

# Syllabus for ME7443

## Advanced Vibrations

### Spring, 2008



#### Course Information

Instructor: Dr. Maurizio Porfiri  
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Office Hours: Tuesday 12:00-12:55  
Lecture: Friday 6:00-8:30 RH704  
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#### Course Goals

This course presents fundamental material for a modern treatment of vibrations, with an emphasis of analytical tools and computational approaches. Topics include Lagrange equations for lumped systems; variational formulations of mechanics problems; free and forced vibrations of lumped systems; fundamentals of beam theory; extensional, torsional, and flexural vibrations of beams; modal analysis of lumped and distributed systems; approximate methods for distributed parameter systems; and nonlinear vibrations. Students will learn fundamental tools for modeling and analyzing mechanical systems.

#### Prerequisites

It is assumed that all students have a working with undergraduate dynamics and senior level mathematical analysis. ME5443 (Vibrations) is a prerequisite. ME6003 (Applied Mathematics in Mechanical Engineering) and ME6703 (Linear Control Theory and Design I) are highly recommended corequisites, although they are not required.

#### Required Text

[1] L. Meirovitch, Fundamentals of Vibrations, McGraw-Hill Book Company, New York, (Second Printing), 2003.

#### References

[2] R.M. Bowen and C.-C. Wang, Introduction to Vectors and Tensors: Linear and Multilinear Algebra, Plenum Press, New York, 1979. [3] L. Meirovitch, Methods of Analytical Dynamics, Dover, New York, 1998. [4] C.-C. Wang, Mathematical Principles of Mechanics and Electromagnetism, Plenum Press, New York, 1979.

#### Project

One project will be assigned to every student team comprising 2-3 students. Projects will be formally assigned before the midterm exam, but students are encouraged to meet the instructor in advance to propose relevant research topics. Each project must be typed on a word-processor. Use of LaTeX is encouraged, although

other word processing platforms are certainly acceptable. Students will present their projects during the last day of class and must turn their project to the instructor during that day.

## Exams

There will be one mid-term and one final exam. Exams will be take-home tests and will test the student's comprehension and ability to apply material learned in class. All tests are open books and open notes. Every page of every exam submission should have the student full name and section number. Illegible work and loose sheets will not be graded. Students must complete all exams on their own. Any kind of discussion of exams among students will be severely penalized through the honors system. If a student cannot attend an exam due to a medical condition, certified by a doctor, he/she must notify the instructor in advance. Unexcused absence from an exam will result in a grade of 0 for that exam.

## Grading policy

Project:	30%
Midterm Exam:	30%
Final Exam:	40%

## Extra credit

There are no opportunities for extra credit. The grading policy allows for a "bad score".

## Class attendance and absences

There are no formal requirements for attendance, and there is no direct penalty for missing class. Students are strongly encouraged to attend class since some course material will only appear in lectures. Students that miss class are responsible for obtaining class notes from a classmate.

## Honor system

The honor system is in force for this course. It is assumed that all work submitted by a student is done so under the honor system code. **Homework questions may be discussed with students. Homework solutions may not be discussed.** The final exam must be completed individually.

## ABET a-k criteria compliance

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
ME7443	✓		✓	✓	✓	✓	✓		✓	✓	✓

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context

- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Tentative Lecture Schedule

Lecture	Reading	Topic of the day
Lecture 1 1/25/08	[1] Chapters 3 and 9	Review of relevant mathematics: linear algebra
Lecture 2 2/1/08	[4] pages 1-27	Kinematics and dynamics of systems of particles and rigid bodies
Lecture 3 2/8/08	[1] pages 262-276, [4] pages 27-40	Lagrangian mechanics
Lecture 4 2/15/08	[3] Chapter 2	Variational methods and linearization
Lecture 5 2/22/08	[1] Chapters 3, 4, and 5	Single degree of freedom systems
Lecture 6 2/29/08	Chapter 7	Multi degree of freedom systems
Lecture 7 3/7/08	Chapter 7	Multi degree of freedom systems-continued
Lecture 8 3/14/08		<b>Midterm exam</b>
Lecture 9 3/28/08	Notes	Fundamentals of beam theory
Lecture 10 4/4/08	Chapter 8	Vibrations of beams
Lecture 11 4/11/08	Chapter 8	Vibrations of beams-continued
Lecture 12 4/18/08	[1] Chapter 9	Approximate methods
Lecture 13 4/25/08	[1] Chapter 11	Nonlinear vibrations
Lecture 14 5/2/08		<b>Projects presentation</b>