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

EM 311M - DYNAMICS
Spring 11

SYLLABUS

UNIQUE NUMBERS: 13860, 13865, 13870, 13875

INSTRUCTOR: Dr. Leszek Demkowicz <leszek@ices.utexas.edu>
ACES 6.326, (512) 471-4199

TIME: MWF 1:00 - 2:00 p.m.

LOCATION: ECJ 1.202

TEACHING ASSISTANTS:
Jeff Zitelli < jzitelli@ices.utexas.edu>,
ACES 3SEi5D, 471-1721
Office hours: WRW 308D, Mon, 3-4pm, We, 4-5pm
Jerome Sicard < jeromesicard@mail.utexas.edu >,
WRW 301C, 903 5649
Office hours: WRW 301C, Wed 2-3pm, Fri, 10-11am

EXERCISE SESSIONS:
13860 M 4:00-6:00 pm RLM 6.124 , Jerome Sicard
13865 T 4:00-6:00 pm CPE 2.206 , Jeff Zitelli
13870 M 6:00 8:00 pm RLM 5.118 , Jerome Sicard
13875 T 6:00 8:00 pm RLM 5.124 , Jeff Zitelli

WEB PAGE: http://users.ices.utexas.edu/∼ leszek/classes.html

CATALOG DESCRIPTION:
http://www.utexas.edu/student/registrar/catalogs/ug06-08/ch06/courses/ch0601ge-bme.html#EM

COURSE OBJECTIVES: Learn two- and three-dimensional kinematics and dynamics of a single particle and rigid bodies, applied to a broad class of engineering problems.

PREREQUISITIES: EM306 (or EM306S), M408D (or M308L), **with a grade of at least C**

KNOWLEDGE, SKILLS AND ABILITIES, STUDENTS SHOULD HAVE BEFORE ENTERING THIS COURSE: Prerequisites include basic trigonometry, physics, calculus, vector analysis, and the use of free-body diagrams.

KNOWLEDGE, SKILLS AND ABILITIES, STUDENTS GAIN FROM THIS COURSE (Learning Outcomes) : Students should acquire familiarity with the kinematics of particles and rigid bodies, and gain the ability to solve two- and three-dimensional problems in particle and rigid-body dynamics. In particular, the should be familiar with the basic equations of motion, necessary for their subsequent study of flight mechanics and attitude dynamics.

IMPACT ON SUBSEQUENT COURSES IN CURRICULUM: The knowledge and abilities taught in this course are an essential prerequisite for subsequent courses involving dynamics; in particular, ASE365, 366K, 367K, 167M, and 370L.

RELATION OF COURSE TO PROGRAM OUTCOMES:: This course contributes to the following ABET Criterion 3 outcomes and those specific to the EAC accredited program.

Outcome		Outcome	
a. An ability to apply knowledge of mathematics, science, and engineering	x	g. An ability to communicate effectively	
b. An ability to design and conduct experiments, as well as to analyze and interpret data		h. The broad education necessary to understand the impact of engineering solutions in a global/societal context	
c. An ability to design a system, component, or process to meet desired needs	x	i. A recognition of the need for and an ability in life-long learning	
d. An ability to function on multi-disciplinary teams		j. A knowledge of contemporary issues	
e. An ability to identify, formulate, and solve engineering problems	x	k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	x
f. An understanding of professional and ethical responsibility			

ABET PROGRAM CRITERIA OUTCOMES ACHIEVED:

Criterion		Criterion		Criterion	
A. Aerodynamics		G. Orbital Mechanics	x	M. Preliminary/ Conceptual Design	x
B. Aerospace Materials		H. Space Environment		N. Other Design Content	
C. Structures		I. Attitude Dynamics and Control	x	O. Professionalism	
D. Propulsion		J. Telecommunications		P. Computer Usage	
E. Flight Mechanics	x	K. Space Structures			
F. Stability and Control		L. Rocket Propulsion	x		

TOPICS:

1. Motion of a Point (6) (a,e,k,E,G)
2. Force, Mass and Acceleration (3) (a,c,e,k,E,G,M)
3. Energy Methods (6) (a,e,k,E,G)
4. Momentum Methods (4) (a,e,k,E,G,L)
5. Rigid-Body Kinematics (6) (a,e,k,E,I)
6. Two-Dimensional Rigid Body Dynamics (3) (a,c,e,k,E,I)
7. Energy and Momentum Methods in Rigid Body Dynamics (3) (a,e,k,E,I)
8. Three Dimensional Rigid Body Dynamics (6) (a,c,e,k,E,I)
9. Vibrations (3) (a,E,I)

PROFESSIONALISM TOPICS:
The course helps to develop written and oral communication skills and enforces team work.

DESIGN ASSIGNMENTS: There are no explicit design projects. However, there will be in-class discussions of how the material presented in class influences engineering hardware design. In some assignments, students will be asked how their answers would influence the design of a particular design or system. Overall, it is estimated that about 0.2 semester credit hours are devoted to the general area of "design".

LABORATORY ASSIGNMENTS: There are no laboratory assignments.

COMPUTER: No specific software has been assigned for the homework assignments in this class. At this stage, an understanding of the fundamental aspects of particle and rigid body dynamics, can probably best be obtained through relatively simple problems which have analytic soulutions. Solution of a few problems assigned for homework may be facilitated using a computer, and students are free to use whatever software they wish.

TEXT: A. Bedford and W. Fowler, *Engineering Mechanics: Dynamics*, fifth edition, Prentice Hall, Upper Saddle River, New Jersey 07458, 2008.

CLASS FORMAT: This is a lecture class and meets 3 times a week. The lectures are complemented with *mandatory* exercise (help) sessions once a week (two hours).

CLASS OUTLINE SCHEDULE:

Date	Topic	Reading	Problems solved in class	Anticipated homework problems
Wed, Jan 19 Fri,Jan 21	Kinematics of a point: position, velocity, acceleration	12,1-5 13.1-2	13.5,14,27,48	13.6,15,28,49
Mon, Jan 22 Wed, Jan 26 Fri, Jan 28	Cartesian coordinates Cylindrical coordinates	13.1-33	13.60,80,89,141	13.61,81,90,142
Mon, Jan 31 Wed, Feb 2 Fri, Feb 4	Frenet coordinates Frenet coordinates -cont.	13.1-3 13.1-3	13.150,157,117,133 13.134,129	13.151,158,116,131 13.135,130
Mon, Feb 7 Wed, Feb 9 Fri, Feb 11	Kinetics of a point: equations of motion in Cartesian, cylindrical, and Frenet cordinates	14.1-6	14.15,21,38,55 14.75,83,105,107	14.16,22,36,56 14.76,93,106,108,115
Mon, Feb 14 Wed, Feb 16 Fri, Feb 18	Principle of work and energy, conservative forces	15.1-6	15.12,19,24,70 15.87,93,114	15.13,14,20,26,63 15.88,92,115
Mon, Feb 21 Wed, Feb 23 Fri, Feb 25	Principle of impulse and momentum, impact, principle of angular impulse and momentum	16.1-5	16.10,29,43,60 16.79,91,95	16.11,30,45,61 16.80,92,93
Mon, Feb 28 Wed, Mar 2 Fri, Mar 4	Kinematics of rigid bodies: angular velocity and acceleration vectors	17.1-6	17.6,15,32,58 17.70,71	17.7,34,37,59 17.72,75
Mon, Mar 7 Wed, Mar 9 Fri, Mar 11	Moving reference frames	17.1-6	17.85,91,103,121 17.126,145,149	17.86,92,104,122 17.128,132,133,146, 17.150
Mon, Mar 21 Wed, Mar 23 Fri, Mar 25	Dynamics of rigid bodies: equations of motion	18.1-5	18.5,12,18	18.6,13,19
Mon, Mar 28 Wed, Mar 30 Fri, Apr 1	d'Alembert Principle	18.1-5	18.34,45,51	18.35,46,58

Mon, Apr 4 Wed, Apr 6 Fri, Apr 8	Energy and momentum principles in rigid body dynamics	19.1-6	19.11, 21, 38, 58 19.70,81,93	19.13,22,39,59 19.71,85,94
Mon, Apr 11 Wed, Apr 13 Fri, Apr 15	3D kinematics and dynamics of rigid bodies, Euler's angles	20.1-3	20.11,13,26,32,39	20.12,14,27,33,40
Mon, Apr 18 Wed, Apr 20 Fri, Apr 22	Euler's equations	20.1-3	20.54,70	20.56,71
Mon, Apr 25 Wed, Apr 27 Fri, Apr 29	Vibrations	21.1-3	21.4,6,9,15,19,49 21.51,65	21.8,10,16,50 21.53,66
Mon, May 3 Wed, May 4 Fri, May 6	Vibrations - cont. Review	21.1-3		

FINAL GRADE: Is based upon the final score.

Final score range	grade
86 - 100	A with recommendation letter
81 - 85	A
76 - 80	A-
73 - 75	B+
69 - 72	B
66 - 68	B-
63 - 65	C+
59 - 62	C
56 - 58	C-
53 - 55	D+
49 - 52	D
46 - 48	D-
00 - 45	F

The final score is a weighted average of the test score, three mid-term exams and the final exam, with the following weights:

Tests (homework)	- 15 %
Exams	- 20 % each
Final	- 25 %

HOMEWORK AND TEST POLICY: Homework (an average of four problems per class) will be given each week during the classes. We shall neither collect nor grade the homework. Instead, each exercise session will begin with a test for which one of the homework problems *assigned in the previous week* will be selected. You may ask TAs or the Instructor for help to solve the homework problems before you are tested on them but, in principle, we shall not present complete solutions to the homework problems until after the test. Solutions to all homework problems will also then be posted on the Web. Two lowest test scores will be disregarded when computing the test average.

EXAMINATIONS: There will be three (closed book) exams held during evening hours, according to the following schedule.

Material covered	Time	Location
Exam 1 (through chapter 13)	Wed, Feb 16, 6:00 - 9:00 P	TBA
Exam 2 (through chapter 17)	Wed, Mar 30, 6:00 - 9:00 P	TBA
Exam 3 (through chapter 20)	Wed, May 4 , 6:00 - 9:00 P	TBA

A comprehensive *final exam* will be given on Monday, May 16, 9 - noon, at official scheduled location. Please look up the instructor's web page for samples of old mid-term and final exams.

ATTENDANCE: Regular attendance of *both* lectures and exercise sessions is expected.

OFFICE HOURS: ACES 6.326, WF 12:00-1:00P

IMPORTANT DATES: The last day of the official add/drop period is Feb 14. After this date, changes in registration require the approval of the Chair of the department and (usually) the Dean.

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 College of Engineering Director of Students with Disabilities at 471-4321.

EVALUATION: The Measurement and Evaluation Center forms for the College of Engineering will be used during the last week of class to evaluate the course, the instructor and the TAs.

PREPARED BY: Leszek F. Demkowicz, Jan 11, 2011.