University of Nebraska-Lincoln
CIVE 842: Structural Dynamics
Fall Semester 2019

Course Syllabus

Basic Course Information

Instructor:

Christine E. Wittich
Assistant Professor of Civil Engineering
University of Nebraska-Lincoln
362L Whittier Research Center
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Office Hours:

Monday	3:15 PM – 4:15 PM	362L WHIT (w/ digital connection)
Wednesday	3:15 PM – 4:15 PM	206F PKI (w/ digital connection)

Other times available by appointment

Office hours will be held once per week on both City and Scott Campuses. Typical locations are specified above; however, these may change by the week. All office hours will be concurrently held digitally via an online zoom meeting. Students can join digitally at any time during office hours, though assistance is first-come first-served. The online zoom meeting supports video, audio, screen sharing, and remote screen annotation. To join, please follow the zoom link: https://unl.zoom.us/j/403660216

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

Optional laboratory exercises utilizing a small-scale shake table will be held in Whittier Research Center at mutually agreed upon times throughout the semester (potentially outside of normal lecture time). These laboratory exercises are intended to complement theoretical lectures with visual demonstrations. Video link is possible; however, video latency will reduce its effectiveness.

Textbook:

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 (Sp. 20)
  - CIVE 948: Blast-Resistant Structural Design (Fa. 19; Fa. 20)

Course Policies

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

Grading Policy:

Homework Assignments (approx. 12 in total)	20%
Midterm Exams (2 in total; tentatively: October 7 and November 20)	40%
Final (Cumulative) Examination (December 16)	30%
Attendance	5%
Participation and Quizzes (including evaluations/surveys)	5%

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

100% > **A+** ≥ 96.7%	96.7% > **A** ≥ 93.3%	93.3% > **A-** ≥ 90%
90% > **B+** ≥ 86.7%	86.7% > **B** ≥ 83.3%	83.3% > **B-** ≥ 80%
80% > **C+** ≥ 76.7%	76.7% > **C** ≥ 73.3%	73.3% > **C-** ≥ 70%
70% > **D+** ≥ 66.7%	66.7% > **D** ≥ 63.3%	63.3% > **D-** ≥ 60%
60% > **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.

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

Course Website: This course will utilize **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 timely 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 at the university libraries as well as at any WEPA kiosk (for more information on these services, please refer to: https://its.unl.edu/services/wepa/ and https://www.unomaha.edu/information-technology-services/labs-and-classrooms/wepa-locations.php. It is the student's responsibility to ensure that scanned documents are legible and accurately reflect your work. Acceptable file types and due dates will be specific to each homework assignment and stated clearly on the Canvas site.

   *A student may use a smart-phone app for pdf scanning (e.g. CamScanner, Google Drive Scan, etc.). However, 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 docked 20% of the total available points, with the percentage increasing by another 20% for each additional 24 hours past due.

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.

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, if desired. Digital notetaking is permitted (e.g. via tablet or laptop); however, students should be advised that notes in this course will involve significant mathematical derivations, which makes notetaking on standard keyboards difficult without stylus support. Should any software demonstrations or in-class assignments involve the use of MATLAB, students will be provided advanced warning to bring a suitable laptop.

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** (approximately 10-15 in total), 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 and Participation portion of the final grade.

Final, official course evaluations will be distributed by the university separately on the Omaha and Lincoln campuses at the end of the semester**. It is essential that all students complete this evaluation fully and honestly.**

Attendance: Students are expected to **attend class regularly and on-time**, and to inform the instructor in advance of any absence. Students intending to audit the class are held to the same attendance requirements as all other students in the course. Attendance will be taken daily in the Canvas app and is worth 5% of the total grade, where all classes are weighted equally.

Examinations: Two midterm and one final examination will be given in this class. Specific dates are to be finalized during the first week of classes, with tentative dates noted in this syllabus. Dates for each examination and the range of material to be covered will be provided to students no less than 1 week in advance. Exams will be closed-book and closed-notes; however, one single-sided letter-sized page of equations will be permitted. Exams will include qualitative and quantitative problems.

Missed Exams: If a student misses an exam or intends to miss an examination, it is the student's responsibility to inform the instructor as soon as possible. Make-up examinations will only be accommodated for extenuating circumstances.

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).

Tentative Course Outline

Week**	**Topic**	**Lab**
Week 1: 26-28 Aug	Course Introduction & Equations of Motion	
Week 2: 4 Sept **(No Class Mon.)**	Equations of Motion; HW #1 due	
Week 3: 9-11 Sept	Equations of Motion; Single Degree of Freedom Systems (SDOFs); HW #2 due	
Week 4: 16-18 Sept	SDOF: Undamped and Damped, Free Vibration of SDOFs; HW #3 due	
Week 5: 23-25 Sept	Dynamic Behavior of SDOFs; Introduction to Harmonic Vibration of SDOFs; HW #4 due	
Week 6: 30-2 Sept/Oct	SDOF: Damped and Undamped Harmonic Excitation	Lab #1: SDOF Natural Frequencies
Week 7: 7-9 Oct	Midterm Exam #1; SDOF: Periodic Loads; HW #5 due	
Week 8: 14-16 Oct	SDOF: Base Excitation and Impulsive Loads; HW #6 due	
Week 9: 23 Oct **(No Class Mon.)**	SDOF: Arbitrary Loads; HW #7 due	
Week 10: 28-30 Oct	Introduction to Numerical Methods; Time-Stepping Methods; HW #8 due	
Week 11: 4-6 Nov	Time-Stepping Methods; Stability and Error; HW #9 due	
Week 12: 11-13 Nov	SDOF: Seismic Excitation; Response and Design Spectra; HW #10 due	Lab #2: SDOF Earthquake Response
Week 13: 18-20 Nov	MDOF: Natural Frequencies and Modes; Midterm Exam #2	
Week 14: 25 Nov **(No Class Wed.)**	MDOF: Free Vibration Response	
Week 15: 2-4 Dec	MDOF: Dynamic Analysis and Response; HW #11 due	
Week 16: 9-11 Dec	Generalized SDOF Systems; HW #12 due	Lab #3: MDOF Natural Modes
Final Exam: 16 Dec	Final Exam (Cumulative)	

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