

UNIVERSITY OF PUERTO RICO  
RIO PIEDRAS CAMPUS  
COLLEGE OF NATURAL SCIENCES  
DEPARTMENT OF PHYSICS  
UNDERGRADUATE PROGRAM

Title: Intermediate Mechanics I

Code: FISI 4051 section OU1

Number of Credits: 3

Prerequisites: PHYS 3172-3174

Co-requisite: FISI 4031 (Mathematical Physics I)

### **Description**

This is the first part of the Classical Mechanics course for Physics majors. It covers the fundamental principles of Newtonian mechanics: (i) Newton's laws, frames of reference, equations of motion of point particles, and the conservation theorems; (ii) Linear oscillations: the simple harmonic oscillator, damped oscillations, driven oscillations, resonances; Calculus of Variations and an introduction to Lagrange's Equations

### **Objectives**

After completing this course the student will know the fundamental axioms of classical mechanics and will be able to apply these to actual physical problems. The student will have mastered and practiced the application of simple mathematical techniques to solve problems of Classical Mechanics.

### **Course Content**

**The following material was completed in 1<sup>st</sup> Semester 2015-2016**

I... Review

- A. mathematics: related rates, maxima and minima, the exponential function.
- B.. CURVILINEAR COORDINATES Polar and cylindrical
  - First order problems
- C. Work and Energy
- D. Conservation Momentum

II.. Gravitation

- A. Newton's Calculation of Central Forces
- B. The Gravitational Field and Gravitational Potential
- C Rocket and orbital problems

### III. One dimensional Motion:

#### A frictional forces.

1. Linear drag for a spherical body in a fluid
2. Projectiles Linear and quadratic air resistance

#### B . Simple Harmonic Oscillator

- D. Damped Oscillations
- E. Driven Oscillators
- F. Resonance

### IV.. Introduction to Calculus of Variations

- A. Feynman's lecture of the Principle of Least Action
- B. The functional
- C. The Euler-Lagrange Equations and Fundamental Lemma
- D. Lagrange multipliers and calculations with Constraints

### V.. Begin with Generalized Coordinates, Momenta and Forces.

- A. Derive and begin examples of the use of Lagrange's Equations

## **Instructional Strategy**

The main instructional tool in this class is lecturing. The emphasis in this course is to introduce and train the student in solving mechanics problems using elementary mathematical methods, which are mainly based on solving differential equations arising from Newton's Laws. As such pure theoretical derivations are kept to a minimum and are only used to introduce the basic concepts. Most of the lecturing time is thus dedicated to the demonstration of solving mechanical problems. Weekly homework assignments allow the student to practice problem solving techniques discussed in class and to develop a deeper understanding of the material. Solutions of homework problems are subsequently discussed in class, where a student usually presents his/her solution.

## **Minimum Require Facilities**

Traditional Lecture Room.

## **Student Evaluation**

There were three exams for 75 points and 5 Homework Assignments for 25 points.

### **Grading System**

The overall score is determined by calculating the percentage of points obtained by the student. Grades are then assigned according to the standard curve: 100-90% = A, 89-80% = B, 79-70% = C, 69-60% = D, 59-0% = F.

### **Bibliography**

The content of this course follows Taylor's Classical Mechanics.

1. **Classical Mechanics by John R. Taylor** 2005 University Science Books  
ISBN: 13: 978-1-891389-22-1
2. Classical Mechanics by Barger & Olsson, 1995, McGraw-Hill.
3. Classical Dynamics by Marion & Thornton, 1995, Saunders College Publishing.
4. Classical Dynamics: A Contemporary Approach by J.V. Jose and E.J. Saletan, 1998, Cambridge University Press.

### **Rights of Students with Disabilities**

The University of Puerto Rico complies with all federal and state laws and regulations regarding discrimination, including "The American Disabilities Act" (ADA law) and Law 51 of the Commonwealth of Puerto Rico. Students that receive services from the Vocational Rehabilitation Office should communicate with the professor at the beginning of the semester to discuss any academic accommodation and equipment he (she) needs in accordance to the recommendations from the Office of Disable persons affairs (OAPI) from the Student Dean Office. Other students that need assistance or accommodations should communicate with the professor.