

Intermediate Physics Laboratory

PHYS 3304

Draft Version 0.0

Fall 2011, Science Building

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Office Hours: Tue-Thu 2:00-5:00 PM or by appointment, SC039.

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Course Textbook: I have prepared a draft of a book for this course and we will use these notes to guide our work. There will be updates and correction to these notes as we go along. There are several reference books we will also make use of for this course. You need not purchase them and copies will be available in the lab.

1. Taylor, John, *An Introduction to Error Analyses*, 2nd Edition, University Science Books, 1997.
2. Knoll, Glenn F., *Radiation Detection and Measurements*, 2nd edition, John Wiley and Sons, 1989.
3. Leo, W. R., *Techniques for Nuclear and Particle Physics Experiments*, Springer-Verlag, 1987.
4. Lyons, Louis, *Statistics for Nuclear and Particle Physicists*, Cambridge University Press, 1992.
5. Melissinos, A. *Experiments in Modern Physics*, Academic Press, Second Edition, 2003.

Topics covered: Some experiments will draw upon your knowledge gained in lecture courses and some will require learning anew. The data/error analysis is especially important and we will revisit various aspects throughout the course as we perform experiments. Several experiments in condensed matter, electromagnetism, nuclear and particle physics are on the list. In the Notes that I will distribute, there is a discussion of each topic and a set of questions that follow each experiment. Each of you must perform the experiments and answer these questions in the **e**log (<http://pollux.phys.ttu.edu>). This **e**log is our central documentation. The exact schedule for each experiment will be made in the first week of the course. The experiments are in several different rooms in Science Building.

Requirements:

1. **Logbook:** Each student will keep his/her work in **e**log. All work, description of equipment, measurements, calculations, analyses, plots, *etc* will be contained here (including the answers to questions at the end of each experiment). The instructor will check your **e**log entries frequently.
2. **Attendance:** Attendance is required. You will also need to work in the lab outside class hours.
3. **Exam and Final Grade:** There will be an individual oral final exam (25% of the total grade). 50% will be based on the grading of the **e**log entries. The remaining 25% will be based on the analyses of a particular experiment, chosen in consultation with the instructor. This will be written as a formal

scientific paper (APS Revtex format) and may include a proposal for Senior Thesis. The final grading metric is 100-85:A, 85-70:B, 70-55:C, 55-40:D and 40-0:F.

Outcome and Assessment: Understanding of modern physics phenomena at a deeper level by conducting experiments to reinforce physics concepts; appreciating the tasks of an experimental scientist where the issues range from designing an experiment and making sense of the results; proficiency in error analyses; understanding of basic principles of an experiment from which a proposal for a Senior Thesis can be developed; solid grasp of experimental instrumentation and analyses tools (use of digital scopes, data acquisition cards, LabView, MathCAD, MatLAB, etc).

Assessment is achieved by discussions of theory and the obtained results with the student throughout the semester, review of students' logbook, and discussions of student project presentations.

PHYS 3304 Outcome and Assessment

| Outcome | Assessed by |
|--|---|
| Understanding of physics concept | Discussion of theory before lab work |
| Grasp of experimental methods | Review of papers and texts on topic Discussion of experiment Review of logbook |
| Principle design criteria of experiments | Discussion of project and plan Discussion of instrumentation Review of logbook |
| Error analyses | Discussion of mathematical techniques Working together on computer and discussing results Review of logbook |

Disability: Any student who, because of a disabling condition, may require some special arrangements in order to meet the course requirements, should contact the instructor as soon as possible, so that the necessary accommodations can be made. Proper documentation must be presented from the Dean of Students' Office.

PHYS 3304 Topics

Table 1: List of possible topics/experiments for Fall 2011.

| Week | Topic | M | T | W | Th | F |
|------|---|---|---|---|----|---|
| | Safety Review | | | | | |
| | Semiconductor Characterization | | | | | |
| | Microwaves | | | | | |
| | Optical Pumping | | | | | |
| | Double Slit | | | | | |
| | Quantum Mechanics Experiments | | | | | |
| | Error Analyses | | | | | |
| | Construction of a Counter (PMT) | | | | | |
| | Gamma Spectroscopy | | | | | |
| | Alpha and Beta Spectroscopy | | | | | |
| | Experiments with Optical Fibers | | | | | |
| | Double Pendulum | | | | | |
| | Cosmic Ray Measurements | | | | | |
| | Muon Lifetime and Magnetic Moment | | | | | |
| | Compton Scattering | | | | | |
| | Solar Panel | | | | | |
| | Rutherford Scattering | | | | | |
| | Zeeman Effect | | | | | |
| | Fluorescence Spectroscopy | | | | | |
| | Gravitational Constant | | | | | |
| | Spectral Analyses of Astronomical Objects | | | | | |
| | Machine Shop | | | | | |