

PHYSICS 335
Advanced Laboratory
Davidson College
Spring 2009

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TEXT: Introduction to Error Analysis, John R. Taylor, 2nd ed, University Science Books.

PREREQUISITES: Physics 220/230 and Physics 320; Physics 310 recommended.

MEETING TIMES: Tues/Thurs 1:00 – 4:00 PM, Fri 1:30-3:30 PM.

OFFICE HOURS: will be posted on my webpage; however, I will generally be available any time my door is open.

OBJECTIVES: This course will give the student wide-ranging experience with laboratory apparatus, techniques, and data and error analysis. A heavy emphasis will be placed on problem solving using tools and mechanical devices, electronic circuitry and instrumentation, data acquisition and software, and lasers and optics. A high degree of independent work is expected of the student with guidance and input from Mr. Yukich. A large emphasis will also be placed on keeping a highly-organized, well-labeled laboratory notebook. A second objective of the course is to examine, study and reinforce the fundamental physical principles behind the experiments. A common theme throughout the course will be the various oscillations found in mechanical, electrical, optical, and quantum mechanical systems. Finally, students will also develop the skills needed to present their work in both oral and written formats.

ATTENDANCE: You are expected to be in each Tuesday and Thursday lab meeting, and a *minimum* of one additional afternoon or evening per week. As shown in the schedule, we will formally meet as a group only on four Friday afternoons of the semester. *Students are also expected to attend all department seminars!*

ASSIGNMENTS: Each student will complete four separate open-ended experiments in addition to an independent final project during the semester. We will have a strict rotation of lab partners for the four initial experiments. I urge lab partners to collaborate on the experiments as much as possible. However, each student's work turned in for grading must be a product of that individual student's understanding of the material; i.e., *you may not copy work from another student, book, website, or other external resource without reference.*

GRADING:

- Lab work and notebooks: 60%
- Lab reports (oral and written): 20%
- Final project (including written paper and poster): 20%

LAB NOTEBOOKS: I have very high expectations of the lab notebooks in terms of thoroughness, organization, and labeling. *The lab notebook must offer enough experimental detail that a peer could use your notebook to recreate the experiment:* Each notebook “report” should include the following:

- 1) Title, date, lab partner
- 2) Brief statement of purpose/objective
- 3) References including page numbers
- 4) Introduction/background including theory
- 5) Procedures – what you did and how you did it, including exquisitely-labeled diagrams. Specify dial settings, equipment model numbers and manufacturers. Include problems encountered and solutions to problems.
- 6) Data – a careful record of all measurements and their uncertainties and error bars. All plots and tables must be carefully labeled.
- 7) Analysis and discussion – what can you conclude? Do your results support the theory and to what extent? If they don’t, why not? Discuss sources of error in detail: what are the predominant sources or error? What kind of error are they? What effect do they have on the data and the results? What might be done to diminish their effects?
- 8) Conclusion – brief concluding statements on the experiment, repeating final results and their significance, specific suggestions for ways to improve experiment, etc.

REFERENCES: For many experiments, I will hand you assorted papers or documents. In general you will need to seek additional references. A great place to start is the American Journal of Physics at <http://ojps.aip.org/ajp/>.

SCHEDULE		Oral presentations and notebooks DUE
Jan 12 – Jan 30	Experiment #1	Friday, Jan 30
Feb 2 – Feb 20	Experiment #2	Friday, Feb 20 (incl. formal paper)
Feb 23 – Mar 20	Experiment #3	Friday, Mar 20
Mar 23 – Apr 10	Experiment #4	Friday, Apr 10
Apr 13 – May 6	Final projects	Wednesday, May 6 (incl. formal paper and poster)