Physics 270 Spring 2014

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Lecture: Moulton 309 Tuesdays 2:00-3:50 PM
Lab: Moulton 303 Thursdays 2:00 - 4:50 PM

Learning Goals

The purpose of this course is to train you to be a professional scientist. The specific things for you to learn are:

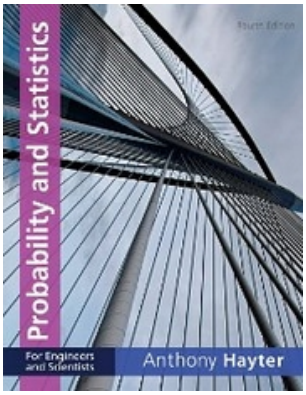
- careful planning and execution of experiments
- creative approaches to examining physical phenomena
- understanding the capability and limitations of a variety of scientific instruments
- data acquisition and analysis using computers
- error analysis and statistical analysis of data
- journal-quality scientific reporting

Required Items

Notebooks:

Students must maintain a lab notebook with the pages numbered consecutively. Lab notebooks will be collected and graded twice during the semester.

Class notes should be taken and kept in a separate notebook.



Textbook:

Probability and Statistics for Engineers and Scientists, 4th edition (ISBN 9781111827045)
by Anthony Hayter

The publisher has arranged a **special deal** for us $140 for the textbook, instead of the $277 list price. To get this price, you must order through the following website:
http://www.cengagebrain.com/micro/978-1111-82704-5

Attendance

Time in this course is expected to strongly affect your growth as a professional physicist. Therefore, attending both lecture and lab sessions is incredibly important. If you must be absent, please contact Dr. Marx for information on what you missed and be sure to get all information from your group.

Homework

Learning the material in this course requires you to practice it. For homework assignments that involve calculations, you are expected to submit well organized solutions that show all equations used, mathematical manipulations, and proper units. If you write a computer program or a Mathematica workbook, you are to submit a copy to your instructor when you turn in your assignment.

Working in Groups

Students will work in small, assigned groups. The assignments and schedule will be given to students during the first or second week of class.

Each student is responsible for his/her own work. The data collected by each group will be shared, but each student must prepare a unique report, including original graphs produced separately by each student for their report. Anyone copying work from someone else may receive a zero for the report or be asked to submit a new report.

No late reports will be accepted without prior approval from Dr. Marx.

Lab Report Requirements and Grading

Preparation

Students must read the experiment description (see Resources & Materials) and be knowledgeable with respect to any assigned readings before coming to class to begin

the experiment. You may also want to read about the physics behind these experiments by consulting various other textbooks and online resources.

Record Keeping

All students must have a lab notebook in which all notes and experimental data, including graphs and tables, will be kept. A notebook that has both vertical and horizontal lines (like graph paper) is preferred, but not required. A loose-leaf notebook is unacceptable. This notebook should be kept such that anyone could open it and understand what is written there. The notebook will be used to prepare your final report for each experiment. The best way to produce a good final report is to have everything you need readily available in your lab notebook. The notebook should contain the original data, analyses that support the results, uncertainties, tables, figures, and calculations. Work done in spreadsheets and/or plotting/fitting programs should be documented with descriptions of the calculations performed. Any circuit diagrams should be those actually used in the experiment. The notebooks will be graded after the first experiment and again at the end of the semester.

The notebook is not a place to scribble or doodle. It should be professional looking.

The pages of the notebook should be consecutively numbered. Use page 1 for a table of contents, writing the name of the experiment and the page number on which it begins. All information should be written in ink. No pages should be removed at any time. Indicate mistakes with a single line through the incorrect material. Any additions, such as graphs, data sets, etc. should be taped in, so that they will be a permanent addition to the notebook.

On the first page for each experiment, indicate the date and the names of persons involved in the experiment. On subsequent days, indicate the date before proceeding to write new information.

When making notes on measurements, properly label the measurement and record numbers with the correct number of significant digits and correct units. Define quantities before they are used. When using equations, perform all algebraic manipulations before inserting the values of the parameters.

Tables should present the data in logical order. If you get a printout from Excel or other program, the cells should be formatted to give the proper precision of the measurements (for example, 1.500 should not be tabulated as 1.5 and 2.97 should not show up as 2.69581043).

Final Reports

For each experiment, there will be a final report that follows the kind of format you might find in manuscripts submitted to a peer-reviewed physics journal. The reports must be prepared using a word processor capable of creating quality scientific equations (such as the equation editor in MS Word). Reports should be single-spaced. The sentences should be grammatically correct and spelling should be checked. The format should be that specified in the American Institute for Physics Style Manual at

http://www.aip.org/pubservs/style/4thed/toc.html

The **title** should match that of the experiment performed and the list of the persons that performed it should be indicated. Your name should appear first on that list as writer of the report.

The text should contain an **Abstract**, a paragraph that gives a short description of the experiment, the reasons for performing it, a short description of the results, and a short conclusion.

The next part of the report is the **Theory** or **Introduction** section. The descriptions in the experimental procedure documents have a detailed theory section. You do not need to reproduce this, but simply put in enough of a description of the theory behind the experiment that anyone reading your report will have a sufficient theoretical basis for understanding the experiment**.** ***All equations should be centered on the line and written using the equation editor in MS Word. If you use an equation number, the number is placed in parentheses and is justified to the right margin.***

The next part of the report will be a description of the **Experimental Procedures** and the equipment used. Again, since the lab description has this in detail, simply describe the equipment, include any wiring diagrams. Also, include any important information that is assumed in the experiment. When including drawings of the apparatus or circuit diagrams, these can be hand drawn. Do not write this section like a cookbook as to the procedures to follow or were followed. Remember: ***You are telling a story about the experiment, not telling someone step by step what to do.***

If the procedure calls for simple measurements, give the results in this section when you are describing the procedure. For example, if the procedure calls for making a length measurement, give the result along with the uncertainty. Describe fully how the measurement was made and determined.

For figures, include a figure number and a description of the figure (figure caption) above the figure. Use italicized font for the figure number and description. My preference is that the figure description be in complete sentences that describe the important features of the figure. There should be at least one blank line above and below the figure.

Numbers written in scientific notation should be in the proper format. Example: 1.23 mm = 1.23×10^{-3} m. Note: the real multiplication sign and a real minus sign **must** be used. Both of these symbols are available in Word using the Symbol palette. Do not use the equation editor to insert scientific notation. All equations should be rendered using the equation editor. If you need assistance on this or any other functionality of Word or Excel, ask Dr. Marx.

The next section is **Results and Discussion**. Here, you present the results and analysis of your experiment in a logical manner. It is important to tell a story about the results. Do not start this section with a figure or tables, rather use text to provide some introductory words or a description of the results found in figures and tables. If possible, the described figure or table should immediately follow the paragraph in which it is described.

You should also present any discussion of uncertainties, error analysis, experimental limitations, etc. When estimating random and systematic errors, explain the process by which you arrived at your conclusions. When appropriate, compare your results with expected values and discuss any differences. When describing differences between experimental and expected values, it isn't good enough to just say "The error was large and probably due to human error." I expect a much more careful analysis of the source of errors and how one might reduce them. Practice using the data handling techniques given in in the data handling section. ***Any discussion of error should be quantitative with values that are supported by observations, measurements, and/or calculations.***

Graphs/plots should have labeled axes with proper units and have a legend. You should include the figure description information as described above, along with the figure number. Errors bars should be included when available. Justify your choice of plot or curve fitting (for example, "As shown in Equation 4, the voltage *V* is expected to decay exponentially with time. Therefore, the data is plotted as log *V* versus time *t* to obtain a straight line."). If a curve fit has been used, include the fitting function on the graph along with any parameters and their associated uncertainties. In your final report, discuss the quality of the fit to the experimental data. If you do use a fitting function, explain why that particular function was used. Unless there is a reason to perform some type of fitting, simply plot the data points with error bars, if appropriate. Graphs must be made in an appropriate scientific graphing program. Graphs made in Microsoft Excel are unacceptable.

Next, you will write your **Conclusions**. In this section, reiterate the purposes of the experiment, summarize the results and discussion, and make recommendations for improvements that may be made to the experimental procedure or apparatus, whenever possible.

References - any book, article, or website that is quoted or from which information has been extracted, must be indicated in a references section. Please use the standard

methods for references indicated in the AIP style manual.

Questions - Be sure that any questions in the lab description have been answered either within the text of your report or in a separate section after the references section.

Reports must be your own work. The text should be your own words. **Members within a group may not share text, graphs or data tables.** All text and drawings must be the work of the author. **Plagiarism will not be tolerated and may result in a zero grade for any or all of the parties involved.** See these websites for information on this important topic.

http://owl.english.purdue.edu/owl/resource/589/01/

http://english.illinoisstate.edu/rlbroad/archive/teaching/plagiarism.htm

ISU academic dishonesty policies...
http://deanofstudents.illinoisstate.edu/students/get-help/crr/academic-dishonesty.shtml

Language

Traditionally, scientific writing uses the *past tense* and a *passive voice* to describe experimental activity. I prefer that you use that style. Therefore, avoid using first person words, such as "I," "my," "me," "our," and "we." There are some exceptions to this, but try to maintain formal usage of English as much as possible. See the discussion of this in the AIP Manual. Also, because the audience for published literature is international, the writing should be formal, use proper technical terms, and avoid slang. Sentences should be constructed so that they will not have multiple meanings – simplicity is best.

Proofread your report before turning it in. If possible, ask someone else to proofread it as well. You might even try reading it out loud, because it's a good way to spot problems because you'll know when something doesn't sound right.

Lab Report Grading

To encourage students to follow journal quality lab report writing and reporting, the following rubric has been devised to evaluate your lab reports. The rubric is set up on an 85 point scale. You may receive up to 15 additional points for showing enthusiasm for the subject matter by using a creative means of analysis, correct additional analyses, or performed additional experimentation beyond that indicated in the lab manual.

The rubric is at the following URL:

http://www.phy.ilstu.edu/~marx/ph270/Report_Rubric.pdf

Lab Safety

Laboratory safety depends primarily on everyone exercising both caution and common sense to the hazards that exist. Cell phones should be turned off during lab periods. See the class website for specific safety information.

Lab Equipment

Laboratory equipment is often difficult to replace or repair. Please exercise care and caution when making electrical connections, adjusting voltages and currents, handling optical components, etc. Any equipment failures/breakages should be reported immediately, so the matter can be fixed as soon as possible.

Grade Components & Scale

Grades will be recorded in the ReggieNet grade book. You can check there to keep updated on your progress. Please check to make sure that all grades are entered

Grading Components:	
Homework	20 %
Tests	20 %
Lab Reports	40 %
Lab Notebooks	5 %
Final Exam	10 %
Class Participation	5 %

Grading Scale (subject to change):	
86 – 100	A
76 – 84	B
66 – 74	C
56 – 64	D
< 56	F