ME 370
Vibration of Mechanical Systems
Spring 2019, Section 3

Instructor: Dr. A. Scott Lewis ARL Science Park Building (Science Park Road) 5-0962
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Office Hours: By appointment

Teaching Assistant and Homework Grader: Himanshu Patel (hxp93@psu.edu)

Class Location and Time: 371 Willard 10:10-11:00 MWF

Text: Engineering Vibration, Fourth Edition, Inman, Daniel J., Pearson, 2014

Prerequisites: Math 220, Math 251, EMech 212, CmpSc 200
This course utilizes mathematical techniques covered in earlier mathematics courses such as ordinary linear differential equations with constant coefficients, Fourier Analysis, Laplace transforms, and functions of complex variables. This course also uses concepts covered in earlier engineering mechanics courses such as free body diagrams, Newton's laws, and deformation of beams. In addition, MATLAB software will be used, primarily to obtain numerical solutions and for plotting.

Grading:		
	Homework	25 %
	Exams (3)	51 %
	Final (Comprehensive)	24 %

Course Objectives: This class deals with mechanical vibrations. Goals of this course include mathematical modeling of mechanical systems by various methods, solving these models by both numerical and analytical techniques, and formulating solutions that produce a desired result. It is my personal goal to help you develop your problem solving skills to solve not only ME 370 type problems, but also other problems in both engineering and non-engineering fields. The design of car suspensions and mountain bikes, as well as rotating machinery and bridges, falls under the scope of vibration theory.

By the completion of the course, you will be able to

- Derive linear differential equations of motion for mechanical systems with multiple components,
- Solve the linear differential equations of motion for mechanical systems with no, harmonic, or arbitrary forces acting on the system,
- Analyze the response of the system,
- Design mechanical systems that meet given vibratory specifications and analyze the design using both numerical and analytical methods, and
- Use appropriate software to aid in solving and analyzing vibratory mechanical systems.

Academic Integrity: The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (refer to Senate Policy 49-20). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9).

An important part of learning how to solve engineering problems is homework assignments. While students are encouraged to work together on the homework assignments, it is assumed that each student will hand in solutions that are largely the results of his/her own efforts. A good indicator of whether or not the solution represents your own work is to ask yourself if you fully understand every step of the solution. Although I do not require a certain type of paper and rigid format requirements for the homework, I do expect it to be neat and your answers clearly indicated. It has been my experience that very little study (or much less) is required for tests if a daily effort is made on the homework.

This class will be interactive! You will have to help yourself. I will not deliver lecture material and ask you to regurgitate it on the exams. I am very willing to help, but I must see an effort on your part. Very often, your questions can be answered quickly and simply if you have attempted the problem with some effort. Please do not come to me and expect me to start and finish a problem for you because it is not going to happen. However, if I feel that you have made a "good" attempt, you will find that I love to help and am easy to approach. Make use of e-mail as an avenue for help.

Reporting Educational Equity Concerns
Consistent with University Policy AD29, students who believe they have experienced or observed a hate crime, an act of intolerance, discrimination, or harassment that occurs at Penn State are urged to report these incidents as outlined on the University's Report Bias webpage.

Counseling & Psychological Services
Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity, and sexual orientation.

Counseling and Psychological Services at University Park (CAPS): 814-863-
0395 Penn State Crisis Line (24 hours/7 days/week): 877-229-6400

Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

The schedule that follows is to be used as a guideline. There might be some deviation and it is the student's responsibility to be aware of any changes that are announced in class. Homework assignments will be handed out regularly and are to be handed in at the **BEGINNING** of class on the date set during class. **NO LATE HOMEWORK OR PROJECTS WILL BE ACCEPTED!**

Tentative Lecture Schedule

Date	Book Chapter	Topic
M 1/7	Chapter 1	Introduction, Concepts
W 1/9	Chapter 1	Elements of Vibratory Systems
F 1/11	Chapter 1	Energy Methods, Equivalent Mass
M 1/14	Chapter 1	Differential Equations Review
W 1/16	Chapter 1	Equations of Motion, Newton's Laws
M 1/18	Chapter 1	More Energy Methods
M 1/21		**Martin Luther King Day, NO CLASS**
W 1/23	Chapter 2	Free Vibration
F 1/25	Chapter 2	Free Vibration
M 1/28	Chapter 2	Forced Vibration
W 1/30	Chapter 2	Forced Vibration
F 2/1	Chapter 2	Base Excitation
M 2/4	Chapter 2	Rotating Unbalance
W 2/6	Chapter 2	Examples
F 2/8		**EXAM 1**
M 2/11	Chapter 3	Fourier Series
W 2/13	Chapter 3	System Simulation
F 2/15	Chapter 3	System Simulation
M 2/18	Chapter 3	Convolution Integral
W2/20	Chapter 3	Convolution Integral
F 2/22	Chapter 3	Examples
M 2/25	Chapter 3	LaPlace Transforms
W 2/27	Chapter 3	Examples
F 3/1	Chapter 4	Multiple Degree of Freedom Systems
M 3/4		**SPRING BREAK**
W 3/6		**SPRING BREAK**
F 3/8		**SPRING BREAK**
M 3/11	Chapter 4	Multiple Degree of Freedom Systems
W 3/13	Chapter 4	Multiple Degree of Freedom Systems

F 3/15	Chapter 4	Examples
M 3/18	Chapter 4	Examples
W 3/20	Chapter 4	Examples/Matrix Review
F 3/22		**EXAM 2**
M 3/25	Chapter 4	Eigenvalue Problem
W 3/27	Chapter 4	Examples
F 3/29	Chapter 4	Lagrange's Equations
M 4/1	Chapter 4	Examples
W 4/3	Chapter 4	Examples
F 4/5	Chapter 5	Vibration Control Strategies
M 4/8	Chapter 5	Vibration Absorbers
W 4/10	Chapter 5	Vibration Control Strategies
F 4/12	Chapter 5	Examples
M 4/15	Chapter 5	Examples
W 4/17	Chapter 6	Continuous Systems, Wave Equation
F 4/19		**EXAM 3**
M 4/22	Chapter 6	Continuous Systems, Wave Equation
W 4/24	Chapter 6	Vibrating Strings
F 4/26	Chapter 6	Transverse Vibration of Beams
M 4/29-5/3		**EXAM WEEK**