

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

Title: Intermediate Laboratory I

Code: PHYS 4076

Number of Credits: 2

Prerequisites: PHYS 3016 - Modern Physics

Co-requisites: PHYS 4049 - Electronics Laboratory

Description

This is the first semester of a one-year laboratory course on fundamental experiments in optics, atomic and modern physics for physics majors, with emphasis on concepts which form the basis for contemporary physics such as: diffraction and polarization of electromagnetic radiation, photon counting, photoelectric effect, Franck-Hertz experiment, measurements of the velocity of light. The students reproduce these and other relevant experiments in modern physics in order to gain a first-hand experience of crucial physics experiments and to deepen their conceptual understanding. Six hours per week.

Objectives

After taking this course, the students will be able:

- To recognize the connection between the mathematical formulation and the corresponding behavior of physical quantities.
- To plan and work in an organized and systematic fashion.
- To recognize the best way of collecting, recording, representing data and analyzing results.
- To draw proper conclusions based on direct experimental evidence.
- To assess the range of validity of results.
- To show the correlation of experiment to theory.
- To write a clear, informative, and logical scientific reports.
- To carry out experiments with minimal instruction.
- To use computers in the collection and analysis of experimental data

Course Content

Topic	Assigned time (hours)
1. Ray optics and the laws of refraction and reflection.	3
2. Image formation in a plane.	3

3. Cylindrical and spherical mirrors.	3
4. Image formation by lenses.	3
5. Optical instruments: the projector, the magnifier.	3
6. Optical instruments: the telescope, the compound microscope.	3
7. Dispersion and total internal reflection.	3
8. Interference.	3
9. Polarization.	3
10. Diffraction.	3
11. Single slit diffraction, general diffraction, and the diffraction grating.	3
12. The interferometer: wavelength of light.	3
13. Interference from multiple reflections.	3
14. The laser.	3
15. Optical activity, light scattering, holography.	3
Total hours	45 contact hours

Instructional Strategy

The main instructional tool in this course is hands-on laboratory experiences. The emphasis in this course is to develop skills in experimental work. The students are instructed in the main methods of proper measurement of physical quantities and of analyzing the experimental results.

Minimum Required Facilities

Laboratory room divided in cubicles (especially for optics experiments) or tables that enable independent work in small groups and in different experiments simultaneously. This room must be properly prepared with the necessary equipment and utilities for the experiments.

Student Evaluation

The grades are mainly based on practical laboratory exams where the student will independently show the ability to prepare the experiments, make them work, and to orally explain the underlying physical phenomena. Two written exams are also administered in order to test the students' ability to properly draw particular experiments and to discuss experimental results connected to the ones done in class.

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

1. E. Hecht, A. Zajac, K. Guardino, Optics, 3rd edition. Addison-Wesley Pub. Co., 1997.
2. M. Born and E. Wolf, Principles of Optics, Sixth Edition. Cambridge University Press, 1998.

3. J.W. Rohlf, Modern Physics, John Wiley and Sons, Inc., 1994.
4. R. Eisberg and R. Resnick, Quantum Physics, John Wiley and Sons, Inc., 1985.

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