# **Mechanical Engineering and Mechanics**

# MEM 238 Dynamics

### **Fall 2006**

Designation:	Required
Catalog description	Kinematics and kinetics of system of particles and of rigid bodies in two and three-dimensional spaces. Force and acceleration, linear and angular momentum, and energy methods.
Prerequisite(s)	TDEC 114, TDEC 115, MEM 202
Textbook(s) and/or	other required material:
Required:	"Engineering Mechanics – Dynamics", by R.C. Hibbeler, 10 <sup>th</sup>
	Edition, Prentice-Hall, Inc., 2004, ISBN 0-13-141678-2.
Reference	"Engineering Mechanics – Dynamics", by Soutas-Little, R.W., and

Inman, D.J., (First Edition), Publisher: Prentice-Hall, Inc., 1999. ADAMS – Dynamic simulation software system available on all cluster computers in the MEM undergraduate laboratory

### **Course Objectives**

The course aims to provide Mechanical Engineering students in their junior year with the fundamentals of Dynamics. The emphasis is on understanding the physical principles governing motion of rigid bodies and applying them to solve simplified engineering problems. Specific objectives are:

- 1. Develop an understanding of the fundamental principles governing the motion of objects and the interaction between forces acting on objects and their ensuing motion.
- 2. Develop the ability to formulate realistic dynamic models of physical systems and to analayze and predict the behaviour of these systems using the established models.

## **Topics Covered**

- 1. Review of particle dynamics kinematics, equations of motion, angular momentum and conservation of angular momentum, work and energy and conservation of energy, impulse and momentum and conservation of momentum, impact.
- 2. Kinematics of rigid bodies in plane motion.
- 3. Motion relative to rotating reference frames.
- 4. Three dimensional kinematics of rigid bodies.
- 5. Newton-Euler equations for motion of rigid body in the plane.
- 6. Work and energy and conservation of energy principles for plane motion of rigid bodies.

7. Angular impulse and momentum and conservation of angular momentum for plane motion of rigid bodies.

### **Class schedule**

Two hour lectures twice a week Two hour recitation once a week

## **Contribution to Professional Component:**

The course builds upon the principles learned in TDEC 114, and Mechanical Engineering and Mechanics Laboratory II, MEM 302. The principles taught in MEM 238 are used by some students in the capstone senior design project course. Knowledge of the fundamental principles governing the motion of bodies is essential to the successful practice of the profession of mechanical engineers and are directly used in many industrial area such as Automotive and Aerospace.

Outcomes a - k	Content	Explanation	Evidence
a. An ability to apply knowledge of mathematics, science and engineering	2	This course builds on the student's knowledge of mathematics such as differential equations and vector analysis and engineering knowledge such as Statics. The students learn how to apply and synthesize this knowledge in designing, analyzing and solving dynamic systems.	Mid-term and Final Exams, Homework
b. An ability to design and conduct experiments as well as to analyze and interpret data	1	No physical experiments are conducted during this course. However, using numerical and simulation tools (such as ADAMS) the students learn how to analyze and interpret data obtain from Dynamics systems.	Lecture notes, ADAMS CD
c. An ability to design a system, component or process to meet desired needs	1	This is primarily a fundamental basic knowledge course in dynamic and no specific design components are included. However, through the solutions of various dynamics poblems students learn indirectly design and structure of dynamics systems.	Lecture notes, Mid-term and final exams, homework, ADAMS CD
d. An ability to function on multidisciplinary teams	0	No team work is involved in this course	
e. An ability to identify, formulate and solve engineering problems	2	This is the main thrust of this course. It provides the fundamental knowledge and uses this knowledge to formulate and solve engineering problems in Dynamics	Mid-term and final exams, homework
f. An understanding of professional and ethical responsibility	1	Problems are presented both in class and in homework that emphasize the professional responsibility of engineers in different industries	Class notes, homework exams

# Relationship to Program Outcomes:

g. An ability to communicate effectively	2	Orally, only to a minor extent through the questions and answers and participation in class. Strong emphasis is placed on clear written communication skills.	Homework, exams
h. The broad education necessary to understand the impact of engineering solutions in a global/societal context	1	The impact of solid broad knowledge in Dynamics in various Industrial and societal discipline (Automotive, Space, Medicine) are emphasized.	Lecture notes
i. A recognition of the need for and an ability to engage in lifelong learning	1	The need for lifelong learning of recent improvements and development of numerical tools in Dynamics are indicated.	Classroom notes, ADAMS CD
j. A knowledge of contemporary issues	0	NA	
k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice	1	Students use EXCEL ADAMS and other numerical tools to simulate physical problems and obtain realistic solutions.	ADAMS CD

Prepared by:

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