Physics 441/841
Experimental Physics I
Fall 2015

Meeting Time

12:30-1:20 PM M, JH 247 (Lecture)
1:30-4:20 PM M or 12:30-3:20 PM T, JH 233 (Laboratory)

Instructor

Ken Bloom, JH 258E, 472-6093, kenbloom@unl.edu
Office Hours: By appointment (or by chance)

Prerequisites

Physics 213, 223 and 231, or permission of instructor

Course Objectives

1) Develop skills and practices needed for work in experimental physics.
2) Gain some understanding of what is involved in making measurements.
3) Develop written and oral communication skills for the presentation of scientific work.
4) Provide hands-on experience with phenomena and principles of physics through laboratory work.

Reference texts

Useful texts, many of which can be found in the QC33 section of the library, include:

Melissinos, *Experiments in Modern Physics*
Squires, *Practical Physics*
Monk, *Light: Principles and Experiments*
Young, *Statistical Treatment of Experimental Data*
Barlow, *Statistics*

There are also some useful texts and manuals in the lab room; these must remain there, except for the copying of brief excerpts.

Format

There is one lecture session each week, to discuss experimental techniques and procedures, and background information for the experiments. Some lectures may cover material not directly related to the lab experiments, for your edification.

There is one three-hour laboratory session each week. (Additional hours can be scheduled if needed, upon request.) During this time you will work on a series of experiments, typically in groups of two students. These experiments will require multiple laboratory sessions to complete, and require more in-depth understanding analysis than the typical 200-level laboratory.

The Experiments
Everyone will do the Thin Lenses and Computer Interfacing experiments, as early in the course as possible. The remaining experiments will depend on what is working well and what student interests are; favorites include the Milliken Oil-Drop experiment, Faraday Rotation, and the Geiger-Mueller Tube/Complex Radioactive Decay. This year we have a new Torsional Oscillator setup and perhaps we'll get the Muon Physics apparatus working. Students are expected to complete at least four experiments.

Lab Reports
A written lab report will be required for each experiment completed; they are the primary output of your work. See the accompanying handouts for details on these reports. You must write your own lab report, even though you will be working with someone else in the laboratory. Lab reports will be due in class on the Monday two weeks after the experimental work is completed; late reports will be marked down by one grade per school day late. You are entitled to re-write *one* report this semester if you are unhappy with the grade; the new grade will replace the original one, and any pre-existing late penalties will still apply. You must consult the instructor within a week of getting the original grade to exercise this option.

Lab Notebooks
You must use a bound laboratory notebook to record all data taken in the laboratory. Do not record data on loose paper and copy it later! It is also best to perform much of your data analysis, and to make some rough plots, in this notebook while you are in the lab. It is best to have a notebook with "graph paper" pages, which make it easier to draw plots and make tables. A printer is available in the lab if you wish to make plots on a computer and paste them into your notebook. See the accompanying handout for details on lab notebooks. At the end of the course, you will turn in your notebook, which will be graded as a component of your final grade.

Oral Presentation
At the end of the term, you will give a ten-minute oral presentation on an experiment of your choosing from the course. You will want to have appropriate visual illustrations for your presentation. Keep in mind that an oral presentation has different characteristics than a written lab report. We will attempt to schedule all of these presentations for the final week of classes, December 7-11.

Course Grade
You may complete as many labs and write as many reports as you wish. Your *four* best lab reports will each count equally towards your grade. The grade for your lab notebook will be equivalent to one lab report, and the grade on your oral presentation will be equivalent to one lab report. Your general preparation and comportment in the laboratory will have some lesser weight in the grade. There will also be a few short homework assignments on some of the statistical techniques we discuss in lecture; these are graded pass/fail, and you must pass all of them to pass the course.

Tentative Lecture Schedule

August 24: Introduction, logistics, significant figures
August 31: Introductory statistics – mean and variance, central limit theorem
September 7: Labor Day, no class
September 14: Propagating uncertainties, optimizing measurements [will be rescheduled]
September 21: Systematic uncertainties
September 28: Straight-line fitting [might be rescheduled]
October 5: Probability distributions
October 12: What is probability? [will be rescheduled]
October 19: Fall break, no class
October 26: Confidence levels
November 2: Needles in haystacks?
November 9: Particles and their interactions
November 16: Tracking detectors
November 23: Calorimetry, all-purpose detectors
November 30: Professional ethics
December 7: Oral presentations

Academic Integrity
Refer to the Student Code of Conduct and Academic Integrity, which can be found at http://stuafs.unl.edu/ja/code/. The first violation of the code will result in at least a failing grade for the assignment and notification of university officials. Further action may be taken. Subsequent violations will result in failure for the course, along with notification of university officials. To avoid situations of cheating, plagiarism or academic dishonesty, contact the instructor in advance if a course-related issue is unclear.

Students with Disabilities
Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

ACE Certification
This course satisfies ACE 10; on the next page is the boilerplate information required in the syllabus, but note that the actual course grade fractions are not as given there.

ACE Certification for PHYS 441 and 442
(i) the ACE Outcome(s) for which the course is certified

Student Learning Objective 10: Generate a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.

(ii) the opportunities the course will give students to acquire the knowledge or skills necessary to achieve the Learning Outcome(s)

The students are required to plan, execute, analyze, and report on a series of laboratory experiments that illustrate both key principles of physics and the practice of laboratory research. The creative scholarly product is the complete process from planning through reporting and is evaluated as such by the instructor(s). This process teaches the following skills. 1) Develop skills and practices needed for work in experimental physics. 2) Gain some understanding of what is involved in making measurements. 3) Develop written and oral communication skills for the presentation of scientific work. 4) Provide hands-on experience with phenomena and principles of physics through laboratory work. The process requires the development and application of broad knowledge and information collection in both the planning and reporting activities, development and demonstration of appropriate technical proficiency in the execution, and finally, interpretation, synthesis, and reflection in the analysis and reporting of their results.

(iii) the graded assignments which the instructor(s) will use to assess the student' achievement of the Outcome(s).

Student achievement will be assessed from the quality of the student's preparation for and conduct of the laboratory work (10%), weekly laboratory notebook records (15%), four written experiment reports (60%) and an oral presentation on one of the experiments (15%). The students will receive timely written and or oral feedback on each graded component.