

THE UNIVERSITY OF TEXAS AT AUSTIN
The Department of Aerospace Engineering
& Engineering Mechanics

EM 311M - DYNAMICS
Fall 07

SYLLABUS

UNIQUE NUMBERS: 14035,14040,14045,14050

DESIGNATION: Required Course

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

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

PLACE: UTC 3.134

TEACHING ASSISTANTS: Kyungjoo Kim <iamkyungjoo@gmail.com>, ACES CS2NEo3B, 232-7420
Ming-Chen Hsu <jmchsu@mail.utexas.edu >, WRW 311, 471-6137

EXERCISE SESSIONS:
14035 W 4:00-6:00 pm RLM 5.126 (Ming-Chen Hsu)
14040 T 6:00-8:00 pm RLM 6.114 (Ming-Chen Hsu)
14045 W 6:00 8:00 pm RLM 5.124 (Kyungjoo Kim)
14050 Th 6:00 8:00 pm RLM 5.124 (Kyungjoo Kim)

WEB PAGE: <http://users.ices.utexas.edu/~leszek/classes.html>

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: 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.

ABET CRITERIA 2000 OUTCOMES ACHIEVED: This course contributes to the following EC2000 Criterion 3 outcomes and those specific to the EAC accredited aerospace engineering 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: (referenced to Criteria 2000 and program criteria outcomes)

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)

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 solutions. 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, Aug 29 Fri, Aug 31	Kinematics of a point: position, velocity, acceleration	12,1-5 13.1-2	13.5,14,27,48	13.6,15,28,49
Wed, Sep 5 Fri, Sep 7	Cylindrical coordinates Frenet coordinates	13.1-33	13.60,80,89,141	13.61,81,90,142
Mon, Sep 10 Wed, Sep 12 Fri, Sep 14	Cylindrical coordinates Curvilinear motion -cont.	13.1-3	13.150,157,117,133 13.134,129	13.151,158,116,131 13.135,130
Mon, Sep 17 Wed, Sep 19 Fri, Sep 21	Kinetics of a point: equations of motion in Cartesian, cylindrical, and Frenet coordinates	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, Sep 24 Wed, Sep 26 Fri, Sep 28	Principle of work and energy, conservative forces	15.1-6	15.12,19,23,70 15.86,93,114	15.13,14,20,26,63 15.87,92,115
Mon, Oct 1 Wed, Oct 3 Fri, Oct 5	Principle of impulse and momen- tum, impact, principle of angular impulse and momentum	16.1-5	16.10,29,43,60 16.79,91,95	16.11,33,45,61 16.80,92,93
Mon, Oct 8 Wed, Oct 10 Fri, Oct 12	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, Oct 15 Wed, Oct 17 Fri, Oct 19	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, Oct 22 Wed, Oct 24 Fri, Oct 26	Dynamics of rigid bodies: equations of motion	18.1-5	18.5,12,18	18.6,13,19
Mon, Oct 30 Wed, Oct 31 Fri, Nov 2	d'Alembert Principle	18.1-5	18.34,45,51	18.35,46,58

Mon, Nov 5	Energy and momentum principles in rigid body dynamics	19.1-6	19.90, 21, 38, 58	19.13,22,39,59
Wed, Nov 7			19.70,81,93	19.71,85,94
Fri, Nov 9				
Mon, Nov 12	3D kinematics and dynamics of rigid bodies, Euler's angles	20.1-3	20.12,26,32,39	20.13,27,33,40
Wed, Nov 14				
Fri, Nov 16				
Mon, Nov 19	Euler's equations	20.1-3	20.54,70	20.56,71
Wed, Nov 21				
Mon, Nov 26	Vibrations	21.1-3	21.7,9,15,49	21.8,10,16,50
Wed, Nov 28			21.51,65	21.53,66
Fri, Nov 30				
Mon, Dec 3	Vibrations - cont.	21.1-3		
Wed, Dec 5	Review			
Fri, Dec 7				

FINAL GRADE: Is based upon the final score.

Final score range	grade
85 - 100	A+
75 - 85	A
65 - 75	B
55 - 65	C
45 - 55	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 in WEL 136 , according to the following schedule.

Exam 1 (through chapter 13) Mon, Sep 24, 6:00 - 8:00 p.m.

Exam 2 (through chapter 17) Mon, Oct 29, 6:00 - 8:00 p.m.

Exam 3 (through chapter 20) Mon, Dec 3, 6:00 - 8:00 p.m.

A comprehensive *final exam* will be given during the official scheduled time. 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 Sep 15. 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.