculty/Staff Disability Services (for faculty and staff) to establish accommodations to address the health concern. Students who prefer not to wear a face covering should work with their advisor to arrange a fully online course schedule that does not require their presence on campus.

Students in the classroom:

1. If a student is not properly wearing a face covering, the instructor will remind the student of the policy and ask them to comply with it.

2. If the student will not comply with the face covering policy, the instructor will ask the student to leave the classroom, and the student may only return when they are properly wearing a face covering.
3. If the student refuses to properly wear a face covering or leave the classroom, the instructor will dismiss the class and will report the student to Student Conduct & Community StandardsLinks to an external site. for misconduct, where the student will be subject to disciplinary action.

Instructors in the classroom:

1. If an instructor is not properly wearing a face covering, students will remind the instructor of the policy and ask them to comply with it.
2. If an instructor will not properly wear a face covering, students may leave the classroom and should report the misconduct to the department chair or via the TIPS system for disciplinary action through faculty governance processes.

Tentative Course Outline**

Week	Dates	Topic	Quizzes
1	Aug 17 – Aug 21	Equations of Motion	
2	Aug 24 – Aug 28	Free Vibration: Undamped SDOF	
3	Aug 31 – Sep 4	Free Vibration: Damped SDOF	
4	Sep 7 – Sep 11	Harmonic Excitation: Undamped SDOF	Quiz #1, Friday 9/11 (covering weeks 1 – 3)
5	Sep 14 – Sep 18	Harmonic Excitation: Damped SDOF	
6	Sep 21 – Sep 25	Periodic and Impulsive Loads for SDOFs	
7	Sep 28 – Oct 2	Arbitrary Loads and Base Excitations of SDOFs	Quiz #2, Friday 10/2 (covering weeks 4 – 6)
8	Oct 5 – Oct 9	Numerical Methods: Procedure	
9	Oct 12 – Oct 16	Numerical Methods: Stability and Error	
10	Oct 19 – Oct 23	Seismic Excitation of SDOFs	
11	Oct 26 – Oct 30	Overview of MDOFs	Quiz #3, Friday 10/30 (covering weeks 7 – 10)
12	Nov 2 – Nov 6	Free Vibration: Undamped/Damped MDOFs	
13	Nov 9 – Nov 13	Dynamic Excitation of MDOFs	
14	Nov 16 – Nov 20	Generalized SDOF Systems	
15	Nov 24	Finals Week	Quiz #4, Tuesday 11/24 (covering weeks)

** Note: This is a preliminary schedule and is subject to change.