PHY 305F – ELECTRONICS LABORATORY I
Fall Semester 2003
LABORATORY NOTEBOOKS

LAB NOTEBOOKS

In the lab, you must maintain a bound laboratory notebook where you record all observations and preliminary data calculations. Your lab notebook must be in diary format and should be a record of what you did, including an adequate explanation and analysis of what you did and found. We do not permit the recording of data on loose pieces of paper. The keeping of lab records is part of your training for your later scientific life. We expect that your notebook will resemble that of a professional scientist. The following is an attempt to clarify our lab notebook expectations.

Note: You will need <u>two lab notebooks</u>, as one will be with a marker while you are using the other.

WHAT THE NOTEBOOK IS FOR

The notebook provides both a structure for recording your experimental work and a record of that work. Thus, records and calculations made during the experiment are systematised by being written in the notebook. These scientific records are kept there for later use. A "typical" scenario is a data-run on a machine on which a group of five researchers work round-the-clock for two weeks. During that time, machine and experimental problems arise and are solved (or not solved), experimental details are changed, both according to the original plan, but also to answer new questions posed by the data obtained. At a later time (sometimes as much as five years later) the data from this run is combined with data from other runs, final calculations are made, and a paper is submitted for publication. Months later, the paper gets returned by the journal's referee with comments requesting revisions. The original data and calculations are then used as a basis for revisions. The revised paper then gets published. Finally, ten years later, there is a patent dispute based on findings from the experiment. In the court proceedings, the original lab notes are used as evidence.

WHEN ENTRIES ARE MADE IN THE NOTEBOOK

Whenever you do any work on an experiment, you should be making entries in the notebook. Often recollection of the exact sequence of happenings in the lab is helped by being able to tie the entry to a given day and time. Notebook entries thus start with a brief description of what the experiment is all about. The next entries should be jottings on your preliminary background reading and investigation. The book should then progress through records of your experimental set-up, should include data (which is both numbers and narrative) and calculations, and end in evaluations and conclusions. All these entries must be made simultaneously with the actions they describe. Thus, indications of apparatus idiosyncrasies must be written at the time the idiosyncrasies are observed, not two weeks later.

WHAT SHOULD BE ENTERED IN YOUR LAB NOTEBOOK

- Dates (and times) liberally spread throughout the data/figures/narratives.
- Page numbers; all pages should be sequentially numbered. Never tear any pages from your logbook
- Sketches of important details of apparati. In most cases, schematic representations are preferable to pictorial detail. This is particularly relevant to electrical circuits.
- Data - numbers, comments and descriptions - systematically entered (in tabular form where possible). All the data should be there, including the data that failed (with annotation of why it failed). In particular, all anomalies and surprises and your reactions to them should be included. Note that error estimates are part of your data.
- Preliminary calculations based on the data, preferably also in tabular form, and preferably as extended columns in the data table. Do not include detailed arithmetic, although algebraic equations, explaining how each calculated column in the table was found, are useful.

- Preliminary graphs based on the preliminary calculations and inserted with the data. These graphs should be well labelled and dated and should be liberally annotated with remarks about features of the graph as related to oddities in the data-gathering process.
  ⇒ NOTE: These preliminary calculations and graphs should always be made while the data is being accumulated. In the "typical" data-run scenario, the preliminary graphing is essential. (Picture two round-the-clock weeks of work with no preliminary graphing. A month later, it is discovered that one data point does not make sense or that more detail is needed around part of the data. By a month later, it is very difficult to start-up the whole run again.)
- Data sheets produced by your equipment (chart recorder sheets etc.). Such sheets should be dated and cross-referenced to the writing in your book and annotated re notable occurrences. Loose sheets should be firmly attached to the book. In the event that data are saved in computer files, complete descriptions of filenames and locations should be included. You should also record any analysis software used.
- Final, more elaborate, calculations and graphs, and descriptions of the methodology and strategies used in the calculations.
- Final comments, conclusions, thoughts about the experiment.
  ⇒ NOTE: Your notebook is not a formal report - it is not a beauty show. It does contain everything about the experiment that is not already recorded elsewhere. (And, if you happen to be tempted to write on scraps of paper in the lab, don't use those scraps - rather use your notebook.)

LENGTH, ORGANIZATION AND WORK OUT OF THE LAB

Your notebook is your complete record and thus the entry for each experiment must be long enough to allow you to fully reconstruct the experiment from the written record. Note also that organisation is essential to work in the lab. It is important for you to learn to plan what you will do and write before you start doing and writing in the lab. It is also important that you organise your work so that a minimum amount of time is spent working on your notebook after you have completed your experimental (and writing) work in the lab. Most of the entries in your lab notebook should be made in the lab. Lab notebook entries should be in pen; pencil disappears with time and is too changeable.

IN GENERAL

The notebook should be sufficiently complete that anyone reading it will know exactly what you did, what happened and what you *think* it means. Note, in particular, what the notebook is not. The notebook is <u>not</u> a summary of theory, nor an essay on the physics involved. That information goes into a formal report.

LAB MARKS

All experiments must be completed and your notebook submitted before work may begin on the next experiment. The mark for each experiment will in general consist of two components.

(1) *Work in the Lab*: The professor and demonstrator will have the chance to interact with you several times as you complete each lab. Your progress and the amount of help you need to complete the lab will contribute to about 1/3 of your grade for each experiment completed. Note that this does not mean that you are expected to get everything right the first time without talking to anyone; it is expected that you carefully read the experiment write-up and any necessary references, show initiative and solve problems without excessive help.

(2) *Lab Notebook*: The marker's impression of the notebook will be based on whether you have a clear, complete and comprehensible record of your actions, thoughts and measurements made during the experiment. This will contribute to about 2/3 of your grade for the experiment. See above for a description of what a lab notebook should look like.