Laboratory General Guidelines

Administrative Details:

Please keep notes on what you do in the lab in an on-line "lab-book", a log file with dates and times, **whole sentences** about what you are doing, and clear and unique references to files containing acquisition and analysis code and to plots of the results. This file should be shared between partners, and we expect both partners to make entries in it..

We will mark the labs one week after the last session of each experiment.

The lab will be open normal hours (MT 2-6) Please try to be done by 6 PM. There is more than enough time within normal hours if you are organized and plan ahead. You might be able to make up missed sessions on a different day if there happens to be an unused station. But people scheduled that day have priority on your station. The lab is closed and locked apart from MTW 2-6, and you cant be there without supervision.

The computers will be on even when the lab is not in session, so you can access your data files and even run your programs which collect or analyze the data any time you like.

Partners: You will work in teams on each experiment, and will register initial pairs on the first day of the lab. You can switch lab partners by mutual consent when we change experiments, which happens several times during the term. Lab partners will be registered as a `group` of users on the computer system so that the default will be that either partner can read their shared data and programs.

What to Bring: Everything is on line for this class, so you should not need to bring anything with you. Bring a snack if you like; four hours is a long time.... But you have to eat or drink **outside the lab.** Inside the lab food is not allowed!! This is probably our single most important safety rule and it will be enforced.

Computers: Get an account on physics.ubc.ca. If you dont have one, visit Hennings 203 or 205 and sign up. You can ask for more disk quota if you need it. Computer abuse will be appropriately punished: Dont interfere with other computers; Dont install MP3 servers, etc. We are aware of what happens when you tell kids not to put beans in their ears, [http://www.youtube.com/watch?v=UgH2KxR25-c] and will not list here all the things **not** to do on our computers. The lack of a written list of prohibitions will not hinder us in enforcing them!

Grading: 40% on lab notebooks from each experiment 20% on assignments, 20% on the exam and 20% for a formal report on one experiment. The lab notebook and formal report grades will be shared by partners! The other components should be done individually and will be graded individually.

Exam: You will be asked to sign on to a P309 work station remotely, *ie* without entering the P309 laboratory, and to perform a simple experiment. You will be given written instructions which ask you to change the settings of some instruments, collect data and analyze what you get. This exam will be scheduled about 2/3 of the way through the term, i.e. late enough that we expect everyone will have mastered the skills the exam tests for, early enough to do something about it if anyone has not, and far enough from mid terms and other finals to reduce overall stress. It is not all that many points, but you must pass this exam to pass the course.

Lab Notebook: You and your partner will keep notes on your computer.

We grade your lab notebook differently than in first or second year labs. We dont expect or want it to look like a lab report. We grade it as a working log, rather than as a presentation of your final results. **Do Not** write down notes on scratch paper throw out the mistakes, and later make a neat table and graph in your notebook after the fact. We expect to see all the steps of the process, including the mistakes and what you learned from them. Dont delete things, just add a note if you write something that turns out later to be wrong. Your lab notes dont need to be grammatically correct, correctly spelled, etc., but the log file should be neat enough and organized enough for you to find things, and understand what you did weeks later. We **do** expect you to write in whole sentences.

Put a date in the log file every time you make a new set of entries, and put a time on every entry. We expect to see an entry at approximately every 15 minutes. Write your initials with each entry. We expect to see both partners initials in the log! Take turns being the scribe. Describe apparatus in enough detail to be able to set it up and repeat your experiments independently (channel numbers, settings). Write down every event that might be relevant. Note the conditions that correspond to each given data file!! Even obviously bad runs should be noted, along with what went wrong (they dont need to be printed). Annotate your graphs: what are the axis units, point out features, etc. It is good to draw crude models or point out anomalies right on the graph. Your log file should have a clear and unique name for each data file and point to a plot of the data. There should be at least a full sentence stating what you have learned from each graph.

It is very important that someone reading the log file will find **all of** the relevant file names in it so that they can find all of your data. Equally, someone looking at any of your data files should find all the other data they need to analyze it in your log, and the connection between them, i.e. which file corresponds to which conditions, should be completely unambiguous. We strongly urge you to write your plotting programs in such a way that the date, the name of the data file(s) which hold the input and perhaps the name of the program which made the plot are al written in place automatically.

When marking labs we will look for the following things with approximately equal weight:

- General clarity (dates, times, readability)
- Are diagrams of apparatus present and clear enough to allow one to repeat the experiment?
- Are all the data recorded and organized? Can I analyze the experiment using only the lab book and manual?
- Were the correct raw data collected(settings, graphs, etc.)?
- Analysis: from raw data to final conclusion, including error analysis
- Are difficulties that were encountered noted? And explained?
- Is there insight on the physics that was studied?

We Want To See Physics Insight. Physics measurements are done in the context of a theoretical prediction. When you get some data, you should look and think: is this what I expected or predicted in every way? We expect you to comment on whether your data makes sense, and whether it agrees quantitatively with the physics of your system. Sometimes the comparison is an internal consistency check, sometimes its agreement with external data. If it doesnt agree completely we expect you to start thinking about why. Sometimes the disagreement is telling you something about your procedure (that you did it wrong). Sometimes its telling you something about the apparatus that you didnt understand. Sometimes, and only if you have gone through these first few options, its telling you something about the physics that you didnt expect!

Lab Notebook Hints: We will provide a link to circuit drawing software. Please use it, and lear to draw circuits which are laid out logically and look physically like what you build. Draw the circuit as you build it, so you are confident they match. If you later find a problem with your data, you can trace the wires in your drawing to see what you really built instead of what you should have built. Our experience helping students troubleshoot electrical circuits is that when we encounter a circuit which is badly mis-wired it is *always* also the case that the student has *not* drawn the circuit in their book.

Physics 309 Philosophy: Were trying to teach you how an experimental physicist goes about checking whether a theoretical model is consistent with the real world or not. Were not particularly trying to teach you physics content through hands-on self-run demonstrations, although we expect youll learn some physics as we go. Were not particularly trying to teach you electronics, or computing, or any particular computer program. The lab procedure starts off being fairly cookbook, because we know youre getting familiar with the equipment and programs. Even in the cookbook parts, we throw a few curve balls at you: things that dont work out in a completely simple way, even if you follow the instructions exactly. Dont let this get you upset. (It wont hurt your grade!) We expect you to think, and make some educated guesses about what might be going on, and ideally to do some more experimentation to test your guesses. It gets less cookbook as the term goes on. We expect you to make more decisions about how to do the measurements and how to analyze them.

Physics 309 Survival Skills: Read the whole lab procedure, before coming to lab. There are often hints in later sections that explain the mysteries in the early sections. Read handouts and lecture notes. They may cover things not explained in the lab procedure. Do your own research (web, library, help-files) on how things work. Notice when there is something that could be done before the lab (first drafts of acquisition scripts, for example). Re-use code you have already used and tested whenever doing so saves work. When pressed for time, be sure at least to collect the essential data. Think about what you expect your data to look like, and check whether it agrees as soon as possible, so you dont find out that your data is trash after the lab is closed and locked. Gordian-knot solutions are OK: measure the resistor with a meter rather than decoding the color bands; find rough parameters of a curve by guessing and plotting rather than extracting them from your data graphs; check whether the parasitic resistance or capacitance of some circuit element is important by adding a real resistor or capacitor to the circuit to see what it does. Write **everything** you do or decide in your lab notebook! You will lose points if it looks like a formal write-up with no false steps or mistaken assumptions that are later corrected.