

# PHYS 112L Syllabus

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**Office Hours:** M–R 9:00–10:00, T–W 2:00–3:00, or by appointment.

**Required Materials:** Lab manual, Physics text, calculator, lab notebook.

**WebCT:** This class has a WebCT page at <http://webct.cofc.edu:8903>. All students will be automatically enrolled. The lab schedule and your grades will be available from this page.

**Lab Meetings:** Lab will meet Wednesdays from 4:00 to 7:00 pm in room 106 of the Science Center. You are expected to attend all labs and to participate fully in the taking and analysis of data. Each student must keep a lab notebook in which all information about a lab is recorded.

**Many labs will begin with a quiz based on the lab for the day.**

**Lab Reports:** Three times during the semester (**16 September, 14 October, and 18 November**) the notebooks will be collected and graded. When the notebooks are returned each person in your lab group will be assigned to write a formal lab report on one of the completed labs. The notebooks are collected at the end of lab Wednesday, graded and returned Friday at the start of class. The formal report is due at the beginning of lab the following Wednesday.

**Your grade in lab is determined by:**

Quizzes and “Shoot for your grade” labs	1/3	A:	90-100	C:	70-75
Lab notebook	1/3	B+:	86-89	D:	65-69
Formal lab reports	1/3	B:	80-85	F:	Below 65
		C+:	76-79		

**Schedule of Labs:**

9/2	Electrostatics-2	
9/9	Electric Fields	
9/16	DC Circuits (Bulbs)	Not in lab manual
		Notebooks turned in
9/23	Kirchhoff’s Laws	Report Due
9/30	Oscilloscope	
10/7	Magnetism-2	
10/14	Electric Motor	Notebooks turned in
10/21	RC Time Constant	Report Due
10/28	Reflection and Refraction	
11/4	Lenses	
11/11	Young’s Double Slit	
11/18	Spectroscopy	Notebooks turned in
12/2	Photoelectric Effect	Report Due

## Introduction

Physics is a science of observation and measurement of the properties of the physical world. The primary purpose of this laboratory is to provide firsthand experience in making observations and recording and analyzing data in order to gain an understanding of basic physical concepts and theories. To accomplish this purpose it will be necessary for you to gain familiarity with a variety of instruments used to make measurements and to analyze these measurements. Computers may play a significant part in the collection and analysis of the data.

## Operation of the Laboratory

The laboratory will meet at 3:00 pm on Wednesdays in room 106. Prior to lab time you are expected to have studied the material in the lab manual for the current week's lab. Many labs will begin with a quiz. Following the quiz a short explanation of the current week's lab will be presented. The actual execution of the experiment will normally be done in groups of two or three. Each person is expected to participate fully in all aspects of the experiment and to keep their own lab notebook.

## Laboratory Notebook and Good Laboratory Practice

The book in which the initial measurements are taken and in which the results are calculated and a conclusion made is called the lab notebook. The data in the lab notebook must be recorded in a permanent form and with enough explanation so that memory is not required to figure out what a set of numbers is about. The lab notebook should be written so that someone years in the future can tell what you did and what the results were. It only requires a few sentences and a few words of explanation to make the lab notebook intelligible to such a person. Try to keep this person in mind as you are recording data in your lab notebook.

It is also important to remember to write everything down in the lab notebook as it happens. Don't write information on scraps of paper to later "copy" into the lab notebook. This practice defeats one of the main purposes in keeping a lab notebook.

There are several important points to remember about working in the laboratory and keeping a lab notebook. The following are taken from Walter Pauk's *How to Study in College*.

- **Do not trust memory.** Write down everything you think may be pertinent. Some things observed in the laboratory may strike you as being so clear at the time that there seems to be no point in writing them down. But memory fades and if the experiment is not completely written up in the same period in which it is performed, you may not be able to recall important items. These may include identification and properties of the instruments, ranges and units of the scales in the meters, dimensions and schematic diagrams of apparatus, sensitivity of a balance, headings and units for columns of data, quirks of performance of equipment, need for repetition of measurements, and numerous other details.
- **Make a permanent record of observations.** Follow the practice of professional scientists in keeping a full record of your calculations, observations, and results in your laboratory notebook — don't ever write anything down on separate scraps of paper — not even your arithmetical calculations. If you make a mistake, cross them out lightly and go on from there, but keep everything as part of your complete record. Start your record of each new experiment or laboratory session on a new

page headed with the date. In this way you will have a permanent log of all your data and mental processes pertaining to any problems on which you have worked — all the materials for your final report.

- **Organize the recording of data.** Arrange them so that they will be clear and fully labeled for future reference. The few extra minutes you take to make neat and orderly records during the laboratory period will save you time that you would otherwise have to spend later in deciphering and arranging haphazard notes.
- **Do not trust yourself or the apparatus too much.** It is an unwise practice to record a lot of untested numbers, dismantle the apparatus and leave the laboratory, intending to analyze that data and deduce the result of the experiment at a later time. It is much better to carry out at least an approximate analysis (including rough graphs) of the data while they are being taken, so that you have a chance to detect anything that is going wrong in time to do something to remedy the situation — such as readjusting the apparatus, checking or repeating an observation or asking an instructor for advice or assistance.
- **Baby the apparatus.** Another skill, often invisible to those who do not possess it, is the ability to manipulate delicate apparatus and distinguish small variations in its behavior. It is sometimes amazing what consistently accurate measurements can be coaxed out of laboratory apparatus by unusually sensitive hands and eyes, or what can be seen in a microscope or telescope by some students and not by others. People are not born with such skills, rather they develop them by conscientious, loving effort.

Poor performance in a laboratory is often due to carelessness, but may also be the result of a pessimistic or uncooperative attitude: being too ready to say an apparatus doesn't work, or to accept unnecessary limitations on its capability. The trick is to regard the apparatus as your friend, not your opponent; the rest follows naturally with practice. So treat it tenderly, and coax out of it all the resolution and accuracy of which it is capable. Make notes of its limitations and the expected accuracy of the measurements. And watch the apparatus like a hawk for signs of strange behavior. No real equipment is quite like the ideal version pictured in a textbook or laboratory manual. Typically, each piece of apparatus has an individual personality.

- **Keep purpose in mind.** Try to know the purpose of the particular laboratory work in which you are engaged, which varies a great deal from case to case, and keep it in mind. Doing so can save much expenditure of useless effort and prevent overlooking the main point of the exercise.

## Formal Laboratory Reports

Three times during the semester you will be required to write a formal laboratory report. In your report you should try to explain what you were trying to do, how you did it, and what the results and conclusions were. At a minimum, your report must contain:

1. An abstract — A short summary of your objective, results, and conclusions. This should normally be no more than a paragraph.

2. Theory — This section contains any derivations which you carried out and a summary of the theoretical expectations of your experiment. You must include at least one outside reference. *The Physics Teacher*, *American Journal of Physics*, and *Scientific American* are good sources.
3. Procedure — Include the equipment used and the actual steps you took in doing the experiment.
4. Data — A record of all measurements you made in a neat and orderly fashion.
5. Calculations and Results — Show **one** example of each type of calculation needed. The end result of your experiment is put in this section.
6. Conclusions — Examine your results and summarize any conclusion you can draw (what you tried to prove is true, untrue, inconclusive). Any error analysis is put in this section.

All reports must be typed.

Mathematical formulae may be neatly written by hand (in ink) unless you have a very good scientific word processor, i.e.,  $\text{\LaTeX}$ , that can easily typeset beautiful mathematics:

$$-\frac{\hbar^2}{2m} \frac{d^2\psi}{dx^2} + V(x)\psi = E\psi$$

$$\vec{\nabla} \cdot \vec{E} = \rho / \epsilon_0, \quad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\vec{\nabla} \cdot \vec{B} = 0, \quad \vec{\nabla} \times \vec{B} = \mu_0 \vec{J} + \epsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}$$