

EML 4220 : Vibrations
Class Periods: M,W,F 5th period (1145-1235)
Location: FAB 0103
Academic Term: Fall 2024

Instructor

Rick Lind
ricklind@ufl.edu
352.392.6745
Office Hours in 324 MAE-A : M,W (13:55-14:45)

Teaching Assistants

- Aydan Soto
 - aydan.soto@ufl.edu
 - Office Hours over email/zoom : Th (1605-1905) and F (1605-1905)
- Riley Richards
 - rileyrichards@ufl.edu
 - Office Hours over email/zoom : M (1605-1800) and T (1250-1445)

Zoom Information	
Meeting ID :	954 1377 9083
Passcode :	018508

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., 6th 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 23		syllabus
Aug 26	1.3-1.4	definitions
Aug 28	1.7-1.10	mass/spring
Aug 30	2.2	mass/spring
Sep 02		–
Sep 04	2.3	torsion spring
Sep 06	2.6	viscous damping
Sep 09	3.2-3.3	dynamics
Sep 11	3.4	damping
Sep 13	3.6	base vibration
Sep 16	3.11	self-excitation
Sep 18		review
Sep 20		review
Sep 23		EXAM01
Sep 25		–
Sep 27	5.2	2-mass systems
Sep 30	5.3	2-mass systems
Oct 02	6.8	modeling
Oct 04	6.9	state-space
Oct 07	6.10	state-space
Oct 09	6.13-6.14	mode shapes
Oct 11	6.15	modes
Oct 14		review
Oct 16		EXAM02
Oct 18		–
Oct 21	8.1	string
Oct 23	8.2	string
Oct 25	8.4	torsion
Oct 28	8.5	beam
Oct 30	8.5	beam
Nov 01	8.5	beam
Nov 04		review
Nov 06		review
Nov 08		EXAM03
Nov 11		–
Nov 13		experimental testing
Nov 15		FFT
Nov 18		FFT
Nov 20		FFT
Nov 22		FFT
Dec 02		office hours
Dec 04		office hours

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 23	exam01	(15%)
October 16	exam02	(25%)
November 08	exam03	(25%)
	HOMEWORK	35%
September 09	homework01	(3%)
September 13	homework02	(3%)
September 20	homework03	(3%)
September 30	homework04	(4%)
October 07	homework05	(3%)
October 14	homework06	(3%)
October 30	homework07	(3%)
November 06	homework08	(3%)
November 22	homework09	(5%)
December 04	homework10	(5%)

Grading Policy

The scores required to earn a grade are determined based on the level of difficulty for each assessment. This determination is not based on class performance or the student average; instead, the determination is finalized before the assessments are graded.

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 assignment 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.

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code”. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

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

- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources

- Health and Wellness

- **U Matter, We Care**

- Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

- **Counseling and Wellness Center**

- <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

- **Sexual Assault Recovery Services (SARS)**

- Student Health Care Center, 392-1161.

- **University Police Department**

- 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

- Academic Resources

- **E-learning technical support:** 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

- **Career Resource Center:** Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

- **Library Support:** <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

- **Teaching Center:** Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

- **Writing Studio:** 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

- **Student Complaints Campus:** https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

- **On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.