THE UNIVERSITY OF TEXAS AT AUSTIN
Department of Aerospace Engineering and Engineering Mechanics

ASE 365 STRUCTURAL DYNAMICS
Fall 2016

SYLLABUS

Unique Number: 13425

Instructor: Dr. Jayant Sirohi
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Time: TuTh 9:30-11am

Location: PAR 1

Teaching Assistant: Daiju Uehara
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Catalog Description:
Discrete and continuous models of structures; analysis of transient and steady-state responses; design of dynamic structures by analytical and computer methods. Two lectures a week for one semester.

Course Objectives: Many aerospace structures are subjected to time-varying loadings, including impact and cyclic excitations. Dynamic response to these loadings can have a character very different from static response. This dynamic behavior must be anticipated in the design of the structure if its performance is to be satisfactory.

In this course, we will learn how to represent dynamic behavior of structures mathematically, and how to solve equations of motion to determine how structures will respond dynamically. We will begin with systems having a single degree of freedom, then consider systems with multiple degrees of freedom, and finally systems with an infinite number of degrees of freedom. We will study response to a variety of types of excitations using a number of analysis methods..

Prerequisites: Aerospace Engineering 330M with a grade of at least C-.

Knowledge, Skills, and Abilities Students Should Have Before Entering This Course:
Students should have a mastery of dynamics and strength of materials resulting from successfully taking courses such as Dynamics (EM 311M) and Mechanics of Solids (EM 319). They should be comfortable solving ordinary differential equations and some separable partial differential equations, and analyzing linear dynamic systems, as was done in Linear System Theory (ASE 330M).

Knowledge, Skills, and Abilities Students Gain from this Course (Learning Outcomes):
Students will gain an understanding of, and an ability to analyze and predict, structural dynamic behavior. They will understand when it is appropriate to use various types of models, and will be familiar with basic methods of analytical dynamics. They will understand structural dynamic concepts that are important to design, and will be comfortable using some computational methods in structural dynamic analysis and design.

Impact On Subsequent Courses In Curriculum:
This course provides students with background that may be useful for design courses (ASE 361K, 361L, 363Q), since some concepts in these courses involve structural dynamic behavior, and for Aeroelasticity (ASE 355), which is concerned with structural dynamics. However, this course is not a formal prerequisite for these or any other courses in the curriculum.

Relationship of Course to Program Outcomes:
This course contributes to the following ABET Criterion 3 outcomes and those specific to the EAC accredited program.

AEROSPACE ENGINEERING PROGRAM OUTCOMES

√	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 within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
	d. An ability to function on multidisciplinary 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, economic, environmental, and societal context.
	i. Recognition of the need for and an ability to engage in life-long learning.
	j. Knowledge of contemporary issues.
√	k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET Program Criteria Achieved:
Program criteria are unique to each degree program and are to be compiled from the program criteria given for each degree program and listed in table format below. The faculty should check which of the program criteria are achieved in the course.

AEROSPACE ENGINEERING PROGRAM CRITERIA

	Programs must demonstrate that graduates have A. knowledge of:	
	1. Aeronautical engineering:	
		a. Aerodynamics
		b. Aerospace materials
	√	c. Structures
		d. Propulsion
		e. Flight mechanics
		f. Stability and control.
	2. Astronautical engineering;	
		a. Orbital mechanics
		b. Space environment
		c. Attitude determination and control
		d. Telecommunications
	√	e. Space structures
		f. Rocket propulsion
	3. Of some topics from the area not emphasized	
	B. Design Competence which includes integration of aeronautical or astronautical topics	

Topics:
1. Derivation and solution of equations of motion governing structural dynamic behavior, for single-degree-of-freedom, multi-degree-of-freedom, and continuous systems. Systems have discrete mass, spring or damping elements or members in axial, bending, or torsional deformation, and are subjected to various types of excitation. (28 hours)
2. Design issues related to structural dynamic behavior, including design to avoid resonance, frequency response characterization of systems, isolation of vibrating subsystems from their support, response to characterize peak responses in terms of system parameters, vibration absorbers. (8 hours)
3. Use of Lagrangian Dynamics and Modal Response in the analysis of structural dynamic systems. (6 hours)

Professionalism Topics:
None.

Design Assignments:
None.

Laboratory Assignments:
None.

Computer:
Use of computers for analyzing vibrating systems, including solving eigenvalue problems and performing modal transient response and frequency response analysis. Requires computer and Matlab software.

Text:
Fundamentals of Vibrations by Leonard Meirovitch, Waveland Press, Inc., 2010, ISBN 1577666917.

Class Format:
This is a lecture class that meets two times a week.

Class Schedule/Outline:
The schedule given below is approximate.

Week 1: Introduction, review of dynamics. (Chapter 1)
Week 2: Free vibration of single-degree-of-freedom (SDOF) systems. (Chapter 2)
Weeks 3-4: SDOF response to harmonic and periodic excitations. (Chapter 3)
Weeks 5-6: SDOF response to nonperiodic excitations. (Chapter 4)
Weeks 7-9: Two-degree-of-freedom (2DOF) systems. (Chapter 5)
Weeks 10-12: Analytical dynamics, multi-degree-of-freedom (MDOF) systems. (Chapters 6,7)
Weeks 13-14: Distributed-parameter (continuous) systems. (Chapter 8)

Grading:
Grades will be based on a weighted average of tests and homework. The grading will be relative. There will be no +/- grades.

Quiz 1 (Sep 22nd, 2016)	16%
Quiz 2 (Oct 18th, 2016)	18%
Quiz 3 (Nov 10th, 2016)	16%
Homework	20%
Final Exam	30%

Homework Policy:
Homework will be assigned approximately every week. Assignments are to be turned in by the beginning of class the following week. Make sure that your homework is neat, legible, and well organized so that it is easy to follow and grade. Late homework will not be accepted except under unusual extenuating circumstances.

Examinations:
There will be three quizzes and a final examination as noted above. The final examination is scheduled for **December 8th, 2:00pm-5:00pm.** The room for the final examination will be scheduled by the university a few weeks before the end of the semester, and can be looked up under the unique course number at **http://www.utexas.edu/student/registrar/rose**.

Attendance:
Regular attendance is expected.

Office Hours:
Office hours are TuTh 11am-12noon, and at other times by appointment. Feel free to stop by my office at any time to see if I am free to talk with you. You may also call ahead to see if I am available. You are also welcome to ask me questions by e-mail.

Special Notes:
The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the Cockrell School of Engineering Director of Students with Disabilities at 471-4321.

Evaluation:
Online course instructor surveys will be used during the last week of class to evaluate the course and the instructor. I will appreciate any feedback you can give me at that time (or earlier!) to help me improve the quality of the course.

Prepared by: Dr. Jayant Sirohi Date: 8 August 2016