PHYSICS 335
Advanced Laboratory
Davidson College
Spring 2012

Professor John Yukich **Dana 169**
Email: joyukich@davidson.edu TEL: (704) 894-2323

REQUIRED 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 – 3:00 PM (see schedule).

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 five Friday afternoons of the semester. *Students are also expected to attend all department seminars*!

ASSIGNMENTS: Each student will complete five 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 five regular 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:

- Laboratory work, lab notebooks and oral reports: 70%
- Final project (including written paper and poster): 20%
- Written homework assignments: 10%

LAB NOTEBOOKS: Students are expected to purchase **two laboratory notebooks** so that one experiment can be graded while students begin the next experiment. I have very high expectations of the lab notebooks in terms of thoroughness, organization, and labeling. *The lab notebook must offer enough theoretical and experimental detail that a peer could use your notebook to understand the background theory, to recreate the experiment, and to obtain results similar to yours.*

Each notebook "report" should include the following (but not necessarily in this order):

1) Title, dates, lab partner and daily log of time spent on the experiment.
2) Brief statement of purpose/objective
3) Introduction/background including theory
4) Procedures – what you did and how you did it, including exquisitely-labeled schematics and diagrams. Specify dial settings, equipment model numbers and manufacturers. Include problems encountered and solutions to problems. Photographs are also helpful to record set-up of mechanical and optical equipment. For any electronic or electrical circuits, be sure to include a circuit schematic instead of an artistic drawing.
5) Data – a careful record of all measurements and their uncertainties and error bars. All plots and tables must be carefully labeled. Each graph should be accompanied by a statement of what you've learned from it (What does it tell you? Meaning of the slope? Of the intercept?, etc.)
6) 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?
7) Conclusions – brief concluding statements on the experiment, repeating final results and their significance, specific suggestions for ways to improve experiment, etc.
8) References including page numbers.

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 16 – Jan 27	Lectures/intro	(Homework due Jan. 23 and 30)
Jan 30 – Feb 10	Experiment #1	Friday February 10
Feb 13 – Feb 24	Experiment #2	Friday February 24
Feb 27 – Mar 16	Experiment #3	Friday March 16
Mar 19 – Mar 30	Experiment #4	Friday March 30
Apr 2 – Apr 13	Experiment #5	Friday April 13
Apr 16 – May 9	Final projects	Wednesday, May 9 (including formal paper and poster)

Finally, *in order to facilitate face-to-face communication and to maintain a professional atmosphere*, there should be no use of ipods or other music sources during the formal lab meeting times. This rule may be relaxed after business hours when all students in the laboratory are in agreement.