PHYS 1100L/1101L: University Physics I & II Laboratory (fall and winter)

Contents

Overview

The instructors of the laboratory portion of PHYS 1100 and PHYS 1101 enjoy some autonomy in how the lab is conducted, but it is the instructor of the lecture portion of the course, hereafter the "lecturer", who is responsible for the overall course, assigns final grades to the students, and is judged by student evaluations. Therefore, the lab instructor(s) need to consult with the lecturer in how the lab is conducted, and where there is disagreement, the view of the lecturer shall prevail.

The primary aim of the laboratories is to develop the skills and tools necessary for experimental physics. Secondary aims include reinforcing physical concepts introduced in the lectures, and learning how to communicate results in a scientifically meaningful and useful fashion.

As much as is practical, labs are designed and sequenced so that the physical concepts are reviewed in the lectures before they are used in the lab.

From time to time, instructors may wish to develop new experiments to enhance the students' education, skill sets, lab experience, etc. Any new experiments should be reviewed and approved by the Curriculum Committee, in consultation with the lecturer, the physics technician, and the instructors assigned to other lab sections before being implemented.

Prerequisites

Students must be enrolled in PHYS 1100 (University Physics I) in the fall term, and PHYS 1101 (University Physics II) in the winter term. Thus, see the prerequisistes sections for those courses.

As students will come from varying backgrounds, no previous lab experience or skills are assumed. All lab techniques including safety, lab conduct and practise, data acquisition,

propogation of uncertainties, rules on plagiarism, *etc.*, should be taught as if students are seeing it for the first time.

Dependent courses

PHYS 2300L Vibrations, Waves, and Optics laboratory

> The lab skills acquired in PHYS 1100L and 1101L are the starting point for the lab associated with PHYS 2300. However, new rules for uncertainty propagation, introduction of computer analysis and graphics, and significantly higher standards for scientific writing will make PHYS 2300L seem like a very different lab from PHYS 1100L and PHYS 1101L.

Student Outcomes

Students completing the first year lab should begin to develop the following skills:

1. develop a methodical, systematic approach to gathering data
2. propagation of uncertainties using approximate "first-year method"
3. use of basic experimental equipment (*e.g.*, multimeters, frequency generators)
4. communicate scientific results, including:
   - uncertainties;
   - qualitative and quantitative discussion of results;
   - experimental methodology
   - representing data using tables and graphs
5. understand lab safety, and use of appropriate laboratory protocols

Curriculum

Following is a list of the labs in the order in which they appear in the 2008/09 version of the PHYS 1100/1101 Laboratory Manual. Labs 1–5 are done in the fall term, labs 6–10 are done in the winter term. The sequencing assures students will cover the material in class before the lab.

1. Measurement of density
2. Force-table
3. Finding g with inclined-plane air-track
4. Ballistic pendulum (momentum-conservation)

5. Shear modulus
6. Finding g with simple pendulum
7. Standing waves
8. Specific heat (calorimetry)
9. Electric field and equipotential surface mapping
10. DC currents and circuits

Suggested texts

There is just one: *PHYS 1100/1101 Laboratory Manual*, edition 2007–08, produced and sold by the Department of Astronomy and Physics, SMU.

Notes to the instructor

1. It is recommended that students *do not* use computer analysis techniques at their tables. Instead, they should learn how to generate graphs, tables and analysis by hand before these aspects of the lab are automated electronically.

   It is suggested, however, that a single computer equipped with data acquisition and analysis capabilities could be used occasionally as a demonstration tool to acquire, sort, and plot data to illustrate the benefits and point out potential pitfalls associated with the use of the computer for these activities (*e.g.*, hidden systematic uncertainties, ease of "fitting a line" even when data aren't linear or have high scatter, *etc.*).

2. Students (and TA's) should complete the Indiana University "plagiarism quiz'" at the beginning of the term to raise awareness of what constitutes plagiarism.

3. The physics technician and faculty laboratory coordinator should organise and run a beginning-of-term TA/Instructor Orientation to establish consistent lab goals, protocols, grading, and safety issues, possibly including WHMIS training.

4. The first lab (measuring the density of various objects) is deliberately simple. Students have yet to cover any real physics in class, and such a simple lab gives the lab instructor time to train students in lab safety, protocol, procedures, the use of measuring devices such as vernier calipers and micrometers, uncertainty propagation, desired format for lab reports, *etc.* Accompanying the first lab in the lab manual is a "take-home" assignment on the propagation of uncertainties, graphing, tables, *etc.*, that the instructor may use to reinforce the material covered in the first lab.

5. Labs are designed to be completed, analysed, and written up in three hours, and students should hand in lab books for grading at the end of each lab session. This helps to:

- teach students to work quickly and efficiently;
- ensure that TA and instructor are available to help students if and when they run into difficulties;
- guarantee more individual/independent work.

6. In addition to the bi-weekly in-class lab reports, the lab instructor is encouraged to include a more comprehensive task in the grading scheme roughly equal in weight to the in-class labs, such as a formal report based on one of the labs, or an end-of-the-year laboratory exam.