PHYS 310
Experimental Physics
Fall 2013

Martin Ligare, Olin 154, 7-1213, mligare@bucknell.edu
Michele Thornley, Olin 164, 7-3174, m.thornley@bucknell.edu

Text

Measurements and their Uncertainties: A Practical Guide to Modern Error Analysis, by Ifan Hughes and Thomas Hase, (Oxford University Press)

Course Website

http://www.eg.bucknell.edu/physics/ph310/

Synopsis

PHYS 310 is an upper-level course designed to give you in-depth experience with advanced laboratory and computational techniques. The experimental work that you will do in this class will differ from the laboratory exercises you completed in lower-level physics courses; the experiments you conduct in this class will be less stringently prescribed, and you will have more freedom to design and modify your experimental method to improve the quality of your results. It is a primary goal of this course to provide you with an experience that more closely mimics the kind of experimentation that takes place in academic and industrial research labs, within the limits imposed by time constraints and course structure. In addition to more independent experiments, there will be a strong emphasis throughout the course on *documentation* of your experimental work and *presentation* of the results, in both oral and written form.

Course Structure

We will meet every Tuesday and Thursday from 1–4 pm. During the semester you will complete five projects, each sponsored by one of the faculty instructors and lasting two to three weeks. While some of the work required for each of these experiments will be completed during the Tuesday/Thursday class periods, you will need to devote additional time outside of class to finish the experiments, complete your analysis, and work on assigned homework problems.

While the majority of our scheduled time will be spent in the labs, we will also have regular class activities in the first hour discussing various research skills; topics will include errors and uncertainties in measured data, the writing of scientific papers, delivering scientific talks, and other research skills. Most Thursdays we will spend the first hour together in Olin 264, and each group will give an oral progress report on the previous week's activities. The reports will provide you with an opportunity to explain your projects and what you have been doing, and to receive feedback from your peers on problems that you encountered. These reports will also help you to develop the oral presentation skills that will prove to be important in your life beyond Bucknell. On the last Tuesday of the semester each of you will deliver a longer and more formal individual presentation of one of your projects.

Written Work

An essential component of research science is documentation of the experimental and computational work. Every successful researcher maintains a laboratory notebook in which (s)he writes everything in detail, including comments about the results and direction of the project. We will emphasize the use of laboratory notebooks in this course and a significant portion of your grade for each project will be based on how well you document your work in your notebook (see Lab Notebook handout). A good lab notebook will also be extremely valuable as you write your papers and prepare your oral presentations.

Effective communication of research results is an essential component of experimental work; after all, what is the value of your new result if nobody knows about it or can understand what you've done? You will practice informal communication of your work during the weekly oral progress reports. For two of the projects you will communicate your work more formally by writing papers in the style of a scientific journal publication describing the project, the results, and the main conclusions. For each paper we will dedicate substantial class time to work with you on outlines and drafts, and to help you communicate your results effectively and concisely.

For each paper you will be required to hand in a complete draft of the paper, on which you will receive feedback that can be used to improve the paper. (20% of your grade on the paper will be based on the effort you put into your initial submitted draft.) You will then have a week to revise the paper before submitting your final version. Each paper will be an individual effort; while you and your partners will share experiences, data, and analysis, each of you will construct your own articulation of your project.

Seminar Attendance

As part of this course you will be required to attend and report on any four of our department's coffee talks; the talk schedule will be publicized widely.

Your seminar reports should be a few paragraphs in length and should (a) summarize the talk (what is the subject of talk, what techniques are used to investigate the subject, what are the main results); and (b) give your impressions of the talk (Did you find the talk interesting? Was the delivery effective? Did it connect to things you have learned in any of your classes? Do you have more questions about the subject of the talk?,etc.). We will grade your seminar reports mostly based on effort — if it is clear that you paid attention to the talk and made a strong effort to write a reasonable report of the talk, then you'll do fine.

Grading

5 Labs @ 100 points each (including quality of lab work, participation, oral reports, and notebooks):	500 points
2 Papers @ 100 points each (20% based on drafts):	200 points
Final Presentation:	60 points
4 Seminar Reports @ 10 points each:	40 points
Homework:	100 points
Total	900 points

Note: In order to pass the course, you must satisfactorily complete all 5 labs and both papers (with drafts), maintain a lab notebook, and make a final oral presentation.

Bucknell Honor Code

As a student and citizen of the Bucknell University community:

1. I will not lie, cheat, or steal in my academic endeavors.
2. I will forthrightly oppose each and every instance of academic dishonesty.
3. I will let my conscience guide my decision to communicate directly with any person or persons I believe to have been dishonest in academic work.
4. I will let my conscience guide my decision on reporting breaches of academic integrity to the appropriate faculty or deans.

Learning Goals

Students completing the course will

- demonstrate proficiency in the methods of scientific inquiry in laboratory projects, and
- present well-organized, logical and scientifically sound oral and written scientific reports

as called for in our department learning objectives.

University Expectations for Academic Engagement

Courses at Bucknell that receive one unit of academic credit have a minimum expectation of 12 hours per week of student academic engagement. Student academic engagement includes both the hours of direct faculty instruction (or its equivalent) and the hours spent on out of class student work. Half and quarter unit courses at Bucknell should have proportionate expectations for student engagement.