Introduction to the Circuits and Electronics Lab

Objectives:

In this experiment you will learn the following:

- The basic safety rules in the lab.
- What tools to bring with you to the lab.
- The different types of components used in the lab.
- How to read the coded values on resistors, capacitors, and inductors.

A. Lab Safety

The voltages used in the circuits you will build and test in the Circuits and Electronics Lab are not dangerous since they do not exceed +/- 15V. Nevertheless the equipment that supplies and measures these voltages operates at hazardous levels (110 and 220 Volts AC.) Therefore you are required at all times to follow the proper procedures of handling the equipment in the lab to ensure your well-being, the well-being of people around you.

Always report any dangerous situation you encounter in the lab, eg. strange smell, spark, broken power wire, loose socket, etc. Report anything you are not sure about or that feels hazardous.

Plugging instruments for use

Always plug the power lead in the instrument on the bench *first*, and then in the socket. Never plug the power connector in the socket before the instrument: doing so may cause electrocution!

Unplugging instruments after use

After you are done using a device in the lab, you first start by detaching the power cable form the socket first and then form the instrument. Failing to do so is also hazardous.

Note As engineers you should always assess the situation around you and act appropriately to ensure the well-being of the people and environment around you. Always practice utmost safety when working in the lab and ask about anything you don't understand or you are not sure about. The lab instructor is always there to help you solve your problems and to show you the proper procedures to follow in the lab.

ANY STUDENT WHO INTENTIONALLY IMPOSES A DANGEROUS SITUATION IN THE LAB WILL NOT BE ALLOWED IN THE LAB BEFORE S/HE IS GIVEN PERMISSION BY THE APPROPRIATE DISCIPLINARY COMMITTEE.

B. Lab Reports

The cover sheet of your lab report should include the following:

- Your name and ID number
- Your e-mail
- Course number
- Your lab section and bench numbers
- Experiment number

The last sheet of the lab report should contain the following signed statement:

"I HAVE NEITHER GIVEN NOR RECEIVED AID ON THIS REPORT NOR HAVE I CONCEALED ANY VIOLATION OF THE AUB STUDENT CODE OF CONDUCT."

Note Reports lacking this statement and/or the signature will not be corrected.

Never use pencil in writing your lab report.

C. Lab Tools

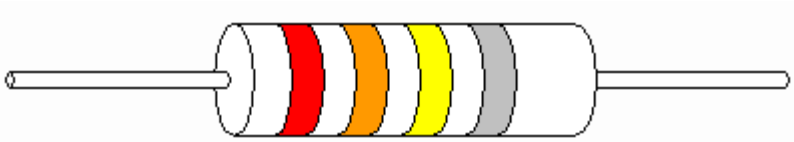
You are required to bring a complete toolbox with you every time you come to the lab. *A student with no toolbox will not be allowed in the lab*. The toolbox should include the following tools:

- Wire stripper for electronics
- Wire cutter for electronics
- Long nose pliers for electronics
- A set of precision screw drivers
- A good soldering iron with a silver-coated tip
- A good quality solder wire
- A stand for the soldering iron
- A plastic tool box for component storage

D. Electronic Components

Resistors

Resistors come in different varieties. The type you will use in the Circuits and Electronics Lab is color-coded: the colors on the resistor indicate the value of resistance.



Black	0	x 1
Brown	1	x 10
Red	2	x 100
Orange	3	x 1,000
Yellow	4	x 10,000
Green	5	x 100,000
Blue	6	x 1,000,000
Violet	7	x 10,000,000
Gray	8	x 100,000,000
White	9	-

The last band indicates the tolerance:
Gold=5% Silver=10% None=20%

Q **How do I read the resistor value?**

A *First find the tolerance band, it will typically be gold (5% tolerance) or silver (10% tolerance). Starting from the* other *end, identify the first band - write down the number associated with that color. Read the next color and write down the number associated with the second color. Now read the third or 'multiplier' band and write down that number of zeros.*

Resistors also come with different power ratings ranging form 0.25 watts to hundreds of watts. Resistors with big wattage usually have their values printed on them along with the power rating.

Exercise D–1: Write the values of the all the resistors you have in your lab component box.

	Resistor Value	*Resistor Colors*
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Variable Resistors

Resistors don't need to have fixed values variable resistors come in different packages and values. Some are linear in motion and others are circular.

Capacitors

Capacitors come in all kinds of shapes and colors depending on the material they are made of and their intended use. There are two main types that we will be using in the lab: the ceramic capacitor and the monolithic or chemical capacitors.

Ceramic capacitors don't have polarity and have a three digit number written on them. Similar to resistor codes, the first two digits represent the value, and the third is the number of zeros. The unit in this case is picofarads (1 Farad = 10^{12} picofarads.)

Electrolytic capacitors are polarized and have an arrow on the side indicating the negative pin. Failing to recognize the proper polarity while connecting the circuit will cause the capacitor to blow up! The value of capacitance along with the unit is printed on the case of the capacitor.

Exercise D–2: Write the values of the all the capacitors you have in your lab component box.

	Capacitor Value	*Capacitor Codes*
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Inductors

Inductors are supplied in packages similar to those of resistors. They also share the same color code of the resistors except for the unit which in the case of inductors is microhenry (1 Henry = 10^6 microhenrys.) Inductors can also be made out of a coil (a piece of rolled up wire.)

Exercise D–3: Write the values of the all the inductors you have in your lab component box.

	Inductor Value	*Inductor Codes*
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Diodes

There are three main types of diodes which we will use in this lab: The rectifier diode, the zener diode, and the light-emitting diode. Diodes are two terminal devices with a positive terminal and a negative terminal. Current flows from positive to negative. The negative terminal is indicated by a band printed on the case of the diode.

Bipolar Transistors and Mosfets

Bipolar transistors and mosfets are important components that are used in building analog and digital circuits. They come in different packages and sizes. Some have metallic cases while others have a plastic or ceramic package. Sometimes the case itself is one of the connecting pins. Transistors have three or four pins. The data sheet is the most important source of information to know the proper pin configuration and the element's internal characteristics. Each transistor is identified by a number imprinted on its case by the manufacturer. This number is used to locate the datasheet provided by the manufacturer on the appropriate web site.

Integrated Circuits

An integrated circuit (IC), sometimes called a chip or microchip, is a semiconductor wafer on which tens to hundreds of millions of tiny resistors, capacitors, and transistors are fabricated. An IC can function as an amplifier, oscillator, timer, counter, computer memory, or microprocessor. A particular IC is categorized as either linear (analog) or digital, depending on its intended application. These chips can be packaged in cases with different number of pins depending on the application.

Switches and Push Buttons

A switch or a push button is a device that makes a circuit connection or disconnects one depending on its type. They are characterized by whether they are normally closed (NC) or normally open (NO), and by the number of throws and number of poles.

Relays

A mechanical relay is a switch that is activated by an electromagnet. Once current flows in the coil, the resulting magnetic field will attract a metallic plate, causing the switch to change state. The coil can be energized by different power sources. The proper voltage is indicated on the relay package. The main disadvantage of mechanical relays is that they can't operate at high switching frequencies due to mechanical limitations.

Solid-state relays are electronic devices that are easy to connect as a mechanical relay, and can operate at relatively high frequencies. Their drawback is that they don't have as many poles as other types of relays.