## Intermediate Physics Lab
### PHYS 390 - Spring 2005

http://hendrix2.uoregon.edu/~dlivelyb/390/

*Updated 3/28/05*

### This page is for second-year physics students (concurrent with PHYS 353)

**Second Year Information | Blackboard Website**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Dr. Dean Livelybrooks</th>
<th>Willamette 225, 346-5855 <a href="mailto:dlivelyb@hendrix2.uoregon.edu">dlivelyb@hendrix2.uoregon.edu</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Assistants</td>
<td>Forest Patton</td>
<td><a href="mailto:forest@darkwing.uoregon.edu">forest@darkwing.uoregon.edu</a></td>
</tr>
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<td>Rodrigo Guzman</td>
<td><a href="mailto:rguzman@gladstone.uoregon.edu">rguzman@gladstone.uoregon.edu</a></td>
</tr>
<tr>
<td>Class</td>
<td>(tentative) Tuesday 9:00-9:50 Willamette 17</td>
<td></td>
</tr>
<tr>
<td>Labs</td>
<td>Sign up for lab sessions during the first week View lab roster here</td>
<td></td>
</tr>
<tr>
<td>Textbook</td>
<td>Advanced LabVIEW Labs, by John Essick Copies are on reserve at the Science Library.</td>
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</table>

### Overview

The Intermediate Physics Lab is taught along with the Foundation in Physics II sequence, which covers the topics of vibrations, waves, and statistical physics. During the Spring term we will introduce the concepts of computer-assisted data acquisition and learn the fundamentals of the LabVIEW programming environment.

In this class, basic skills in LabVIEW will be learned. These skills will be used to explore the nature of the Fast Fourier Transform, build a simple digital oscilloscope, and automate the data acquisition of other instruments. To conclude the term, students working in small groups will propose, design, and execute a lab project on a topic of their choice. Further details on the projects will be given later in the term.

### Course Learning Goals

- Computer-assisted data acquisition basics
- LabVIEW programming fundamentals
- Data sampling and Fourier analysis
- Computer instrumentation and interface methods
- Experiment design and techniques
- Technical presentation skills

### Grading
Course grades will be based on the completion of the two lab modules and the final project. The first and second lab are worth 20% and 30% respectively, while the final project is worth 50%. An optional class presentation on the topic of your final project can be used to gain an additional 5% of extra credit.

### 2nd Year Syllabus

<table>
<thead>
<tr>
<th>Week</th>
<th>Tuesday Lecture</th>
<th>Lab assignment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Mar 29)</td>
<td>Course Intro</td>
<td>Lab Signup</td>
<td>Start the LabVIEW modules on your own</td>
</tr>
<tr>
<td>2 (Apr 5)</td>
<td>No Class!</td>
<td>LabVIEW Basics</td>
<td></td>
</tr>
<tr>
<td>3 (Apr 12)</td>
<td>LabVIEW Basics</td>
<td></td>
<td>LabVIEW Modules due by 4/19 at 4PM</td>
</tr>
<tr>
<td>4 (Apr 19)</td>
<td>No Class!</td>
<td>A/D Conversion and FFT</td>
<td></td>
</tr>
<tr>
<td>5 (Apr 26)</td>
<td>A/D Conversion and FFT</td>
<td>A/D Conversion FFT Lab</td>
<td></td>
</tr>
<tr>
<td>6 (May 3)</td>
<td>Project Instruction</td>
<td></td>
<td>FFT lab due Tuesday 5/11 at 5PM</td>
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<tr>
<td>7 (May 10)</td>
<td>Project Discussion</td>
<td></td>
<td>Project Proposal due Monday 5/10 at 5PM</td>
</tr>
<tr>
<td>8 (May 17)</td>
<td>Project Help</td>
<td>Projects</td>
<td>Project Update due Monday 5/24 at 5PM</td>
</tr>
<tr>
<td>9 (May 24)</td>
<td>Project Help</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 (May 31)</td>
<td>No Class!</td>
<td></td>
<td>Project reports are due at 5PM on June 4th. Optional presentations will be arranged on Friday June 4th.</td>
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</table>

This syllabus is tentative, and is subject to change as the quarter progresses. Please check the website for the latest information.

### LabVIEW Modules

The first few weeks will be dedicated to learning the basics of the LabVIEW programming language. This essentially follows the first four chapters of the Essick book. There are a few parts which you can skip, or go over briefly, so please check the lab handout for detailed instructions. Each student should work independently and complete the assigned modules by April 19th. The modules (typically one per Essick chapter) need to be graded by a TA or the instructor for satisfactory completion by that time. **No formal lab writeups will be required for the LabVIEW modules.**

**Note:** Because we only have six workstations, you must finish your work and vacate your seat by the end of your scheduled two-hour lab period if there is another lab scheduled afterwards.

**Another Note:** You may turn in your modules during any lab session, and it is probably better to get these checked off as you complete them, rather than saving them up until the last minute.

### Term Projects

The term projects are intended to be self-directed and involve more in-depth analysis and experimentation than the other PHYS390 labs. Starting from a working hypothesis developed from theoretical considerations, you should establish a model through a process of experimentation and refinement. **No real experiment works properly the first time!** Please allow yourself enough time in planning your project to make some changes and try again.

The term projects should be pursued with a lab partner, with each person equally responsible for the planning, construction, execution, and
analysis of the lab. **Separate final reports will be due for each lab partner at the end of the term**, following roughly the same format at the regular PHYS390 lab reports. During the final week of the term, each group will have the option of making a short 10 minute presentation to the class and other interested members of the department.

The use of LabVIEW in the final project is not required, although presumably you would like to put your newly learned skills to use. You may choose any reasonable topic for your final project, pending approval, and some are much more suitable for LabVIEW data acquisition than others. The best projects will have an even mix of physics content, instrumentation, and analysis.

Students who wish to pursue particularly unique and novel projects are encouraged to discuss their plans with the instructor in advance. Specific additional equipment beyond what is available in the project labs may be available with enough advance warning.

Some ideas which may be suitable for term projects and additional information can be found here.

**Directions for using Vernier LabPro sensors with LabVIEW can be found here.**

**Lab Notebooks**

Lab notebooks should constitute an honest record of:

- the purpose of an experiment (question addressed, physics “law” tested)
- what the experiment looked like and how it was done
- diagram of setup
- notes about how to do experiment
- any data taken, both raw and analyzed or refined
- estimation of errors involved in experiment
- conclusions and speculations (if things didn’t work as planned)

**Lab Reports**

There is an art to communicating scientific findings—besides being prepared in a concise, neat, grammatically correct and organized manner, a report must contain certain specific information. The goal is to communicate what you set out to do, how you did it, what you found out and what conclusions you reached. Your report should include enough information so that a person with your level of knowledge of physics can understand what you did and duplicate the experiment.

Do not assume that the reader of your report has undertaken the experiment and knows of what you write! Try to keep complete lab reports to a maximum of 3 pages (both sides) plus figure and tables. As we grade the lab reports, we will suggest improvements in organization and grammar so that you can better learn to communicate technical information in an effective manner. Reports can be neatly written by hand. If typed or written on a computer, you need not typeset equations and the like. Diagrams of experimental apparatus can also be hand-drawn, but you should print out graphs of important data. The IBM-type PCs in 17, Willamette (the lab room) are available for you to use.

Your Lab Reports should include four parts. Here is some advice about each element.

**Abstract:** a clear and concise abstract or summary of your lab, not to exceed two short or one long paragraph(s). The abstract, which succinctly describes the experiment(s) and your findings, is to help the reader decide whether to read the report. Typically this is the last part of the report you should write.

**Introduction & Description:** This section should include:

- a paragraph (or two) discussing the science under consideration that motivates what is to follow (think big picture!).
- a statement (in words as well as equations) of the theory and critical physics parameters under consideration (e.g., relationships governing motion of pendulum, words about the mass of the pendulum and whether it is important).
- figures depicting how those parameters act on the body/bodies under study (e.g., force diagrams)
- a brief introduction to the experiment
- labeled drawings of the experimental apparatus.

The idea is to provide enough information so that another physics undergraduate could replicate the experiment. It is important to label all elements of figures and drawings.

**Analysis:** This section should be organized around each of the experimental goals. For each goal, then:

- start with any predictions you make as part of the lab.
- expoit, with writing and equations, how your experiment relates to each experiment goal.
- include and refer to graphs giving experimental data and their errors.
• include a brief explanations about how error was estimated/calculated for each experiment goal.
• analysis of results should speak clearly to whether the stated hypotheses were, indeed, confirmed.

Analysis sections without cogent explanations involving words will result in the deduction of points. In other words, don't just hand in a massive sprawl of equations.

Summary: a summary section listing the physics principles addressed by your investigation(s), the results of your investigation(s), any procedural problems you encountered and how you solved them, and a short statement giving your impression of the lab.

Each report will be graded according to the clarity and conciseness of the writing, the organization and thought put into describing the experiment and assumptions made, the quality and pertinence of diagrams, and the appropriateness and correctness of the interpretation and analysis as presented in the last two sections.

A final word. The challenge of experimentation is to remain both organized and on task on one hand, and to be creatively playing with science on the other. The Intermediate Physics Labs are intended to be both challenging and fun, and have been designed to provide you with further insight into the material you will be/have been studying in the Foundations of Physics II course. As budding experimentalists, you are now are colleagues. Please let us know what you think!
Intermediate Physics Lab

PHYS 390 - Spring 2005
Lab Schedule

Updated Thursday, March 31, 2005

The following shows the best match of student request to available lab times. Please contact me if you are not assigned a lab session, or this time really will not work for you.

W2-4 | W4-6 | H1-3 | H3-5 | F2-4

Please note: The TA is only guaranteed to be present during the first hour of the scheduled lab session. Labs will be held in Willamette 17, which is accessible at any time by key-code. See Jani in the Physics office to get a code. You are encouraged to develop your labs on your own whenever you wish.

Wednesday 2 - 4 PM

TA: Livelybrooks
  - Michelle Deveny
  - Andrew Chastain

Wednesday 4 - 6 PM

TA: Forest Patton
  - Lance Storm
  - Autumn von Flotow
  - Rob Prime

Thursday 1 PM - 3 PM

TA: TBA
  - Jeanine Amacher
  - Hal Cambier

Thursday 3 - 5 PM

TA: TBA
  - Randy Sexton
  - Emily Miller
  - Matt Ritter
  - Ritter

Friday 2 - 4 PM

TA: TBA