## Instructor:

Name: Dr. Tom Kirkman
Office: PEngel 111 Phone: 363–3811 email: tkirkman@unix.csbsju.edu
Office Hour: 11:00 A.M. Day 5 Informal Office Hours: 7:30 A.M. – 5:30 P.M.

## Texts:

- *An Introduction to Error Analysis*
  by John R Taylor (University Science, 1997)
- http://www.physics.csbsju.edu/370/
  http://www.physics.csbsju.edu/stats/

## Grading:

Your grade will be determined by averaging five scores: 3 lab scores, electronics workshop score and poster score. Lab grades are based on what is recorded in your lab notebook. Please be complete and legible! You will probably need at least 2 of these notebooks (which may be "used") as I'll be grading old labs while you'll working on current labs. Assigned work is generally due at the beginning of the following class period. In particular your lab notebook must be turned in before the lab lecture for the following experiment. (If your lab work is incomplete, you may request an improved grade for a completed report, nevertheless turn in what you have!) All work contributing to your grade must be turned in by our last meeting day: Tuesday 8 December.

## Questions:

There is no such thing as a dumb question. Questions asked during lecture or lab do not "interrupt", rather they indicate your interests or misunderstandings. The aim of lab is to do things you've never done before; it's no surprise if you've got questions.

Remember: you are almost never alone in your interests, your misunderstandings, or your problems. Please help your classmates and yourself by asking any question vaguely related to physics lab. If you don't want to ask your question during class, that's fine too: I can be found almost any time on the 100-level floor of Engel Science Center. Ask if you don't find me, as I spend just as much time in the nearby labs as I do in my office.

## Times/Locations:

Half of this course will be self-scheduled. I hope many of you will still choose to do that work in the scheduled slot, because you can be then sure to find me (i.e., help) at those times and it will help you avoid the crime of procrastination. However, because of limited lab equipment, in fact you cannot all perform the data collection simultaneously. Of course, data analysis (which usually takes much longer than data collection) can be done simultaneously.

Three cycles are scheduled for each lab. Most of the actual data collection and analysis will take place in the suite of labs across from my office.

Half of this course will meet at the scheduled time: lab lectures, workshops and the poster sessions. We will be using the astronomy lab room (PEngel 319) for lab lectures. If you cannot attend at those times, the responsibility of mastering the material falls on you. (An alternative class time—agreed to by all—would also be fine.) Note that lab lectures typically run a bit more than an hour, which leaves plenty of time to start the lab immediately following the lab lecture. Groups will also need to schedule a night lab at the observatory for photometry data collection.

**"Do I have to do my lab work during the scheduled lab period?"**

The answer is "No, but be forewarned:" currently (summer 2009) 20% of the students in my PHYS 370 Fall 2008 course have Fs for that course as they did not turn in the required reports at the required time. While I will give some credit for late lab work, do you have any idea how unpleasant it is to be analyzing data that you collected six months ago? If you actually put in the scheduled four solid hours[1] of lab work per cycle, I'll work with you to make sure you complete labs on time. Again: the lab is scheduled for 1 P.M. to 5 P.M., if you fiddle around in lab and leave at 3:30, you are doing half the required work and 50%=F.

## Lab Notebook:

Your lab notebook is the primary, graded work-product for this course. It should represent a *detailed* record of what you have done in the laboratory—complete enough so that you could look back after a year or two and reconstruct your work just using your notebook and this manual.

Your notebook should include your preparation for lab, sketches and diagrams to explain the experiment, data collected, comments on difficulties, sample calculations, data analysis, final graphs, final results, answers to questions asked in the lab manual, and a critique of the lab. A list of suggested sections can be found in the 191 lab manual.

**DO NOT** collect data on scratch paper and then transfer to your notebook. Your notebook is to be a running record of what you have done, not a formal (all errors eliminated) report. There will be no formal lab reports in this course. Do not delete, erase, or tear out sections of your notebook that you want to change. Instead, indicate in the notebook what you want to change and why (such information can be valuable later on). Then lightly draw a line through the unwanted section and proceed with the new work.

We will be experimenting this semester with a larger-format, more expensive lab notebook. You'll be given (free!) a copy of a "computation notebook" to use as a lab notebook. At the end of the semester you'll be asked if you think the larger format is worth asking students to pay the $10 cost (cf. $2 for the old-style 'composition' notebooks).

[1] i.e., hours when I'm immediately available to answer to your questions and not counting time spent on computer games, web browsing, waiting for your lab partner, etc.. . .

## Be Prepared!

In this "Advanced Lab" you will typically be combining some fairly advanced physics concepts with equally advanced instruments. The 10 minute pre-lab talk from 191/200 is now stretched into an hour "lab lecture"; in a four hour "workshop" you will demonstrate your ability to use the electrical instrumentation you spent a whole semester developing in Physics 200. It will be quite easy to be overwhelmed by the theory and the instrumentation. Your main defense against this tsunami of information is to *read and understand the material before the lecture/lab.* I know that this is difficult: technical readings never seems to make sense the first time through. But frankly, one of the prime skills you should be developing (i.e., the prime skill employers seek) is being able to read, understand, and act on technical documents. What I told you in 191 was: *Read aggressively!* Read with a pencil in hand so you can jot down questions, complete missing steps of algebra, and argue with the author. (In this case you can actually take your complaints, comments, and arguments to the author, rather than imagining how the author would respond.) A significant problem is that readings (in contrast to lectures) generally aim at getting the details right. But details obscure the big picture and misdirect attention. This leads to the suggestion of "skimming" the material... which is OK as long as that's just the first step to understanding. I usually instead start by reading for detail, but bit-by-bit my confusion grows and I switch to skimming. But then I repeat the process from the start. After several repeats, I usually reach a point where I'm not making progress, and I find I must do something more active like: talk to somebody about the material, or try to solve a problem—perhaps one of my own design. The aim is to try to find out why the author thinks his points are the important ones.

## Topics:

The following schedule is based on Day 2 labs.
Equivalent labs occur on the following Day 3.

| Day | | Date | Topics |
|---|---|---|---|
| 1/2 | R | Aug 27 | Lab Lecture: Bubble Chamber[a] & Photometry[b] |
| 2/2 | F | Sep 4 | |
| 3/2 | T | Sep 15 | |
| 4/2 | W | Sep 23 | Electrical Measurements Lab[c] |
| 5/2 | R | Oct 1 | Lab Lecture: Thermionic Emission, Fortran, GPIB |
| 6/2 | T | Oct 13 | |
| 7/2 | W | Oct 21 | |
| 8/2 | R | Oct 29 | |
| 9/2 | F | Nov 6 | Lab Lecture: Langmuir Probe?[d] |
| 10/2 | M | Nov 16 | |
| 11/2 | T | Nov 24 | Brief Poster Workshop |
| 12/2 | T | Dec 7 | Poster Conference |

[a] Read "Systematic Error" and skim lab chapters before the lab lecture!
[b] Report schedule for data collection at observatory
[c] Read "Electrical Measurement Review" *before* the lab!
[d] Only if observatory observations were impossible due to weather.

**Posters:** A stitch in time saves nine.

Presentation of a lab project as a poster is the final component of this course. While I know procrastination always seems like the easiest course, in fact, putting together a poster months after you've completed the lab is time consuming. The easy course is actually to start your poster (particularly the figures) soon after you've completed the lab. While you can delay final construction, preparation of poster-quality figures immediately following the lab will save you a lot of time just when you most need it (at the end of the semester). See page 131 for basic poster information and that section's references for much more detailed information. Poster topics will be assigned on a first come first served basis, so there is no reason to delay selecting your poster topic.