EAS 215 Dynamics

Spring term 2018

Instructor: Hormoz Zareh, PhD
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General information

Course web site:
http://web.cecs.pdx.edu/~hormoz/eas215/spring18/dynamics_outline_sp18.htm

You will need the following username and password for access to lecture notes and HW solution from the course site ☹

E-mail: *hormoz@pdx.edu* **Phone: (503)725-4286**

Office hours: Mon. & Wed. 9:30-10:30 Tue. & Thu. 2 – 3:30 and by appointment

Teaching Assistant: Daniel Ringle (meet him at cubicle behind ME reception desk)
TA office hours: Tue. & Thu. 11 - 1

Grading Policy

Grades will be based on homework assignments and exams as follows:

- **Homework 10%**
- **Two midterm exams *55%**
- **Final Exam 35%**

*** No make up exams! Percentage of missed midterm exam(s) will be added to the Final Exam.**

Exams will be multiple-choice, true-false question format. Scantron will be provided. Students must bring university-issued ID to each exam session.

Homework Format

All homework submitted should conform to the following:

- **Each homework must include Given (problem statement), Required (what is to be solved), followed by Solution. If applicable, a free-body-diagram must be included.**
- **Each problem must be clearly demarcated (separated) from the next one.**
- **Solution must include relevant equations, assumptions, and clearly indicate numerical substitutions with proper units.**
- **All required final answers must be highlighted, underlined or boxed, and must include units.**
- **All homework must be uploaded (to D2L site) in *PDF* format. No other format will be accepted.**

D2L Homework Submission guidelines

1) Entire homework set must be submitted as one (single) PDF file.

2) Only PDF format will be accepted and graded. *Other formats (including JPEG images) will be ignored and will not be graded.*

3) Use the following naming convention for homework:
   Last-name_First-name_HWxx (where xx indicates the set number).
   For example: Smith_Jane_hw2.PDF

Use of MathCAD

- You are encouraged to use MathCAD software to complete your homework assignments.
- Allows the user to combine text and formulas (including Greek symbols)
- Equations can be defined as "live" so that variable substitutions can take place and lead to solution.
- Student version is available for $45 (this is full strength software, not stripped version). See course web page for details.
- Bonus 10% credit for each homework set completed with MathCAD.

Classroom attendance and etiquette

- Class attendance is not mandatory.
- Turn off mobile phones and other electronic devices during lecture. You will be asked to leave the classroom for the remainder of the session if your phone or other devices create distraction.
- Refrain from eating, talking to others, etc. during lecture.
- Homework submissions that do not follow the specified guidelines will not be accepted. Late homework will not be accpeted (cannot be uploaded).

Global course objectives

To develop an understanding of the classic Dynamics, a branch of Newtonian Mechanics.

Identify and define Dynamics problems.

Develop a simplified mathematical model of a common Dynamics problem.

Apply mathematical solutions based on the principles of Dynamics to particle and rigid body problems.

Interpret the results and present the solutions in a professional manner.

Specific course objectives

1) Ability to extend the previous knowledge of physics (mechanics) to particle motion kinematics, including projectile motion.
2) Ability to solve particle dynamics problems using Newton's Second Law and concept of Free Body Diagram.
3) Ability to apply Work-Energy Principles to the particle dynamics problems.
4) Ability to apply Impulse-Momentum Principles to the particle dynamics problems.
5) Ability to understand the motion of rigid bodies, concept of moment of inertia.
6) Ability to understand the concept of relative velocities and acceleration in rigid bodies, including relative motion of coincident rotating bodies and Coriolis Acceleration.
7) Ability to solve kinematics problems using vector cross product concepts and unit vectors.
8) Ability to apply concepts in objective 2-4 to the rigid body Kinetics.

Background and Historic overview

Dynamics is a branch of Mechanics dealing with the motion of bodies and its cause(s).

There are two principle concepts:

- Kinematics: Deals with the study of motion without considering the underlying cause of it.
- Kinetics: Study the underlying cause of motion (forces). Relates the action of the forces to the resulting motion.

Background and Historic overview (continued)

- The principles of Dynamics started with experiments by Galileo Galilei (1564-1642), including motion of pendulums and falling objects, and motion along inclined planes.
- Isaac Newton (1642-1727) made Dynamics a scientific cornerstone by formalizing the three-dimensional dynamics and proposing the law of universal gravitational attraction. His famous work is *Principia* recognized as one of the greatest recorded contributions to knowledge.
- Other notables in the field include Euler, D'Alambert, and Lagrange.

Some Basic Concepts and Definitions

- Space: Geometric region occupied by bodies under study. Position of the bodies is defined relative to a set of geometric references. Basic frame of reference for Newtonian mechanics is the *primary inertial system*.
- Time: Measure of succession of events and is considered an absolute quantity.
- Particle: Ideal object of negligible mass and size, relatively speaking!
  - More formal definition: An object whose size is negligible compared to the radius of curvature of motion.
- Rigid Body: Collection of particles whose changes in shape are negligible in comparison with its size.

Solving Dynamics Problems

- **Read the problem statements carefully.**
- **Establish what is given, draw a free-body diagram as appropriate.**
- **Select a coordinate system, and formulate the problem using the appropriate principles.**
- **Simplify the derived equations and solve them numerically using consistent units.**
- **Examine the answer to make sure it makes sense and is not counter-intuitive.**