University of Waterloo
Department of Civil & Environmental Engineering

CIVE 505: Structural Dynamics
Spring 2022

Instructor	Prof. Eugene Kim kekim@uwaterloo.ca Office: CPH 3611B	Office Hours: Wed. 10:30 AM – 11:30 AM or by appointment
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COURSE OVERVIEW

This course is designed for advanced undergraduate students to foster an understanding in structural (flexible body) dynamics. It is assumed that the students have sufficient background in solid mechanics and basic structural analysis. Students are also expected to write and execute short programs in MATLAB. Success in this course requires both an understanding of the concepts and practice solving problems. Several examples will be solved in class to support the concepts presented.

COURSE DELIVERY / MANAGEMENT

Lectures	Tutorials
Mon. 8:30 AM – 10:20 AM CPH 1319 Wed. 8:30 AM – 10:20 AM CPH 1319	Fri. 8:30 AM – 10:20 AM CPH 1319

- Course materials will be posted on LEARN.
- MATLAB will be used for parts of this course.
- Any missed course content is the responsibility of the student.

COVID-19 EXPECTATIONS

- Do not come to campus if you are ill or have been in close contact with someone who is ill.
- If you are ill or need to self-isolate, complete the self-declaration and notify the teaching team as soon as possible.
- All students and members of the teaching team must wear a mask or face-covering in class and in common use areas on campus.
- Students are expected to practice frequent hand hygiene.
- In the event of a COVID-related shutdown, all in-person activities will be moved online.

TEXTBOOK / REFERENCES

- Notes with missing information will be posted on LEARN to be filled in during lectures.
- The annotated course notes will not be provided.
- There is no required textbook but the following are recommended references:

  Fundamentals of Structural Dynamics, 2nd Edition, by Craig, R., and Kurdila, A., Wiley, 2006.

  Dynamics of Structures: Theory and Applications to Earthquake Engineering, 4th Edition, by Chopra, A. K., Pearson, 2012.

  Dynamics of Structures, 2nd Edition, by Clough, R. W., and Penzien, J., McGraw-Hill, 1993.

ASSESSMENTS

- Four (or five) assignments to help you master the course concepts.
- Two 90-minute quizzes – June 13th and July 6th (tentative).
- 150-minute final exam.
- Open course notes will be allowed for the quizzes and final exam.

GRADING

Your overall course grade will be determined using the following scheme:

Assignments	Quizzes (2)	Final Exam
10%	40%	50%

TOPIC SUMMARY

1. Introduction to Structural Dynamics
   a) Dynamic loads
   b) Classification of analytical models
   c) Basic framework of a dynamic analysis
2. Single-Degree-of-Freedom Systems
   a) Elements of lumped parameter models
   b) Formulation of equations of motion for a SDOF system
   c) Rigid body dynamics
   d) Natural frequency of a SDOF oscillator
   e) Free vibration of a SDOF system
   f) Viscously damped free vibration
   g) SDOF response to harmonic excitations
   h) Force transmissibility and base motion
   i) Equivalent viscous damping
   j) Response of a SDOF system to arbitrary excitations
3. Multi-Degree-of-Freedom Systems
   a) Formulation of the equations of motion for a MDOF system

b) Solution for a 2-DOF system
c) Modes of the system
d) Damped MDOF system
e) Modal analysis for MDOF systems

4. Earthquake Response of Structures
   a) Numerical integration
   b) Earthquake excitation
   c) Earthquake response spectra
   d) Earthquake response of inelastic systems
   e) Earthquake response of linear MDOF systems
5. Continuous Systems
   a) Axial vibration of a rod
   b) Transverse vibration of an Euler-Bernoulli beam
   c) Rayleigh's Method for approximating the fundamental natural frequency
   d) Important properties of natural modes of continuous systems

ACADEMIC INTEGRITY, GRIEVANCE, DISCIPLINE, AND APPEALS

Academic Integrity: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for his/her actions (check the Office of Academic Integrity for more information). A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g. plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline. For typical penalties, check Guidelines for the Assessment of Penalties.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4. When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals.

NOTE FOR STUDENTS WITH DISABILITIES

AccessAbility Services, located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.