REU Orientation

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General

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General Rules

• All equipment, tools, and materials are the property of the University of Tennessee and may only be used for University business, not personal use.
• Please be careful with food and drinks and clean up after yourself.
• Electrostatic Discharge (ESD) sensitive devices
  – Symbol
  – Do not handle without using a ground strap or touching ground first
  – Do not permit static producing materials around ESD sensitive devices, i.e., tape, Styrofoam cups or containers.
• Use paper or cardboard on tables to protect the surface from glues and markers.
• Do not write on equipment or furniture.
• Please exercise caution on campus, especially at night or in secluded areas.
General Lab Safety

• Our power labs can be dangerous so please exercise extreme caution in these labs
  – Experiments are not normally allowed to be run with a person present.
    • One experiment in room 125 is powered on without a person present to control it
    • Extreme planning and test set-up changes were made to allow this exception
  – Be proactive, ask the person running experiments to define hazardous voltage and current conditions
  – Ask your mentor

• Safety Equipment
  – First Aid kits are by the main lab door
  – Safety glasses are provided for your use
    • Located by the main lab door
    • Must be worn when doing any mechanical or electrical work or when there is a flying particle risk
  – Hearing protection is available – please ask when needed
  – Respiratory protection is available – please ask when needed

• All injuries must be reported
Electrical Safety

• Low voltage does not mean low hazard!
• Currents greater than 75 mA cause ventricular fibrillation (very rapid, ineffective heartbeat). This condition will cause death within a few minutes unless a special device called a defibrillator (AED) is used to save the victim.
  – Two AED’s in Min Kao (1st & 4th floors)
  – One in SERF (3rd floor lobby)
• Heart paralysis occurs at 4 amps, which means the heart does not pump at all.
• Tissue is burned with currents greater than 5 amps.
Electrical Safety

  – Electrocution is the fifth leading cause of work-related deaths for 16- to 19-year-olds.
  – Electrocution is the cause of 7% of all workplace deaths for 16- to 19-year-olds.
• The amount of internal current a person can withstand and still be able to control the muscles of the arm and hand can be less than 10 milliamperes (milliamps or mA).
• Currents above 10 mA can paralyze or “freeze” muscles. When this “freezing” happens, a person is no longer able to release a tool, wire, or other object.
• People have stopped breathing when shocked with currents from voltages as low as 49 volts. Usually, it takes about 30 mA of current to cause respiratory paralysis.
Power Electronics Lab Safeguards

- Red emergency off buttons by lab exit doors in Min Kao
  - This button is different from the emergency exit button which also is by the door
  - Hit red button to kill power
  - Kills all power in room except lights
- Most outlets in Min Kao Power Electronics labs for CURENT are GFCI protected
  - GFCIs are set at 5 or 30mA and are designed to protect workers from electrocution.
  - GFCIs are able to detect the leakage current through a person who is beginning to be shocked. If this situation occurs, the GFCI switches off the current in the circuit.
  - GFCIs are different from circuit breakers because they detect leakage currents rather than overloads.
  - GFCIs detect far lower currents than wall outlet circuit breakers
- SERF lab has neither emergency off buttons nor GFCI protection
Electrical Safety Restrictions

• Lab Access
  – REU students are not allowed in power electronics labs without an escorting mentor
  – Use caution and stay away from bench test setups even if you believe it is powered off
• Live power testing restrictions
  – Two persons must be present when live testing is performed
  – Both persons must know how to fully de-energize the test set-up in the event of any unsafe incident
  – No REU students may work on live circuits – (They may observe testing from a safe distance with proper safety training and use of any necessary safety equipment, i.e. safety glasses)
• Equipment Use
  – If you aren’t familiar with specific equipment, ask for training by your mentor before using
  – Pay particular attention to input ratings
  – Equipment damage is extremely expensive to repair, $1K- $5K
Electric Boundaries

• Electrical Shock Boundary Definitions
  – The limited approach boundary is the closest an unqualified person can approach, unless a qualified person accompanies you.
  – The restricted approach boundary is the closest to exposed live parts that a qualified person can go without proper PPE (such as, flame-resistant clothing) and insulated tools.
  – The prohibited approach boundary—the most serious—is the distance you must stay from exposed live parts to prevent flashover or arcing in air.

• Electric Shock Boundaries To Live Parts for 300–600 Volts
  – Limited Approach Boundary = 3 ft. 6 in.
  – Restricted Approach Boundary = 1 ft.
  – Prohibited Approach Boundary = 1 inch

• The flash protection boundary is where you need Personal Protection Equipment (PPE) to prevent incurable burns, if there’s an arc flash. This distance is 4 feet.
General Fire Safety

• Emergency exits
  – East side, 1<sup>st</sup> floor North & 1<sup>st</sup> floor South exits
  – West side, 4<sup>th</sup> floor North & 5<sup>th</sup> floor South exits
  – Remember that the quickest way out may be up

• Fire alarms, pull on exit

• Evacuation routes,
  – Don’t use elevators
  – Some hall doors are unidirectional during fire alarm

• Meeting point
  – Parking lot East of building
  – Across the street away from building
Fire Extinguishers

- Know the location of fire extinguishers where you are working
- You are not required to fight a fire
- If a fire is too big to be put out with one extinguisher – pull the fire alarm and evacuate
- Use the extinguisher, if you know how – otherwise, get out!
- All fire extinguishers are marked with letter(s) that tell you the kinds of fires they can put out.
- The letters and symbols are:
  - A (think: Ashes) = paper, wood, etc.
  - B (think: Barrel) = flammable liquids
  - C (think: Circuits) = electrical fires
Electrical Fires

• Electricity is one of the most common causes of fires and thermal burns in homes and workplaces.

• Defective or misused electrical equipment is a major cause of electrical fires.

• If there is a small electrical fire
  – Shut off the power first, if possible
  – Use only a Class C or multipurpose (ABC) fire extinguisher, or you might make the problem worse.