INTRODUCTION

This manual is your guide to the first electronics laboratory in the electrical engineering program. It is assumed that by completing the first electronics laboratory course you are familiar with basic electronic measurements and instrumentation, as well as with elements of data analysis, presentation of results, and reporting. Professional engineering practice requires using proper experimental methods and procedures. They include not only good measurement techniques, but also proper recording of all relevant information, preparing tables and graphs, etc. Almost as important as obtaining good data is their proper presentation which often determines success in this laboratory course as it does in engineering practice. Upon completion of the first laboratory course you should be very familiar with effective laboratory practices and professional style data presentation. They will be a great asset in your future.

The experiments in this lab manual are designed to give the student practical experience in working with diodes and transistors (BJT, FETs and MOSFETs). The laboratory will complement and support the theory taught in the lectures, and should help the student to apply his knowledge of electronics.

Laboratory Guidelines (Laboratory procedures)

Every week before lab, each student should read over the laboratory experiment and work out the various calculations, etc. that are outlined in the prelab. The student should refer to **Microelectronic Circuits, 4th edition by Sedra and Smith for the fundamental theory**.

- Return parts and jumper wires to correct bins when you are finished with them.
- Do not put suspected defective parts back in the bins. Give them to the Lab Technician for testing or disposal.
- Report all equipment problems to Lab Instructor or Lab Technician.
- Most experiments have several parts; students must alternate in doing these parts as they are expected to work in group.
- Each student must have a laboratory notebook. The notebook should be a permanent document that is maintained and witnessed properly, and that contains accurate records of all lab sessions.
- Laboratory and equipment maintenance is the responsibility of not only the Lab Technician, but also the students. A concerted effort to keep the equipment in excellent condition and the working environment well-organized will result in a productive and safe laboratory.

Safety in the Laboratory

To minimize electric shock hazard, the experiments are designed for low-voltage; however one should never assume that electric circuits are safe. Few milliamps of current through the body can be lethal. For your safety you must follow safety rules particularly:

- Turn off power before working on circuits.
- Know the location of emergency power-off switch.
- Make sure that the transformers and equipments are plugged into utility lines, have no exposed wiring. Check with the instructor if you are not certain about the procedure.

Laboratory Notebook

The laboratory notebook is a record of all work pertaining to the experiment. This record should be sufficiently complete so that you or anyone else of similar technical background can duplicate the experiment and data by simply following your laboratory notebook. Record everything directly into the notebook during the experiment. Do not use scratch paper for recording data. Do not trust your memory to fill in the details at a later time.

GUIDELINES FOR LABORATORY NOTEBOOK

- State the objective of the experiment.
- Draw the ciruit digram and mention the values of resistances etc. which are used.
- Make a note of all the measuring instruments you have used.
- Mention the formulas used.
- Create a table and write down the readings, including the units.
- Show all your calculation neatly and SYSTEMATICALLY. Do this is an organized manner.
- Attach graph if any.
- Be concise. Complete sentences are not necessary as long as the context is clear.
- If mistakes are made, they should not be erased. Just bracket them and make a short note explaining the problem.
- Make entries as the lab progresses; don't assume you can fill it in later. The instructor will ask to see it during the lab.
- Date every page.
- All important results must be underlined.
- Attach simulation and hand calculation to your note book.
- Draw the figure using pencil before you come to the lab so that you can make corrections to it in case you need to do so by erasing and redrawing. This will ensure tidy and neat work.
- Prepare the READING TABLE using pencil and ruler and not just by sketching lines. Sketching gives rise to crooked lines and gives the lab notebook a haphazard look.
- Take a few short notes (2-3 lines), which explains some of the problems you encountered while doing the experiment. This will help you write better reports.

General Lab Report Format

Following the completion of each laboratory exercise in Electrical Engineering courses, a report must be written and submitted for grading. The purpose of the report is to completely document the activities of the design and demonstration in the laboratory. Reports should be complete in the sense that all information required to reproduce the experiment is contained within. Writing useful reports is a very essential part of becoming an engineer. In both academic and industrial environments, reports are the primary means of communication between engineers.

There is no one best format for all technical reports but there are a few simple rules concerning technical presentations which should be followed. Adapted to this laboratory they may be summarized in the following recommended report format:

- Title page
- Introduction
- Experimental Procedure
- Experimental Data
- Discussion
- Conclusions

Detailed descriptions of these items are given below.

- **Title Page:**

  The title page should contain the following information
  - Your name
  - ID
  - Course number (including section)
  - Experiment number and title
  - Date submitted
  - Instructors Name

- **Introduction:**

  It should contain a brief statement in which you state the objectives, or goals of the experiment. It should also help guide the reader through the report by stating, for example, that experiments were done with three different circuits or consisted of two parts etc. or that additional calculations or data sheets can be found in the appendix, or at the end of the report.

- **The Procedure**

  It describes the experimental setup and how the measurements were made. Include here circuit schematics with the values of components. Mention instruments used and describe any special measurement procedure that was used.

- **Results/Questions:**

This section of the report should be used to answer any questions presented in the lab handout. Any tables and/or circuit diagrams representing results of the experiment should be referred to and discussed/explained with detail. All questions should be answered very clearly in paragraph form. Any unanswered questions from the lab handout will result in loss of points on the report.

The best form of presentation of some of the data is graphical. In engineering presentations a figure is often worth more than a thousand words. There are some simple rules concerning graphs and figures which should always be followed. If there is more than one figure in the report, the figures should be numbered. Each figure must have a caption following the number. For example, *"Figure 1.1: TTL Inverter"* In addition, it will greatly help you to learn how to use headers and figures in MS Word.

- **The Discussion**

It is a critical part of the report which testifies to the student's understanding of the experiments and its purpose. In this part of the report you should compare the expected outcome of the experiment, such as derived from theory or computer simulation, with the measured value. Before you can make such comparison you may have to do some data analysis or manipulation.

When comparing experimental data with numbers obtained from theory or simulation, make very clear which is which. It does not necessarily mean that your experiment was a failure. The results will be accepted, provided that you can account for the discrepancy. Your ability to read the scales may be one limitation. The value of some circuit components may not be well known and a nominal value given by the manufacturer does not always correspond to reality. Very often, however, the reason for the difference between the expected and measured values lies in the experimental procedure or in not taking into account all factors that enter into analysis.

- **Conclusion:**

A brief conclusion summarizing the work done, theory applied, and the results of the completed work should be included here. Data and analyses are not appropriate for the conclusion.

Notes

Typed Reports are required. Any drawings done by hand must be done with neatness, using a straight edge and drawing guides wherever possible. Free hand drawings will not be accepted.

Prelab results should be reported in the provided sheets at the end of the manual. It is your responsibility to obtain the instructor's signature and to include the signed sheet with your final experiment report.

Each student must submit an individual report based on an individual effort.