Welcome to UBC Physics 309

"Electrical Laboratory"

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(Lecture + Monday Lab)
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Other Lab Professor:
Arthur Mills (Tuesday)

Teaching assistant:
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Lectures in DMP 110
Thursday 11:30-12:30

Lab sessions in Hebb 42
2:00-6:00, (one of) Monday and Tuesday

Web site: www.physics.ubc.ca/~quantmat/PHYS309_2008.html

Administrivia 1: Schedule

The "0th" experiment is only 1 session long, the others are 3 sessions.

We will collect the lab books one week after the last session of that experiment.

You will write the next lab in a second lab book, which gives us more time to grade the first one.

No labs scheduled for the week of Thanksgiving (Oct. 13-14)

The lab will be open normal hours (MT 2-6)
during that week if you want make-up lab time.

Remembrance Day (Nov. 11) is a Tuesday lab on Wednesday 12?

You can come in on a different day to make up missed sessions, 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 MT 2-6, and you can't be there without supervision, so you have to convince one of the staff to stay there with you if you want more lab time.

Please try to be done by 6 PM.

Administrivia 2: Partners

As of now, there are 15 students signed up for Monday and only 4 for Tuesday. This is NOT ideal!

We have 8 lab stations, and you will work in pairs. NOTE, however, that the more students, the more difficult it is to provide guidance.

Can a few people move to the Tuesday section?

We really need some volunteers!!

If you can arrange a trade with someone on another day, I don't particularly care if you switch days. Both of you should send me an email message

If you want to work with someone in particular, both of you should email me your choice

We'll do pair up the rest on the first day of the lab.

You can switch lab partners by mutual consent when we change experiments, 3 times during the term.

Administrivia 3: What to Bring

You need to have a lab notebook the first day.

Each team will keep a common lab book, and take common data.

Both partners should buy lab notebooks. We don't get the first notebook back to you and graded before the beginning of the second lab.

Bring your own tape and scissors too. You will be printing computer files and plots, and taping them into your lab book.

Bring a memory stick to save data on.

Bring a snack. Four hours is a long time....
but you have to eat or drink OUTSIDE the lab: inside it's not allowed!!

Computers

Get an account on physics.ubc.ca; if you don't have one, contact Mary Ann Potts, Systems Analyst - map@physics.ubc.ca

Ask for more disk quota if you need it (up to 10 MB)
check with "quota -v" command
email to sysadmin if you don't have 10 MB total

Pay for some print quota ($5 for 67 pages, Hennings 325)
check with "pquota" command

There are no page-charges on the printer in Hebb 42,
but don't abuse it.

Computer abuse will be appropriately punished
- Don't "customize" the setup (other days need it)
- Don't interfere with other computers
- Don't hack root on your own computer
- Don't install MP3 servers, porno servers, etc.
- Don't install password sniffers, trojans, rootkits,...

Playing games, web surfing, e-mailing, etc. is OK
(but it is wasting your time...)

We sorted some of this out: NO NETWORK connection
available on experimental PCs!

Experiments

Introductory experiment

- Acquiring and fitting data with a computer
- Familiarization with lab computers and procedures
- Quick feedback on how we grade Phys 309
- 1 lab session

Junction Diode

- Current-voltage behavior of PN diodes
- Temperature dependence (measure $q/K_{Boltzman}$)
- 3 lab sessions

Faraday Effect

- Rotation of light polarization in magnetized material
- More elaborate procedure to get data
- Multi-stage fitting
- Measure q/m of electron (sort of)
- 3 lab sessions

Junction Transistor

- Identifying transistor terminals and type
- The common emitter amplifier
- Transistor logic
- 3 lab sessions

Grading

40% on one formal write-up (LaTex, Word, etc.).

50% on lab notebooks (collected from each experiment)

10% on pre-lab assignments (collected at start of labs)

There's no conventional final exam, written or otherwise.

The pre-lab assignments, presence/performance, and formal write-ups will be done and graded separately.
The lab notebook grades will be shared by the partners!

The pre-lab assignments are to encourage you to think about the physics and data analysis issues before you come to the lab. They'll be fairly short.

Formal Report

You, individually (two lab partners will have to choose different topics - zero tolerance!), will have to work on a formal report written in the style of a scientific paper (Nature-like), which will be due at the end of classes: Monday December 8th

You choose which of the labs to write up. again, two lab partners will have to choose different topics - zero tolerance!

You could write up the first lab. But it will be a long time since you did it, so you will have to have done a good job taking notes in your lab book and keeping your data.

We don't care if you use LaTeX, Word, or any other word processor, but you do need to have equations, embedded figures, etc. We'll be able to give the most help with LaTeX.

You are required to bring your draft to me for a preliminary constructive discussion; this free advise is usually very useful.

Lab Notebook Grading

We grade your lab notebook differently than in first or second year labs.

We don't 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.

We don't want you to write down your data on separate sheets, 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.

Don't erase things, just add a marginal note if you write something that turns out later to be wrong.

Your lab notes don't need to be grammatically correct, correctly spelled, etc., but the notebook should be neat enough and organized enough for you to find things, and understand what you did weeks later.

Lab Notebook Grading (2)

Date on every page, time on every entry.

We expect to see an entry at least every 15 minutes.

We expect to see both partners' handwriting in the book! Take turns being the scribe, trade about once an hour.

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 a given data file!!

Even obviously bad runs should be noted, along with what went wrong (they don't need to be printed).

Annotate your graphs:

what are the axis units, point out features, etc.

it's OK to write units by hand on computer graphs

Attach printed output in the lab to your notebook.

Write with a pen (no pencil) and cross out 'mistakes' with a single line (no ink patches) so that we and you can read it.

We shake your lab books over a garbage can before grading them, and anything that falls out is gone!

An example lab notebook grading scheme

Format

10	General (dates, times, readability)
10	Is all the data recorded and organized?

Can I reproduce the experiment using the lab book?

10	Diagrams of apparatus
10	Getting the raw data (settings, graphs, etc.)
20	Analysis: from raw data to final conclusion
10	Error analysis

Insight

15	Are difficulties that were encountered noted? And explained?
15	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, and in every way?

We expect you to comment on whether your data
makes sense, and whether it agrees quantitatively
with the physics expected.

Sometimes the expectation is an internal consistency check,
sometimes it's agreement with external data.

If it doesn't agree perfectly, and it never does, we expect you to
start thinking about why.

Sometimes the disagreement is telling you something about your
procedure (that you did it wrong).

Sometimes it's telling you something about the apparatus that
you didn't understand.

Sometimes it's telling you something about the physics that you
didn't understand.

Lab Notebook Hints

Cut and attach graphs to your books as soon as you print them, so you know at least the right order. It's not any faster to wait until later.

If you let them pile up before attaching, it's too easy to confuse which page is which, or lose one. At the very least, write what the conditions are on the loose page!

It's OK to cut the circuit diagram from the instructions and tape that in your book, rather than re-drawing it.

But you should do more than just tape in the circuit you should have been working with.

You should also draw the circuit so it looks physically like what you built, because 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.

Physics 309 Philosophy

We're trying to teach you how an experimental physicist goes about checking whether a theoretical model is consistent with the real world or not.

We're not particularly trying to teach you "physics content" through hands-on self-run demonstrations, although we expect you'll learn some physics as we go.

We're 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 you're getting familiar with the equipment and programs.

Even in the cookbook parts, we throw a few curve balls at you: things that don't work out in a completely simple way, even if you follow the instructions exactly.

Don't let this get you upset. It won't hurt your grade!

We expect you to think about them, 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 it 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 outside of the lab (detailed analysis, making a plot "pretty"). When pressed for time, take data now and analyze later.

Think about what you expect your data to look like, and check whether it agrees as soon as possible, so you don't find out that your data is trash after the lab is closed.

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 <u>everything</u> 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.

We Hate Mathematica!

Actually, we only hate using it as an experimental data analysis tool.

Mathematica is great for symbolic mathematics
(which was the original purpose).

It's OK for numerical calculations and simulations
(although for most such purposes Matlab is better).

But it's quite hard to make a simple plot of some measurements, or a function, let alone fit the function to the measurements and make a combined plot with error bars!

The problem is that Mathematica is really a general programming language, rather than a dedicated plotting-fitting application.

Symbolic mathematics requires a very general logical structure. The result is that nearly anything that you type into Mathematica has some possible legal interpretation, so it can't give you decent error messages.

We will teach you how to use Gnuplot instead. It's free!

Gnuplot is a dedicated plotting-fitting application. So the commands are designed to be easy to use and type. It does have a scripting language when you want to do more complicated or repetitive things.

Lab Procedures, Handouts and Tutorials

The procedure for the "0th" lab and a bunch of handouts are already availableon the course web page.

Handout 1 is simple Unix/Linux survival skills.

Handout 2 is some basics about Gnuplot, the program we will be teaching for plotting and fitting data.

Handout 3 is about the computers in Hebb 42, and moving data back and forth.

Handout 4 is about the data acquisition hardware and software in Hebb 42.

Prelab 1 is due when you come to lab next week.
It's a simple exercise in using Gnuplot to plot some data,
then printing out the plot.