PH 461/561 Classical Mechanics I

Fall Semester 2005

Time and location: Tuesdays & Thursdays 9:30am – 10:45am (CH 396)

Instructor and office hours:
Dr. Renato Camata, camata@uab.edu, Thursdays 11:00am – 12:00pm
CH 306, (205) 934-8143 (Other times by appointment)

Textbook: Analytical Mechanics, 7th edition, Fowles & Cassiday

Other useful resources:

Mechanics	**Classical Mechanics**	**A Modern Approach to Classical Mechanics**
K. R. Symon	*John R. Taylor*	*Harald Iro*
Addison-Wesley	University Science Books	World Scientific

Catalog Description: Kinematics and dynamics, including central forces, rotating coordinate systems, and generalized coordinates. Lagrangian, Hamiltonian, and other equivalent formulations of mechanics.

Prerequisite: PH 222 and MA 252

Course Activities: This course will comprise formal lectures integrated with classroom discussions and written problem-solving exercises assigned by the instructor (Problem sets). Through these activities, undergraduate students enrolled in **PH 461** are expected to acquire a solid understanding of classical mechanics and a high degree of problem-solving skills in the subject. Graduate students enrolled in **PH 561** will be required to demonstrate the same proficiency of **PH 461** students and, in addition, develop an advanced level of understanding and problem-solving skills in this area by completing an Integrative Project. This Integrative Project will consist in a series of mechanics problems whose solutions require the *integration* of knowledge from multiple topical areas covered in the course. This series of problems will be made available during the third week of classes and students will be required to complete it and turn in all solutions for grading by **Tuesday, November 22.** In addition, **PH 561** students will be asked to select *one* problem from their Integrative Project which will be presented in the form of an oral presentation in class on **Thursday, December 1.**

Related UAB core learning outcomes: Students successfully completing this course will demonstrate knowledge of fundamental concepts in Classical Mechanics and the ability to apply this knowledge in the description of the 1D, 2D, and 3D motion of massive point particles in inertial and non-inertial frames of reference.

Course learning objectives:

- Demonstrate knowledge and understanding of the following specific fundamental concepts in Classical Mechanics **(PH461 & PH561)**:
  1. *Newton's laws of motion*
  2. *Application of Newton's laws to constant, position-dependent, and velocity-dependent forces.*
  3. *Oscillations.*
  4. *Newton's laws of motion in non-inertial frames of reference*
  5. *Particle motion under central forces*
- Demonstrate an ability to effectively apply the knowledge of the fundamental concepts above in solving problems involving motion in the following classic areas of mechanics **(PH461 & PH561)**:
  1. *Particle motion in 1D, 2D, 3D*
  2. *Oscillations*
  3. *Rotating and otherwise accelerating rotating coordinate systems (e.g., Earth)*
  4. *Celestial mechanics, scattering (e.g., Kepler problem, Rutherford scattering)*
- Demonstrate enhanced quantitative reasoning skills and mathematical analysis skills **(PH461& PH561)**.
- Demonstrate the ability to communicate the solution of mechanics problems both in oral and written form **(PH561)**.

Measurement of learning objectives: Problem sets with exercise assignments and exams will be used regularly to measure *understanding of the fundamental concepts* presented as well as students' *abilities to apply this understanding* to classic problems in mechanics. Prompt grading of the problem sets by the instructor will provide feedback to students on their strengths and weaknesses, in preparation for the exams. Both, problem sets and exams also provide an opportunity to evaluate the progression of students' reasoning and mathematical skills. These two measuring tools will be used for both **PH461** and **PH561** students. In addition, students enrolled in **PH561** will have an opportunity to integrate their knowledge more extensively through the completion of the Integrative Project. This higher level of learning will be measured through their turned in solutions. Measurement of **PH561** students' *ability to communicate problem solutions both orally and in writing* will be achieved through their written report and oral presentation to the class.

Course Grade:

PH 461 *(Undergraduate)*	**PH 561** *(Graduate)*
50% - Problem Sets	25% - Problem Sets
50% - Exams*	50% - Exams*
-	25% - Integrative Project

Three exams – equal weight:

- **Exam 1:** Thursday, Sept. 22; 9:30-10:45 AM
- **Exam 2:** Tuesday, Oct. 25; 9:30-10:45 AM
- **Exam 3:** Tuesday, Dec. 13; 8:00-10:30 AM

Letter grades will be assigned according to the following table:
(All calculated grades will be rounded up to the nearest 0.1%.)

88.0% to 100% inclusive	**A**
76.0% to 87.9% inclusive	**B**
63.0% to 75.9% inclusive	**C**
50.0% to 62.9% inclusive	**D**
0.0% to 49.9% inclusive	**F**

Turning in all assigned work is a necessary condition for an **A** grade

Problem set policy:
Group work and discussions prior to turning in problem sets are appropriate.

Special accommodations:
Please contact Dr. Camata for an appointment to discuss special accommodations.

Web Page: **http://www.phy.uab.edu/~rcamata/PH461-561.htm**
(Class information and grades will be posted on this web page)

Topical Outline

1. Newtonian Mechanics: Particle motion in one dimension (Text Chapter 2)
   (a) Newton's laws of motion
   (b) Constant force
   (c) Position-dependent forces
   (d) Velocity-dependent forces
   (e) Time-dependent forces

2. Oscillations (Text Chapter 3)
   (a) Harmonic motion
   (b) Damped harmonic motion
   (c) Force harmonic motion

3. Vector Analysis (Text Chapter 1)
   (a) Vector algebra
   (b) Scalar and vector products
   (c) Derivative of a vector
   (d) Cartesian, cylindrical and spherical coordinates

4. Newtonian Mechanics: Particle motion in three dimension (Text Chapter 4)
   (a) Conservative forces
   (b) Separable forces
   (c) Harmonic oscillator in three dimensions
   (d) Charge particles in electric and magnetic fields

(e) Constraints

5. Non-inertial frames of reference (Text Chapter 5)
   (a) Accelerated translation and rotation of coordinate systems
   (b) Laws of motion and the Earth's rotation
   (c) The Foucault Pendulum

6. Central forces and Celestial Mechanics (Text Chapter 6)
   (a) Gravitation
   (b) Central force problems
   (c) Scattering