CIVE 842: Structural Dynamics

Fall Semester 2015
University of Nebraska-Lincoln
MW 9:00 AM – 10:15 AM
Scott Engineering Center 111/Peter Kiewit Institute 160

Prerequisites: CIVE 341 (Introduction to Structural Engineering) or similar.
CIVE 443 (Structural Analysis) or similar is recommended.

Description: Dynamic behavior of civil engineering structures. Free and forced vibrations of single and multiple degree-of-freedom systems. Response of continuous beam and frames. Elastic-plastic behavior and introduction to nonlinear analysis. Analysis and design considerations for buildings and bridges subjected to seismic loadings. Application of computer-aided numerical procedures.

Course Objectives:

1. Describe the fundamental dynamic parameters of civil structures and their influence on response.
2. Explain and derive the equations of motion that govern the response of single and multiple degree-of-freedom structural systems.
3. Write the equation of motion for a generalized single degree-of-freedom structure.
4. Select the most appropriate method and solve an equation (or set of equations) of motion for a structural system.
5. Describe the limitations and assumptions of various solution strategies as compared to experimental or real world applications.
6. Measure, estimate and document the dynamic response of structures using experimental, analytical, and numerical methods.

Textbook: Chopra, Anil K. (2011). *Dynamics of Structures.* 4th Edition, Prentice Hall, Stamford, CT. 992p. ISBN-13: 978-0132858038

Optional Reference: Clough, Ray W. and Penzien, Joseph. (2003). *Dynamics of Structures.* 3rd Edition, Computers & Structures Inc., Berkeley, CA. 730p.

Background References: Hildebrand, Francis B. (1992). *Methods of Applied Mathematics.* 2nd Edition, Dover Publications, Englewood Cliffs, NJ. 362p.

Palm, William J. (2010). *Introduction to MATLAB for Engineers*. 3rd Edition, McGraw-Hill, New York, NY. 576p.

Instructor: Richard L. Wood (rwood@unl.edu)
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Teaching Assistant: Mohammad Ebrahim Mohammadi (me.m@huskers.unl.edu)
362C Whittier Research Facility

Office Hours:

Monday 1:30 pm – 3:00 pm (teaching assistant, Whittier 362S)
Monday 3:30 pm – 5:00 pm (instructor, Whittier 362K/PKI 206F)
Tuesday 3:30 pm – 5:00 pm (teaching assistant, Whittier 362S)
Wednesday 10:30 am – 11:30 am (instructor, Whittier 362K/PKI 206F)
other times are available by appointment

Digital office hours will be experimentally used using Adobe Connect with the course instructor. To facilitate login, a computer with internet is required. However a university IP address is not required.
http://connect.unl.edu/rwood

Email Policy:

In each email, use "CIVE 842" 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:

Coursesites (similar to blackboard) will be used to distribute course material (notes, assignments, reference documents, etc.). It is required for students to have access to download the appropriate material and verify your e-mail address on the site. An invitation to join will be sent during the first week, if one is not received please contact the instructor. If registration is not completed, any scores will not be recorded into the online grade book.

Grading:

Homework (approx. one per week, drop of the lowest assignment)	20%
Midterm Exams (announced 1 week ahead of time)	35%
Final Exam	40%
Attendance, Quizzes, and Participation	5%

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 grading breakdown, there will be **two midterm exams and a 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 will 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 format).

7. **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.
8. **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 1% 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 must be **stapled** or bound.

Digital Meeting Place:

A virtual space is provided to enable communication with your fellow classmates. You will be able to access this virtual Adobe Connect room by clicking on the link below. It will also serve as the area where any interactive online video sessions will occur. More details are available online.

http://connect.unl.edu/cive842

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 Course Outline:

	Topic	Reference
I.	Overview, Motivation, and Introduction to Single Degree-of-Freedom (SDOF) Systems	Chapter 1
II.	SDOF Free Vibration (Undamped and Damped)	Chapter 2
III.	SDOF Forced Vibration (Harmonic and Periodic Excitations)	Chapter 3
IV.	SDOF Forced Vibration (Arbitrary, Step, Pulse Excitations)	Chapter 4
V.	Numerical Evaluation of Dynamic Response	Chapter 5
VI.	Earthquake Response of Linear Systems	Chapter 6
VII.	Earthquake Response of Inelastic Systems (as time permits)	Chapter 7
VIII.	Response Spectra	Chapter 7
IX.	Generalized SDOF Systems	Chapter 8
X.	Multiple Degree-of-Freedom (MDOF) Systems	Chapter 9 Chapter 10
XI.	Approximate Methods for MDOF Systems (as time permits)	Chapter 12
XII.	Modal Participation and Contributions (as time permits)	Chapter 12
XIII.	Seismic Response of MDOF Systems (as time permits)	Chapter 13
XIV.	Design for Seismic Loads within Building Codes (as time permits)	Chapter 22