EML 4220 : Vibrations

Class Periods: M,W,F 5th period (1145-1235)
Location: CSE E119
Academic Term: Fall 2025

Instructor
Rick Lind
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Office Hours in 427 NEB : M,W (12:50-13:40)

Teaching Assistants

- Colin Whatley
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  Office Hours in NEB 508 : T (1145-1340)
  Office hours on Zoom : Th (1145-1340)
- Adam Smith
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  Office Hours in MAE-A 321 : Th (1500-1550) and F (1250-1445 and 1605-1655)

Zoom Information	
Meeting ID :	961 0820 4577
Passcode :	749647

Course Description
(3 credits) Single and multiple degree of freedom systems, including application to mechanical systems with problems employing computer techniques.

Course Pre-requisites
Minimum grades of C in :

EGM 3344	Introduction to Numerical Methods of Engineering Analysis
EGM 3401	Engineering Mechanics : Dynamics
EGM 3520	Mechanics of Materials
MAP 2302	Elementary Differential Equations

Course Objectives
This course will develop a rigorous foundation in the principles associated with vibrations of dynamical systems. This foundation will result by relating topics from the pre-requisite courses to understand the mathematics governing vibration. You will learn how to predict the vibration properties of systems and learn how to analyze experimental data for learning about those vibration properties.

Relation to Program Outcomes (ABET)

	Outcome	Coverage
(1)	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	HIGH
(2)	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	LOW
(3)	an ability to communicate effectively with a range of audiences	LOW
(4)	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
(5)	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
(6)	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	MEDIUM
(7)	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	LOW

Required Textbooks and Software

- S.S. Rao, *Mechanical Vibrations*, Pearson Education Inc., 6^{th} edition, 2017.
- Matlab (Python is acceptable but assistance will not be provided)

Course Schedule

The course will essentially have 4 parts. The first part will cover the concepts of oscillations, both free and forced, and the associated fundamental mathematics associated with solutions to differential equations for mechanical systems with a mass-spring analogy. The second part will cover the use of state-space modeling and issues related to mode shapes. The third part will cover vibrations in high-dimensional systems such as strings and beams along with the concept of waves. The fourth part will cover signal processing and interpretation of the associated results to understand the dynamics of experimental systems.

Date	Textbook Section	Topic
Aug 22		syllabus
Aug 24	1.3-1.4	definitions
Aug 27	1.7-1.10	mass/spring
Aug 29	2.2	mass/spring
Sep 01		–
Sep 03	2.3	torsion spring
Sep 05	2.6	viscous damping
Sep 08	3.2-3.3	dynamics
Sep 10	3.4	damping
Sep 12	3.6	base vibration
Sep 15	3.11	self-excitation
Sep 17		review
Sep 19		review
Sep 22		EXAM01
Sep 24		–
Sep 26	5.2	2-mass systems
Sep 29	5.3	2-mass systems
Oct 01	6.8	modeling
Oct 03	6.9	state-space
Oct 06	6.10	state-space
Oct 08	6.13-6.14	mode shapes
Oct 10	6.15	modes
Oct 13		review
Oct 15		EXAM02
Oct 17		–
Oct 20	8.1	string
Oct 22	8.2	string
Oct 24	8.4	torsion
Oct 27	8.5	beam
Oct 29	8.5	beam
Oct 31	8.5	beam
Nov 03		review
Nov 05		review
Nov 07		EXAM03
Nov 10		experimental testing
Nov 12		FFT
Nov 14		FFT
Nov 17		FFT
Nov 19		FFT
Nov 21		FFT
Dec 01		office hours
Dec 03		office hours

Required Computer

- Recommended Computer Specifications: https://it.ufl.edu/get-help/student-computer-recommendations/
- HWCOE Computer Requirements: https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/

Attendance and Expectations

Students will need to know the material from each lecture so attendance, while not mandatory, is strongly advised. The entirety of exams and homeworks are constructed based on content and concepts presented in these lectures so you will not be properly prepared if you do not attend class. The lectures and recommended textbooks are meant to present complementary approaches and examples so the textbooks are supplementary to, but not replacements for, the lectures. Also, some lectures may have unannounced in-class quizzes. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies at `https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies`

Evaluation of Grades

tentative date	event	course value
	EXAMS	65%
September 22	exam01	(15%)
October 15	exam02	(25%)
November 07	exam03	(25%)
	HOMEWORK	35%
September 08	homework01	(3%)
September 12	homework02	(3%)
September 19	homework03	(3%)
September 29	homework04	(3%)
October 06	homework05	(3%)
October 13	homework06	(3%)
October 29	homework07	(3%)
November 05	homework08	(3%)
November 21	homework09	(3%)
December 03	homework10	(8%)

Grading Policy

The scores required to earn a grade are determined based on the level of difficulty for each assessment.

Grade Evaluation

Any assessment for which a student wants the grade to be re-evaluated must be given to the instructor within 48 hours, and before the start of the subsequent lecture, of when the graded exams were available to the class. You must clearly indicate what you did correctly for which points were not awarded.

Cheating Policy

Cheating on any exam or homework assignement will be reported to the Dean of Students Office with an initial recommendation of a grade of 0 for the entirety of that assessment.

- Homework submissions must be an original copy of the solutions. It is acceptable to use outside resources (classmates, internet, books) to help learn the procedures to solve the problems; however, students must eventually generate and prepare their own solutions for submission.
- Exam submissions must strictly reflect your own work so any use of unauthorized materials (other students, notes, phones, computers, books) will be strictly penalized.

Homework Submission

Homework are due by the start of class. Due dates are not extended. Late submissions will not be accepted.

Academic Policies and Resources
`https://go.ufl.edu/syllabuspolicies`

Commitment to a Positive Learning Environment
The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:

- Your academic advisor or Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu