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

Title:	University Physics I
Code:	PHYS 3011
Number of Credits:	3
Co-requisite:	University Physics Lab I (PHYS 3013)
Requisite:	Calculus (MATH 3051 or equivalent)

Description

This is the first part of University Physics, which includes kinematics, Newton's Laws of Motion, Work, Energy, Momentum, Rotation, Angular Momentum, Torque, Equilibrium, Simple Harmonic Motion, Gravity and Orbital Motion, Fluids and Waves.
Esta es la primera parte del curso de Física Universitaria que comprende cinemática, leyes de Newton del movimiento, trabajo, energía, momento, rotación, momento angular, torque, equilibrio, movimiento armónico simple, gravedad y movimiento orbital, fluidos y ondas

Objectives

After the completion of this course the student will:

- Explain the basic laws of physics and their range of application.
- Apply problem solving skills in physics and other disciplines.
- Use physical intuition to guess the character of a solution without actually solving the problem.
- Translate physical concepts into mathematical language.
- Design experiments, including developing procedures for optimal data collection.
- Analyze data using relevant curve fitting and error analysis methods.
- Analyze experimental results and draw reasonable conclusions from them
- Interpret experimental data to draw meaningful conclusions from properly conducted experiments.
- Identify and use standard laboratory equipment and instrumentation.
- Apply critical thinking skills to solving problems in physics.
- Develop critical thinking and conceptual understanding of phenomena.
- Show the relationship between mathematical descriptions and the understanding of physical phenomena.
- Explain the significance of models, theories and experiments in the scientific method.
- Provide the student with sufficient background in classical physics so that they can take elective courses offered in Modern Physics for non-majors as well as related courses in meteorology and astrophysics.

Course Content

Topic	Assigned time (hours)
1. Introduction, Measurement, Estimating	3
2. Describing Motion: Kinematics in one dimension	3
3. Describing Motion: Kinematics in one dimension	3
4. Vectors	3
5. Kinematics in Two or Three Dimensions	3
6. Dynamics: Newton's Laws of Motion	3
7. Dynamics: Newton's Laws of Motion	3
8. Friction, Circular Motion, Drag Forces	3
9. Gravitation and Newton's Synthesis	3
10. Work and Energy	3
11. Conservation of Energy	3
12. Conservation of Energy	3
13. Linear Momentum	3
14. Rotational Motion	3
15. Angular Momentum	3
Total hours	45 contact hours

Instructional Strategy

The sections lecture class and laboratories are coordinated so that, although different professors give the instruction, students receive basically the same material. As well, the lecture and laboratory are coordinated with each other so that the student is introduced to the interaction between theory and experiment.

At present, one professor acts and coordinator of the lecture and the laboratory. Coordination of the lecture involves meeting periodically with the lecturers to assure that a uniform progress is made and to make adjustments in the schedule. This is necessary due to the many unexpected interruptions in the schedule with occur in Puerto Rico...Hurricanes, strikes etc. Coordination of the laboratory is a more complex situation. Most of the laboratory sections as given by Graduate Students who are Teaching Assistants. We have found that they need considerable training in how to present the material. This is accomplished by having them work through each laboratory prior to giving their class. This is done under the supervision of the coordination, once a week, in a three hours training period.

The strategy of instruction is to combine, lecture, laboratory experiment, audiovisual material, and demonstrations to convey the content of the course.

The students are assigned homework problems from the textbook to give them experience in problem solving and prepare them for the examinations.

Minimum Require Facilities

Traditional lecture room.

Student Evaluation

The lecture class has three partial departmental examinations, which consist of 16 multiple choice questions on each exam. Each question is valued 1 point, totaling 48 point.

In addition, each professor gives, during the semester a total of 12 questions in the form of QUIZZES. These are made by the individual professor and conform to the general material of the course.

Grading System

The student grade is determined by the formula begin 100 times (total points) 48 where the maximum possible points is 48 + 12 = 60. Grades are then assigned according to:

90% = A
80% = B
70% = C
60% = D
<60% = F

Two coordinated departmental exams are given in the laboratory. In addition, the laboratory section is divided into groups of two of three students. The group produced a combined report. The laboratory grade is based 70% on the laboratory reports and 30% on the exam grades.

Bibliography

Giancoli, D. C. 2008. Physics for Scientists and Engineers with Modern Physics, 4/e, Vol. I. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Rights of Students with Disabilities

UPR complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disabilities Act 1990 (ADA) and the Commonwealth of Puerto Rico Law 51. Students with disabilities will receive a reasonable accommodation for equal access to education or services at UPR.

Requirement: Learn, understand and apply the principles, concepts and methods of Classical and Modern Physics. The carefully chosen and aligned course sequence encompasses the following topics: Kinematics, Dynamics (Newton's Laws), Work, Energy, Momentum, Torque, Angular Momentum, Gravitation, Fluid Statics, Fluid Dynamics, Oscillations, Waves, Electricity and Magnetism, Circuits, Light and the Electromagnetic Spectrum, Radioactivity, Blackbody Radiation, Special Relativity, Photoelectric Effect, Bohr Atom, DeBroglie Waves, Wave-Particle Duality, Heisenbergh Uncertainty Principle, Nuclear Fission, Modern Society Energy Needs, Energy Production and Conversion Technologies, Energy Resources, Energy Cost and Demand, Environmental Impact of Energy Production.

Evidence: Classes are given in small lectures (typically 30 students) that allow and promote interaction with the professor and among peers. The first day of classes, students are provided with a detailed agenda of the topics to be covered and informed that they are expected to give a first reading to the pertinent sections(s) before coming class throughout the semester. The class time is devoted primarily to developing conceptual understanding through the presentation of challenging situations/problems/demonstrations that are solved/discussed interactively with the

participation of the students. Emphasis is given to the connections between conceptual understanding and the derived ability to efficiently and effectively approach problem solving. That is, problem-solving skills are primarily attained through conceptual understanding. The students are then required to re-read the pertinent sections(s) at home and to attempt a particular set of problems carefully chosen for their representative nature and potential for transferring into many other analogous situations. Students are expected to bring back specific difficulties encountered in their independent/collaborative problem solving. The professor gives clues/hints or a sketch of the solution, but does not go through a detailed solution until after the students attempt solving it on their own for a second time. The exams are designed to test both conceptual understanding and problem solving skills.

1.b. Know and understand major concepts and principles unifying science disciplines.

Requirement: The following unifying concepts and processes are embedded in the sequence of Physics courses taken by the students majoring in Physics Education: Change, Constancy and measurement; Evolution and Equilibrium; Evidence, Models and Explanation.

Evidence: The sequence of Physics sources extensively employs the concepts of physical variable, physical constant, and their measurement. All the topics covered employ these concepts, which are further emphasized and experienced in the corresponding laboratory activities. Moreover, deep levels of these unifying concepts are developed in Kinematics, when velocity is discussed as a change in position, and acceleration is discussed as a change in velocity (that is; a change of the change). The constancy of change is also discussed in terms of uniform velocity and uniform acceleration. Evolution and Equilibrium are discussed, for example, in the context of parachute fall, where the acceleration decreases continuously until a steady state or equilibrium (i.e., uniform velocity) is attained for the rest of the falling time. Evolution and equilibrium concepts are analogously presented in the context of collisions, fluids and waves. The concepts of evidence, models and explanation are continuously emphasized in the laboratory exercises, where the students directly submit models and theories (i.e., explanations) to empirical test.

1.c. Design, conduct and report investigations within a science discipline.

Requirement: Candidates for licensure in Physics are required to complete a full year (two semesters) of General Physics Laboratories I & II concurrently with the College Physics I & II courses. Candidates must achieve a C or better in all Laboratory courses.

Evidence: The laboratory experiences are chosen and designed in such a way that there is a healthy balance between theory corroboration experiences and inquiry-based experiences. In the corroboration experiences, the students learn to precisely follow a sequence of complex instructions that they must study and understand before coming to the laboratory. They must also show, through quizzes and/or class-wide discussion, that they understand the underlying Physics concepts and their connections to the laboratory activity to be performed. In the inquiry-based experiences, the students are guided in the performance of a laboratory activity in which they have flexibility of design and no previous knowledge of what they were supposed to obtain. For all laboratories, the students are required to write formal laboratory reports, which are graded. The laboratory activities include: Average Velocity, Acceleration, Graphs of Motion, Free Fall

Acceleration, Projectiles, Force, Newton's Second Law, Motion with Friction, Centripetal Force, Impulse, Collisions and Momentum, Rotational Motion, Moment of Inertia, Archimedes Principle, The Electric Field, Voltage, Ohm's Law, Resistors in Series and in Parallel, The Magnetic Field, Faraday's Law, The Oscilloscope, The RC Circuit.

1.d. Apply mathematics in problem-solving and scientific investigation.

Requirement: Mathematics and problem-solving are integral and fundamental throughout the sequence of six courses (14 credits) designed to cover the range of topics of the National Science Education Standards: College Physics I & II, General Physics Laboratory I & II, Elementary Modern Physics, Energy Production Technology and the Environment.

Evidence: The course exams are primarily designed to test the Mathematics and problem-solving ability of the students. Therefore, satisfactory approval of the sequence of Physics courses implies attainment of proficiency in Mathematics applied to the solution of Physics problems. The conceptual understanding that is formally taught and emphasized together with the problem-solving skills in the lectures, is expected to translate into enhanced problem-solving approaches. The students must show their calculations in the exams, otherwise they do not receive credit. There is always a challenging problem in the exams, designed to encourage the students to think one step beyond what was taught. The corresponding laboratory experiences make extensive use of Mathematics and problem-solving is emphasized as a fundamental laboratory skill. The students must show detailed calculations and the underlying rationale in the laboratory reports.