

West Chester University
Department of Physics
Physics 320 – Intermediate Lab II

Meeting Times: MWF 3:00 - 5:45 pm
Meeting Place: Merion Science Center 116
Instructor: Jeffrey J. Sudol (Dr. Jeff)
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Office Hours: M1-2, T3-4, W1-2, F1-3

Course Description

Physics 320 is a continuation of Physics 310.

Required Course Materials

- ✓ *An Introduction to Error Analysis*, 2nd edition, Taylor.
- ✓ A "Laboratory Notebook" from the BookFactory (soft cover, blue, 162 pages, quadrille ruled paper).
- ✓ A scientific calculator.

Attendance Policy

Attendance is required.

Website

This course has a D2L website associated with it. I will post all course documents on the D2L website. I will also regularly post announcements on the D2L website, so please check the website frequently for updates.

Course Goals

1. The student will become adept at using a wide range of experimental tools and measurement techniques common in the modern physics laboratory.
2. The student will advance his or her ability to work independently to conduct experiments in a laboratory environment.
3. The student will become adept at using a wide range of statistical tools to estimate or determine the uncertainties in measured quantities and to calculate the uncertainty in the final result of an experiment.
4. The student will advance his or her ability to communicate the design of an experiment and the results of that experiment in writing, through formal research papers, and in person, through research presentations.

The Experiments

The Department has purchased the equipment necessary for you to perform the experiments listed below. You must conduct five of these experiments during the semester, but no more than three from List A and at least two from List B. You may not repeat any experiment that you conducted in PHY 310.

List A

The Charge-to-Mass Ratio of the Electron
The Fundamental Unit of Electric Charge (The Millikan Oil Drop Experiment)
Planck's Constant (The Photoelectric Effect)
The Gravitational Constant (The Cavendish Experiment)
Avagadro's Number (X-ray Diffraction)
The Franck-Hertz Experiment (The Quantization of Bound Electron Energy States)
The Half-Life of a Radionuclide¹
The Index of Refraction of Air²

List B

Electron Spin Resonance and the g Factor
Nuclear Magnetic Resonance Spectra
The Hall Effect
The Zeeman Effect
Nuclear Spectroscopy of Materials¹

¹This experiment requires training in the safe handling of radioactive materials.

²This experiment requires an Excel spreadsheet maintained by Dr. Sudol.

The Laboratory Notebook

You will maintain a laboratory notebook during this course. I am operating under the assumption that you know how to document an experiment in a laboratory notebook from previous course work. If you are uncertain about your abilities to accurately document an experiment, please discuss the matter with me as soon as possible.

Course Schedule

Over the course of the semester, your task is to conduct at least five experiments, write and submit formal reports on four of those experiments, and prepare and present one research talk on one of the experiments not documented in a formal report.

Deadlines

Paper #1 is due no later than 5:00 pm on Friday, February 14.

Paper #2 is due not later than 5:00 pm on Friday, March 7.

Paper #3 is due no later than 5:00 pm on Friday, March 28.

Presentations begin Wednesday, April 9 and continue through April 30. Presentation time slots will be randomly assigned.

Paper #4 is due no later than 5:00 pm on Friday, May 2.

Scheduling and Conducting Experiments

You are entirely on your own recognizance to complete five experiments. You may work alone or form working groups of no more than three students to conduct experiments. You must make arrangements with the other students in the class so that no conflicts occur with regard to the use of the equipment or the laboratory space. You must keep the laboratory space in good working order at all times. If, at any time, I find that an apparatus presents a safety hazard, I will lock everyone out of the laboratory until the perpetrator removes the hazard. At the end of the semester, if I find that all of the laboratory equipment has not been properly returned to storage, I will withhold all grades until the laboratory is clean and all equipment is properly stored.

Please report broken or missing equipment immediately to both me and Dr. Sawyer (wsawyer@wcupa.edu). Equipment will break. You should always think ahead and do your best to prevent damage to the equipment, but accidents do occasionally happen and things do fall apart. If you broke something, be honest about it. In fact, record what happened. How did it break? We can all learn from the experience. Moreover, other students need to conduct these experiments, so we need to replace the equipment promptly so that everyone in the class can conduct experiments successfully.

Please also report depleted perishable supplies that need to be restocked, such as latex gloves and radioactive sources.

Submitting Draft Reviews

For the first three research papers, I will offer draft review. You must schedule a time to meet with me for draft review. The schedule of times that I will be available each week for draft review will be posted on my door. Although I use the word draft, I expect a complete paper ready for submission for a grade (see **Research Papers** below). If the paper is not ready for submission, I will not review it. I will spend no more than 30 minutes commenting on the paper. If the draft is in bad shape, this will leave you with an incomplete review, so it behooves you to prepare a good draft.

Assessment

Your "grade" in this course will be based on your performance in the following categories of assessment with the following weights.

- (4) Research Papers 20% each
- (1) Research Presentation 20%

This semester, I will assign each paper and presentation a letter grade of A, B, C, D, or F, based on my professional judgment. I will not be using a scoring rubric (as in PHY 310).

I reserve the right to introduce different forms of assessment as needed and to alter the weight of each of the categories of assessment in the event of some unforeseen circumstance.

Note that I am not the sole judge of your performance. During the research presentations, other faculty in the department will evaluate your work and submit their evaluations to me for consideration.

As in the previous semester, I will provide up to one hour of written commentary on the paper to help you improve in both your approach to conducting experiments and reporting on them, except on the final paper.

Automatic Failure

I will automatically assign a grade of an F and stop reviewing a paper under the following conditions.

1. The paper contains a sentence fragment.
2. The paper contains at least three spelling errors.
3. The paper fails to adhere to the formatting standards for this course.
4. The paper includes diagrams that are difficult to read or not properly cited.
5. The paper contains no references from peer-reviewed journals.

Written Commentary on Papers

The written commentary that I provide you on your papers is for you and you only. You may not share my commentary on your papers with other students in this class. You may, however, consult with one another. That's fine. In fact, I encourage it. Scientists often consult with other scientists who have performed similar experiments to gain from their experience. Scientists often send drafts of their papers to their colleagues for commentary before submitting them for publication, too. The spirit of this rule is one of cooperation, not imitation.

Research Papers

The research papers that you submit must conform to the standards presented in the *Physical Review Style and Notation Guide*. I will post a copy of those standards on D2L as well as one or two publications that exemplify the standards. I will also post a copy of the *American Institute of Physics Style Manual*, 4th edition, on D2L as a supplement to the *Physical Review Style and Notation Guide*.

The notable exception to these standards is that you are not preparing a paper that will be typeset by a publisher and published in a journal. Professional journals ask for each table and figure to appear on a separate page, or, in some cases, to be submitted as separate files, so that the tables and figures can be typeset into the journal. You are not publishing in a journal, so, instead, embed your tables and figures into your research paper rather than placing them on separate pages. In other words, you should prepare a paper that has the look and feel of the "final product" that would appear in a journal.

Research Presentations

Toward the end of the semester, you will give a talk describing one of your experiments and its result to an audience of your peers and professional scientists (notably, the faculty of the Department of Physics). The experiment on which you give the talk must be different from one of the four experiments for which you have written or will write a paper. Your talk is limited to 15 minutes in a 20 minute time slot, leaving 5 minutes for questions. Members of the audience may interrupt you at any time during the presentation to ask questions.

Disability Statement

If you require special accommodations because of a disability, please meet with me as soon as possible to discuss your needs. Supporting documentation is required.

Academic Integrity Statement

If you commit a violation of academic integrity, you will receive zero credit for the entire course. This is not negotiable. For more information regarding violations of academic integrity, consult the Undergraduate Catalog.

Intellectual Property

All of the course materials are either my intellectual property or the intellectual property of another author. Your use of these materials is restricted to your own studies for the duration of this course. It is a violation of Federal Law for you to distribute copies of these materials to anyone in any format at any time.

Electronic Equipment in the Classroom (Unplug)

I do not permit the use of cell phones, cameras, voice recorders, computers, or similar electronic equipment in the classroom unless you need to use such a device to accommodate for a disability, in which case you should schedule a meeting with me to discuss the use of the device as soon as possible. The spirit of the rule is that the classroom should be an electronic free zone where we tune out the distractions of the world and focus on learning physics. The classroom is a place of dialogue, and the electronic gadgets of our modern culture are not necessary for that dialogue to take place.