EE/CE 3110

Electronic Devices Laboratory Manual

Department of Electrical Engineering

The University of Texas at Dallas

Richardson, Texas
This manual was first written by the late Professor Jan van der Ziel. It has been updated by Professors Lawrence Overzet, Jeong-Bong Lee, Samuel Villareal, Gil S. Lee, Randall Lehmann, and William Frensley. Significant help has come from several students including Lance Jensen, Karthik Colinjivadi, Masaho Asahara, Ashish Jindal, David Pierce, and Junhyeon Yoo.
Lab Contents

Lab safety rules and regulations.

Lab 1. Introduction to Lab Equipment

Lab 2. Introduction to LabView

Lab 3. Conductivity and the Hall Effect

Lab 4. Silicon Diode Characteristics

Lab 5. Light Emitting Diodes

Lab 6. Transient Signals of PN Junction Diodes

Lab 7. Bipolar Junction Transistor Characteristics (BJT)

Lab 8. Junction Field Effect Transistors (JFETs)

Lab 9. Metal Oxide Semiconductor Field Effect Transistors (MOSFETs)
Undergraduate Laboratories Rules and Regulations

Electrical Engineering Department
Erik Jonsson School of Engineering and Computer Science
University of Texas at Dallas

This manual introduction is intended to familiarize you with the regulations and requirements of the UTD undergraduate laboratories. Read it carefully. Please ask your TA or laboratory instructor to help you understand anything that is not clear after reading it. You are also invited to contact either the Lab Manager, Kevin Rogers (Office: ECSN 3.918, Email: kar140230@utdallas.edu) or the Electrical Engineering Department Chair about questions.

1. Safety Regulations

Safety must be the most important consideration for all students, staff and faculty within the undergraduate labs. As a result, the safety rules explained in this manual MUST be followed at ALL times. Failure to follow these safety rules may result in expulsion from the labs and the consequences associated with that expulsion.

The MOST important safety rule for Electrical Laboratories is:
Energized devices and/or circuits may not be touched. All energized devices and circuits must be considered dangerous to life and health.

Related (more specific) rules
1. Do not alter/touch any wiring connected to the wall outlets (including outlets that are built into the workstations) under any circumstances.
2. Students must ensure that all devices/circuits are de-energized before working on them or touching them.
   a. Disconnect and/or turn-off power supplies.
   b. Remove the charge from any components that store charge. (Capacitors etc.)
3. Never remove the safety covers from laboratory equipment including but not limited to: all lab instruments and computers.
4. Only lab staff is authorized to perform repair work or system checks on Lab bench equipment. (This includes something as simple as fuse replacement.)
5. Students may not work in the lab unless a lab staff member is present. (“Lab staff” includes: Teaching Assistants, “TAs”, instructors, faculty members and/or the lab manager.)
6. No student or group of students may work in the lab alone. The only exception is the designated “EE open lab” described in the final section of this lab manual introduction.
7. Students may not work on projects unrelated to their class unless the student has first obtained written permission for that work from the lab manager and lab-class faculty member.
   a. TA’s may not authorize projects unrelated to the student’s class.
b. Senior Design Project (SDP) work will take place in the “EE Open Lab” after the student(s) have received permission from the laboratory manager.
8. Since soldering irons are hot; you must carefully protect yourself and others from being burned.
   a. Do not assume that a soldering iron is cool simply because it has been turned off.
   b. Do not “flick” molten solder off the solder tip. Use the wetted sponge that is provided with the soldering iron holder or the steel wool cup solder remover.
   c. Turn off all soldering irons when finished. Leaving soldering irons energized is both a safety hazard and an equipment hazard.
9. Students must act in a professional manner at all times while in the lab. Practical jokes and horseplay are unacceptable and can result in expulsion from the lab.
10. Appropriate attire (clothing) is required inside the lab. Your attire:
   a. Must provide protection against sparks and molten solder for your arms, legs and torso.
   b. Must not be electrically conducting.
   c. Must not be “flowing” or “trailing” away from your person. (Examples include scarfs, boas etc. Such attire can present a hazard by becoming entangled in equipment or circuitry); and
   d. Must not distract other students from their work in the lab.
   e. Appropriate professional attire is required.

2. Lab Regulations

The following regulations are mandatory for all lab classes held in the EE labs. They provide protection for both students and lab equipment. Failure to follow these safety rules may result in expulsion from the labs and the consequences associated with that expulsion.

1. Test equipment may not be moved from one workstation position to another.
2. Computer and lab equipment covers may only be removed by the lab manager.
3. Food and Drink are not allowed in the lab at any time.
4. Students are expected to show up for their lab class at the scheduled time. Tardy students can be refused entrance to the lab.
5. Notify your TA if you damage a device/part or find a damaged device/part.
   a. He / She can check it out and if necessary, replace it.
   b. Note: Breaking a small device/part is generally not a significant problem, since they are subject to natural attrition.
   c. It is, however, important to the good operation of the labs to notify the TA about broken devices/parts.
6. Jumper wires (i.e., connector wires) are NOT to be cut or trimmed.
   a. They are not consumable parts and are to be used from one experiment to another.
   b. Our connector wire kits use multi-stranded, flexible wires with hardened end connectors. If you should badly bend or damage a wire end, tell the TA so the wire may be replaced.
   c. Note: Never use connector wires from the wiring kits for soldering practice! Special wire is provided for soldering practice in labs where soldering is taught.
7. Clean up your workstation after completion of your experiment and prior to leaving the lab.
   a. Leave the workstation position in better shape than when you began.
   b. Turn off ALL test equipment at your workstation.
   c. Clean bench tops, straighten instruments, and return cables to their racks.
   d. Your TA must inspect your workstation before you leave the lab. Students do not have permission to leave until their TA has given approval.
   e. If your workstation is a mess when you enter the lab, please tell your TA, so that it can be reported.
8. Do not wander through the lab. Remain at your workstation unless you must get something or the TA.
   a. Minimize disruption to your classmates and TA.
   b. Minimize hazards caused by unexpected events.
   c. Maximize your lab experience and that of your classmates.
9. Turn the soldering station OFF if you are leaving for longer than a minute or two. Leaving the station on causes extra wear on the equipment, and is an injury hazard.

Lab Security Policy

The following section covers overall lab security. It also covers various aspects of equipment checkout. Please note that violation of these policies may result in severe disciplinary action.

1. Students, TA’s and instructors will ensure that unattended laboratory rooms are locked. Our labs contain a large amount of valuable equipment and this investment must be protected.
2. Removing ANY equipment from a lab without prior written approval from the lab manager and following the standard EE checkout procedures constitutes theft and will be prosecuted.
   a. Undergraduate lab equipment will only be loaned out in extraordinary circumstances.
   b. Senior Design Project students may get permission to access to the “EE Open Lab” from the lab manager.
   c. Students, TA’s, instructors and faculty are not authorized to remove any equipment from the labs without written permission.
3. The “EE Open Lab” is normally available from 9:00 AM to 5:00 PM, Monday through Friday. Other hours may be available by appointment with the lab manager.
4. Students may not work in the lab unless a lab staff member is present. (“Lab staff” includes: Teaching Assistants, “TAs”, instructors, faculty members and/or the lab manager.)
   a. This includes lab classes held in ECSN 3.108/110, 3.112/114, and 3.118/120.
   b. Senior Design Project students may work unsupervised in the “EE Open Lab” once they are certified by the lab manager.
Internet Use Policy

This Internet Use Policy is an adjunct to the UT Dallas Internet Usage Policy. UTD internet policy supersedes this lab policy. This lab internet usage policy supplements UTD policy.

1. Never download any software from any internet source onto lab computers.
   a. The lab manager will do any required updating, system checks etc.
   b. This prohibits the download of all software including software required for viewing active WebPages, messaging software, etc.
2. Do not “surf the internet” using the lab computer. Lab computers are only to be used to control experiments and collect temporary experimental data.

Note: All Lab computers have “freeze” software installed. All changed or added information on the hard-drive is removed whenever the computer is rebooted. Therefore: students must save their experimental data on their own removable media (thumb [flash] drive) before shutting down the computer. Failure to save your data on a removable media will result in it being irrecoverably lost.

“EE Open Lab” Policy

Students in Senior Design Project classes may apply for access to the “EE Open Lab” provided they agree to follow the policy outlined in this document. “EE Open Lab” hours are Monday through Friday, 9:00 AM – 5:00 PM. In special circumstances, students may apply for unsupervised access to the “EE Open Lab” on weekends – see the laboratory manager. Access is via card reader using the student’s Comet Card. Underclassmen (sophomores and juniors) may have access to the “EE Open Lab” during the normal weekday hours when supervision is available. In general, underclassmen are not authorized to work alone in the "EE Open Lab". Note that the “EE Open Lab” hours are not a guarantee of lab access. They will be a good faith effort to enable student access to equipment as much as possible during normal business hours. Occasional closings of the "EE Open Lab" may be necessary due to lack of supervision.
I have attended the Undergraduate Lab Safety Orientation during my first laboratory class and have read the Undergraduate Laboratories Rules and Regulations document. With my signature below I affirm that: [1] I understand the Undergraduate Laboratories Rules and Regulations, [2] I agree to fully abide by all of the Undergraduate Laboratories Rules and Regulations. [3] I understand that a violation of the Undergraduate Laboratories Rules and Regulations may result in my expulsion from the labs until such time as I can receive remedial training and re-approval to enter the labs. Expulsion from the labs may affect my final course grade.

Name: ___________________________ Signature: ___________________________

Printed: __________________________ Signature: ___________________________

Date: ________________________________