Syllabus for Physics 314: Intermediate Laboratory, Fall '09

Basic information:

Class hours and location: 1:30-4:30 p.m., Tues. and Thurs. in Wright 15 (and throughout rooms in the basement of Wright).

Instructor: Ms. Yumi Ijiri
Wright 216/Wright 17
Phone: 775-6484; Home phone: 774-9065
Email: yumi.ijiri@oberlin.edu

Office hours: I'm generally available any morning, so stop by then, but I'll also look at your schedule sheets to set some concrete hours.

Textbook: There will be no required textbook, although there will be several reference books available for use during the course. Course lab instructions and copies of selected readings are available online through Blackboard. Also available are some instructions and primers on using Excel and Igor Pro. You will be required to keep two laboratory notebooks (two, so that one can be graded while a second one is in use.)

Evaluation: Grading will be based on the following, which is a reflection of your oral and written work as well as how well you work in the lab.

- Lab participation 5%
- Lab notebook 10%
- Short lab writeups 35% (due one week after completion of a unit). The lowest writeup score will be dropped.
- In-class oral presentations 10% (on Oct. 29th and Dec. 10th).
- Detailed lab reports 40% (1st report: draft due Oct 13th with the final version on Nov. 3rd; 2nd report: draft due Dec. 3rd with the final version on Wed. Dec. 16th at 4 pm).

Detailed description:

Objectives: The main objective of this course is to help you to develop your skills in experimental physics by introducing you to a range of important measuring methods and associated physical phenomena. Specifically, by the end of this course, you should know better how to:

1) work with specific equipment (such as vacuum pumps or optics),
2) take and analyze data, and
3) write up and present your results effectively.

In contrast to what you encountered in the introductory laboratory courses (110/111/212), the experiments in this class are much more open-ended and are designed to provide you hands-on experience with more sophisticated equipment. The lab manual is less prescriptive, more of a general guide. You will have to make decisions about what sets your experimental uncertainty and how to best take your data. Given that some of you aren't/haven't taken Quantum Mechanics or Electronics, you will not be expected to understand either the full theoretical underpinnings of these experiments or the detailed workings of the experimental apparatus. Instead, you will learn more skills in experimenting-how to take data efficiently, how to work with equipment that you don't

fully understand, and how to use computers more effectively. This class will thus serve as preparation for more elaborate experiments in Advanced Laboratory or in independent research.

Course design: During this course, you will be learning about seven techniques/devices chosen from a list below:

1. Cryogenics--Closed cycle He cryostat
2. Electronics and nuclear physics-Gamma ray spectroscopy
3. Machining/Soldering/Literature searching*
4. Magnetism-(Vibrating sample) Magnetometry
5. Magnetism-Nuclear magnetic resonance
6. Signal processing-the Lock-in amplifier
7. Optics-Holography**
8. Optics-Laser
9. Optics/electronics-Michelson interferometry
10. Vacuum techniques-diffusion, rotary, and turbopumps
11. X-ray diffraction
12. A lab of your design***

*This is a grab-bag lab of miscellaneous things you should have some familiarity with--you can not use this as the basis for one of your two long reports--but it can help in the writing of them.
**The holography lab will require some coordination with rooms (the Biology dark room in particular), so it will not be available for each possible time.
*** I also encourage you to think about designing your own lab--this requires AT least one week in advance planning (to make sure we can get the necessary parts and pieces), but on the other hand can be a really great experience--a mini-Winter Term-like project or some insight into an independent/honors project. Examples include: 1) measuring chaos from a leaky valve 2) characterizing the performance of a home-built analog synthesizer 3) studying vocal tones and the effects of lengthened cavity.

For each unit, lab manuals are available in the laboratory room with supplementary information. You will work in pairs and have **three afternoons** in which to complete the experiment. This should give you plenty of time to finish the work outlined in each experiment. In general, the first afternoon will involve familiarizing yourself with the equipment/background reading, the second will involve most of the experimental work, and the third will allow you to check over your work, estimate errors, and evaluate your results.

Lab participation: An important aspect of the course is learning to work well with others who might have different approaches to doing an experiment. Contrary to the image of a scientist working alone in a lab, much scientific work is collaborative--so try not to be either an equipment hog or an equipment wallflower! You **MUST** change partners at least once during the semester--more would be desirable. In the course of the semester, you will also have some opportunities to critique each other's work. Be as specific and constructive as you can in your suggestions; general positive ("looks fine to me") or negative ("don't like it") statements are not very helpful.

Lab notebook: For this class, you will be required to have **two** notebooks of some sort **dedicated to this class and numbered**: a bound notebook, a spiral notebook, a three-ring binder, etc. Take notes of the reading in it, include diagrams of the equipment, record what you do and observe, and in particular write down as you go, problems you encounter with the lab. The lab notebook should be written such that you can reconstruct what you did in the lab. **The lab notebook must be handed in with your lab writeups, so you will need two.** (They can be "recycled"--the last pages of your 212 notebook …)

Short Writeups: At the end of each lab manual is a section entitled "reporting your results." Answer the listed questions, make the requested graphs, and hand in the results (typed-not handwritten). While you will be working in pairs, you should each submit a ***separate*** writeup. Each lab writeup is due **at the start of class**, one week after the end of the unit. Late writeups will not be accepted unless there are extenuating circumstances which have been discussed with the instructor prior to class (death in the family, illness, etc.) I will drop your lowest short writeup score.

In-class presentations: At the middle and end of the semester, you will make a short 10 minute presentation about one of your experiments, most likely one which is the basis of a detailed lab report. In the presentation, you will briefly describe what you did and then discuss your results. A few minutes will be allocated for questions as well. This is a chance for you to get some practice speaking and dealing with a set time slot.

Detailed lab reports: You will write two more detailed reports in addition to the individual writeups. These lab reports are written more in the style of a research paper (complete with abstract, intro, procedures, results and discussion). See the instructions for "Description of a detailed lab report." **The first detailed lab report is due Nov. 3rd (draft due Oct. 13th) and the second one is due Dec. 16th (draft due Dec. 3rd).**

Schedule: A schedule for the course is listed below:

Date	**Laboratory time**	**Assignment due**
Tues. Sept. 1	Course intro, safety review	
Thurs. Sept. 3	UNIT 1	
Tues. Sept. 8	UNIT 1	
Thurs. Sept. 10	UNIT 1	
Tues. Sept. 15	UNIT 2	
Thurs. Sept. 17	UNIT 2	UNIT 1 short report due at class
Tues. Sept. 22	UNIT 2	
Thurs. Sept. 24	UNIT 3	
Tues. Sept. 29	UNIT 3	UNIT 2 short report due at class
Thurs. Oct. 1	UNIT 3	
Tues. Oct. 6	UNIT 4	
Thurs. Oct. 8	UNIT 4	UNIT 3 short report due at class
Tues. Oct. 13	UNIT 4	Electronic copy of 1st long report draft
Thurs. Oct. 15	DRAFT REVIEW/TIME FOR ADDITIONAL DATA-TAKING	
Tues. Oct. 20 Thurs. Oct 22	**FALL BREAK**	
Tues. Oct. 27	RESEARCH LAB TOURS	UNIT 4 short report due at class

Thurs. Oct. 29	IN-CLASS PRESENTATIONS	
Tues. Nov. 3	UNIT 5	**Final** copy of 1st long report due at class
Thurs. Nov. 5	UNIT 5	
Tues. Nov. 10	UNIT 5	
Thur. Nov. 12	UNIT 6	
Tues. Nov. 17	UNIT 6	UNIT 5 short report due at class
Thurs. Nov. 19	UNIT 6	
Tues. Nov. 24	UNIT 7	
Thurs. Nov. 26	**NO CLASS-THANKSGIVING**	
Tues. Dec. 1	UNIT 7	UNIT 6 short report due at class
Thurs. Dec. 3	UNIT 7	Electronic copy of 2nd long report draft
Tues. Dec. 8	DRAFT REVIEW/TIME FOR ADDITIONAL DATA-TAKING	
Thurs. Dec. 10	IN-CLASS PRESENTATIONS	UNIT 7 short report due at class
Wed. Dec. 16	at EXAM PERIOD at 4:00 PM	**Final** copy of 2nd long report due

The Honor Code as applied to laboratory work

As you are aware, the Honor Code applies to all types of assignments, including tests, papers, and the like. The Honor Code pledge which should be written and signed on all assignments is "I affirm that I have adhered to the Honor Code in this assignment." What does this mean as far as laboratory work?

Lab notebook: For your lab notebook, you should make certain to preserve it as a record of what happened rather than what you think should have happened. For instance, do not "correct" what you later think was a mistake (no "oh, it must've been a 5 here not a 3-let me just change that." If necessary, add dated comments (preferably in a different pen color) to that effect (such as "I think I left the oscilloscope on its default settings but I might have played with the trigger button.")

Short writeup and lab reports: You will be working with a lab partner throughout this course, and I encourage you to collaborate with other students in the class as well. You should feel free to discuss the material with anyone in the course or seniors who've taken the course or other faculty members. **However, the writeups and lab reports that you hand in should be your own work and reflect your own understanding of the material**. If you make use of other written materials, be sure to cite them appropriately. For the two long lab reports, that means citations which are complete, similar to those found in journal articles.

If in doubt, ask questions!

Accommodations for students with disabilities

If you have a disability that you think might impact your performance in this class, please try to contact me as soon as possible. If you prefer not to discuss this, that is fine as well, but in any case, you MUST contact Student Academic Services to get your disability documented before any accommodations can be made.