

Structural Dynamics
EML5223 Section 25SD
Class Periods: MWF Period 3 (9:35am-10:25am)
Location: 0127 Fine Arts C (FAC 0127)
Academic Term: Fall 2025

Instructor:

Dr. Patrick Musgrave
Assistant Professor, Mechanical and Aerospace Engineering Dept.
pmusgrave@ufl.edu
(352) 392-6230
Office Hours: TBD

Course Description

Vibration analysis and synthesis of continuous and multi degree-of-freedom lumped-parameter systems. Computational and experimental techniques in modal analysis. Credits: 3

Course Pre-Requisites / Co-Requisites

Pre-requisite: EML4220 – Vibrations (*or equivalent*)

Course Objectives

This course will address methods for the prediction of dynamic responses of structures, emphasizing applications in mechanical and aerospace engineering. It will review and extend concepts from vibrations of mechanical systems and mechanics of structures to address free and forced response of continuous and multi-degree of freedom structures, including numerical methods and experimental testing.

Upon completion of this course, students will be able to

- Describe the assumptions underlying models of the behavior of structural members such as rods, beams, and strings
- Develop equations of motion and boundary conditions for continuous structures using Newtonian and variational methods
- Develop discretized equations of motion for structures using approximate methods such as finite element analysis
- Incorporate damping into equations of motions
- Determine undamped natural frequencies and mode shapes of structures by formulating and solving the structural dynamics eigenvalue problem
- Determine the dynamic response of structures
- Analyze experimental data of vibrating structures and compare against numerical models.

Materials and Supply Fees

None

Required Textbooks

Fundamentals of Structural Dynamics
Roy R. Craig Jr. and Andrew J. Kurdila
2nd Edition, 2006 (Wiley)
ISBN-10: 0471430447
ISBN-13: 978-0471430445

Additional reference material

Structural Dynamics

Required Software

- MATLAB Student Version
 - This will be used throughout the class and on some homework assignments.
 - You may consider using UFApps to access a number of popular software applications for “free” including Matlab at: <http://info.apps.ufl.edu/>
 - Not all toolboxes are included in this version.

Matlab is also available for purchase and download at:

http://www.mathworks.com/academia/student_version/index.html

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 Policy, Class Expectations, and Make-Up Policy

Requirements for class attendance, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Attendance

- Regular class attendance is expected.
- If the instructor is unable to hold a lecture in-person (due to travel), lectures will be pre-recorded and posted to Canvas. Students are expected to watch the recorded lectures before the following class.
- You are expected to take a sincere interest in learning the classroom material.
 - You are expected to show up on time for class.
 - Please silence/turn-off all cell phones prior to the start of class
 - If you are a distraction in class, you will be asked to leave.
 - Please do not bring food to class.

Exams/Projects

- The primary evaluation method in this course will be exam and/or projects
- The exact format of these evaluations is subject to change as the semester progresses.
- If you do not agree with the grading of a particular exam/project, you will have one week from the date the assignment is returned to submit a written argument of why you think the grade should be higher. However, the final decision will remain the instructor's.

Homework

- HW will be posted on Canvas along with its due date
- HW will be turned in on Canvas.
- Homework will be submitted online and must be in .pdf format. If submitting handwritten assignments, **the submission should be a scanned version**. Do not take a picture of your homework, as this results in unnecessarily large files. Scanner apps are available for free for mobile devices (e.g. Adobe Scan).
- Late HW policy:
 - HW submitted after the deadline will have a 25% deduction.
 - Late HW will not be accepted 24 hours after the due date.
 - Hardship cases will be considered on an individual basis and only if the instructor has been contacted before the due date of the assignment. Students with hardship cases (e.g., due to medical problems) will be referred to the Dean of Students office, which will perform a background investigation to determine if the hardship is legitimate.

- If you do not agree with the grading of a HW problem, you will have one week from the date the HW is returned to submit a written argument of why you think the grade should be higher. However, the final decision will remain the instructor's.

E-learning course web site (Canvas)

- E-Learning/Canvas system (<https://elearning.ufl.edu>) – all documents, homework, grades, etc. will be posted on this system.
 - Students are expected to check Canvas on a regular basis for up-to-date course information. This may include changes to the syllabus, homework assignment due dates, and project due dates.

Course Schedule

**All schedules and exam dates are approximate and subject to change given sufficient notice.*

Week 1:	Review - Vibrations
Week 2:	Review – Vibrations; PDEs of Continuous Systems
Week 3:	PDEs of Continuous Systems
Week 4:	PDEs of Continuous Systems
Week 5:	PDEs of Continuous Systems; Analytic Solutions of Continuous Systems
Week 6:	Analytic Solutions of Continuous Systems
Week 7:	Analytic Solutions of Continuous Systems
Week 8:	Analytic Solutions of Continuous Systems
Week 9:	Mid-term Exam (<i>Exact Date TBD</i>)
Week 10:	Finite Element Method
Week 11:	Finite Element Method
Week 12:	Finite Element Method
Week 13:	Experimental Vibrations
Week 14:	<i>No Class (Thanksgiving)</i>
Week 15:	Experimental Vibrations; Final Project

Important Dates

10/20 – 10/24	Mid-term Exam (<i>Exact Date TBD</i>)
12/10	Final Project Due

Evaluation of Grades

Assignment	Percentage of Final Grade
Exams/Projects (75% total)	
Mid-term Exam	35%
Final Project	40%
Homework	25%
Total	100%

Grading Policy

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00

70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Academic Policies & Resources

To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: <https://go.ufl.edu/syllabuspolices>. Instructor-specific guidelines for courses must accommodate these policies.

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 by discrimination or harassment of any kind, please contact your instructor or any of the following:

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