ENGR 3130: DYNAMICS

University of Detroit Mercy
Term I, 2013-2014

Course Description: The application of kinematics and kinetics to particles and rigid bodies. The course considers fixed and moving reference frames, momentum and energy methods, and applications in engineering problems.

Prerequisites: ENGR 3120, Statics

Instructor: Rick Hill, Assistant Professor
Department of Mechanical Engineering
Room E274
hillrc@udmercy.edu

Class meetings: MW 3:40-4:55 pm, Room E224

Discussion section: to be scheduled

Office hours: MW 2:00 - 3:30 pm, T 3:00 - 5:00 pm, TH 4:00 - 5:00 pm

Course homepage: http://knowledge.udmercy.edu

Required text: Plantenberg, K., and Hill R., *Conceptual Dynamics*.

Additional references:
Meriam, J.L., and Kraige, L.G., *Engineering Mechanics: Dynamics*.
Hibbeler, R.C., *Engineering Mechanics: Dynamics*.
Bedford, A.M., and Fowler, W., *Engineering Mechanics: Dynamics*.

Class Elements: Homework - Problem sets will be assigned approximately weekly over the course of the semester.

Quizzes - Quizzes will be given every one to two weeks including two oral quizzes.

Exams - Two cumulative midterms will be given during the semester in addition to a cumulative final.

Class Policies: Late work - Homework must be turned in at the beginning of class. Late homework is not accepted.

Emergencies - Your lowest homework and quiz score will be dropped, thereby allowing for emergencies. If there are further extenuating circumstances, they can be discussed on a case-by-case basis.

Exams - Exams will in general be closed book and closed note. An equation sheet will be provided to you. Make-up exams will only be given if prior arrangements have been made with me.

Regrades - If you feel a mistake has been made in the grading of an assignment or exam, you have one week from the date of its return to submit the item for a regrade.

Academic Integrity - Any suspected cheating will be dealt with according to the College policy - see the Engineering Science Student Handbook. In the case of homework, working together is encouraged, but you must write your own solutions that reflect your own understanding of the material.

Students with Disabilities - It is very important for students to be proactive with regard to requesting disability accommodations. While it is never required that you disclose your disability to your professors, all students at UDM are encouraged to talk to their professors to discuss their concerns. Faculty cannot provide disability accommodations without official notification from the Disability Support Services office. If you need an accommodation because of a disability, if you have emergency medical information to share, or if you need special arrangements in case the building must be evacuated, please contact Emilie Wetherington as soon as possible to schedule an appointment (gallegem@udmercy.edu or (313) 578-0310). Disability Support Services is located in the Student Success Center, Room 319, on the 3rd Floor of the Library, McNichols Campus.

Grading:

Homework	20%
Quizzes	5%
2 Oral Quizzes	5%
2 Midterm Exams	40% (20% each)
Final exam	30%

Scale:

Percentage	93-100	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	60-66	< 60
Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F

Course Topics:

1. Kinematics of particles
2. Planar kinematics of rigid bodies
3. Newton's laws for particles
4. Newton's laws for rigid bodies
5. Work and energy for particles
6. Work and energy methods for rigid bodies
7. Impulse and momentum for particles
8. Impulse and momentum methods for rigid bodies

Course Outcomes: After taking this course, students will be able to:

1. **Employ** vectors and calculus to **describe** and **predict** the planar motion of particles and rigid bodies (translation and rotation). [ME Outcome a, e, and m]
2. **Apply** kinematic principles to **describe** and **predict** the planar motion of a system of connected particles and rigid bodies including pinned, rolling, and sliding connections (translation and rotation). [ME Outcome a, e, and m]
3. **Produce** free-body diagrams for particles, rigid bodies, and systems of rigid bodies along with their components. [ME Outcome a and e]
4. **Apply** Newtons laws of motion to **relate** forces obtained from free-body diagrams and accelerations from kinematics to **derive** the equations of motion for particles and rigid bodies in planar motion. [ME Outcome a, e, and m]
5. **Generate** simplified models and dynamic equations of motion for connected mechanical systems including rigid links, rigid inextensible cords, sliding and rolling contact conditions, springs and masses, and be able to **critique** the limitations and appropriateness of these models. [ME Outcome a, e, g, and m]
6. **Apply** work and energy principles to **analyze** and **predict** the motion of particles and rigid bodies in 2-D. [ME Outcome a, e and m]

7. **Apply** impulse and momentum principles to **analyze** and **predict** the motion of particles and rigid bodies in 2-D. [ME Outcome a, e, and m]

8. **Differentiate** between approaches and **explain** why a particular approach (Newtons laws, work-energy, impulse-momentum) was employed in solving a given problem. [ME Outcome a, e, and g]

9. **Obtain** numerical results for the dynamic equations of motion employing algebraic manipulation, solution of differential equations, or computational methods and be able to **evaluate** how reasonable the results are. [ME Outcome a, e, k, and m]

10. **Design** mechanical systems (make design choices) based on knowledge of the kinematic/kinetic theory. [ME Outcome a and c]

ENGR 3130 Schedule for Term I, 2013-2014

(note: all elements of this schedule are subject to change)

DATES	TOPICS	DUE
8/26	Syllabus, review, and introduction	
	Kinematics of particles	
8/28	Rectilinear motion	
9/2	**LABOR DAY HOLIDAY**	
9/4	Planar motion (fixed frame: x-y coordinates)	HW #1
9/9	Projectile motion	
9/11	Planar motion (moving frame: n-t coordinates)	HW #2
9/16	Planar motion (moving frame: r-θ coordinates)	
9/18	Relative motion (translating axes)	HW #3
9/23	Constrained motion of connected particles	
9/25	Review	HW #4
9/30	**Midterm #1**	
	Kinematics of rigid bodies	
10/2	Rotation about a fixed axis	
10/7	Relative velocity	
10/9	Relative acceleration	HW #5
	Newtonian mechanics	
10/13	Newtonian mechanics rectilinear motion for particles	
10/15	**FALL BREAK**	
10/20	Newtonian mechanics planar motion for particles	
10/22	Newtonian mechanics fixed-axis rotation	HW #6
10/27	Newtonian mechanics general motion	
	Work and energy	
10/29	Work and kinetic energy for particles	HW #7
11/4	Potential energy for particles	
11/6	Review	HW #8
11/11	**Midterm #2**	
11/13	Work-energy for systems of particles	
11/18*	Work-energy for rigid bodies	
	Impulse and momentum	
11/20	Linear impulse and momentum for particles	HW #9
11/25	Angular impulse and momentum for particles	
11/27	**THANKSGIVING HOLIDAY**	
12/2	Impulse and momentum for systems of particles	
12/4	Impulse momentum for rigid bodies	HW #10
12/9	Review	
12/11	**FINAL EXAM (2:00-3:50pm)**	

* The last day to withdraw is November 18.