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

ASE 375 ELECTROMECHANICAL SYSTEMS
Fall 2016

SYLLABUS

Unique Number: 13475, 13485, 13490, 13495

Instructor: Dr. Jayant Sirohi
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Time: TuTh: 2-3pm

Location: Lectures: BUR 116
Lab: WRW 12

Teaching Assistants: TBD

Catalog Description:
Introduction to sensors, actuators and instrumentations systems. Experimental setups to illustrate measurements of quantities typically encountered in the aerospace industry. Error analysis and statistical spread of data. Second order, single degree of freedom system response. Measurement of displacement using dial gage, laser displacement sensor and LVDT. Principle of Wheatstone bridge. Measurement of strain and pressure using strain gages. Accelerometers, impulse hammers and electromagnetic shakers. Triggering of measurements, transient loads. Digital Image Correlation for strain measurement. Two lecture hours and three laboratory hours per week for one semester.

Prerequisites:
Engineering Mechanics 319 with a grade of at least C. Physics 303L, 103N with a grade of at least C.

Course Objectives:
The objective of this course is to introduce students to the theoretical and practical aspects of measurement. Students will obtain hands-on laboratory experience with a variety of transducers and instruments through a set of nine experiments that are focused on practical problems typically encountered in the Aerospace industry. At the conclusion of this course, students will be able to design their own experimental setups and perform measurements.

Knowledge, Skills, and Abilities Students Should Have Before Entering This Course:
Students should have credit for EM 319 - Mechanics of Solids, and PHY 303L, 103N. They must have a good understanding of freshman physics and be able to use a word-processor computer program and a spreadsheet program to create text and graphs for computer-generated lab reports.

Knowledge, Skills, and Abilities Students Gain from this Course (Learning Outcomes):
Students will have an understanding of the theoretical and practical aspects of measuring temperature, displacement, strain, force, pressure and acceleration. They will understand how physical systems behave and will know how to choose and use transducers for making specific measurements. Students will be able to design their own experimental setups for making measurements.

Impact On Subsequent Courses In Curriculum:
This course is a prerequisite for ASE 363Q - Design and Testing of Aerospace Structures. It also provides valuable background for ASE 365 - Structural Dynamics, and ASE 370L - Flight Control Systems.

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	

Professionalism Topics:
The students are required to maintain original lab data in neat laboratory record books. They are given information on the requirement for honesty in the writing of their technical reports and their ethical and legal responsibilities as professional engineers. The University policies can be found at http://deanofstudents.utexas.edu/sjs/scholdis_whatis.php.

Topics:
1. Fundamental concepts of measurement systems: components of measurement systems, measurement accuracy and uncertainty, quantification of error, statistical spread of data.
2. Introduction to data acquisition, temperature measurement, dial gage, LVDT, laser displacement sensor. Principle of Wheatstone bridge, strain gages for strain and pressure measurement. Theory of rap test, impulse response, impulse hammer and accelerometers. Electromagnetic shakers, frequency domain measurements, triggering, acquisition of

transient data. Introduction to digital image correlation.

Design Assignments:
None.

Laboratory Assignments:
There will be nine laboratory assignments as per the schedule below.

Week of	Lab
29 Aug. 2016	1. Error analysis
12 Sep. 2016	2. Temperature measurement
19 Sep. 2016	3. Wing bending-torsion coupling
26 Sep. 2016	4. Column buckling
3 Oct. 2016	NO LAB
10 Oct. 2016	5. Pressure measurement
17 Oct. 2016	6. Impulse response
24 Oct. 2016	7. Frequency response
31 Oct. 2016	8. Landing gear drop test
7 Nov. 2016	9. Photodiode
28 Nov. 2016	Final project demonstrations

Computer:
Use of computers is required for processing experimental data and writing laboratory reports.

Text:
Lab notes distributed by the Instructor. Various vendor data sheets are available in the laboratory.

Class Format:
Two 50 min lectures per week, and nine three-hour, hands-on laboratories during the semester.

Class Schedule:
The schedule given below is approximate.
Week 1-2: Error analysis and statistical spread of data. Digital data acquisition.
Week 3: Temperature transducers.
Week 4-5: Displacement transducers.
Week 6: **6 Oct. 2016. Quiz 1. NO LABS.**
Week 7: Wheatstone bridge, strain gages, pressure transducers.
Week 8: Accelerometers.
Week 9: Shakers and frequency response.
Week 10: Triggered measurements.
Week 11: Digital Image Correlation.
Week 12: **17 Nov. 2016. Quiz 2. NO LABS.**
Week 13-14: Review, discussion of final project.

Grading:

Lab Reports	40%
Quizzes	30%
Final project	30%

There will be no +/- grades. For the final project, you will have to choose to measure anything that interests you and write a report detailing the procedure, results and error analysis. You will present your projects during the final week of classes. Final projects will be completed in groups consisting of 4-5 students each.

Homework Policy:
Laboratory reports are due one week after each lab session. Late reports will not be accepted for grading unless you have made specific arrangements with the Instructor or TA prior to the due date. Each lab group will submit a single report.

Examinations:
There will be two quizzes as noted above. There will be no final examination.

Attendance:
Regular attendance is expected.

Office Hours:
Office hours are **TuTh 3-4pm**, 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 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: 24 August 2016