DEPARTMENT OF PHYSICS

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LABORATORY INSTRUMENTS SAFETY MEASURES MANUAL

1. Objective:

The purpose of this document is to inform the physics student of the basics of laboratory safety and point out the most common types of safety hazards in the physics laboratory. Department of Physics are equipped with many Instruments and tools that has to be used very carefully to obtained precise output. You will be learning all safety instructions or warnings given throughout this manual that relate to specific measurement functions. This document listing of the safety hazards in the laboratory and play the role of alerting the students about common sense when working with laboratory equipment.

Student Responsibilities

The students in the physics lab are expected to exercise good sense while working with laboratory equipment, the student should exercise extra caution and ask the instructor for assistance. Safety is more important than pride and questions about safety will be answered promptly by the instructor. Note that it is better to NOT proceed if you suspect a safety issue than to learn the hard way! Students are expected to listen to and follow all instructions given by the laboratory instructor. This includes all safety precautions and guidelines.

Primary Physics Laboratory Safety Concerns

The physics laboratory doesn't usually use chemicals like biology and chemistry labs, there are still safety concerns that not everyone is commonly aware about. In the physics lab, the main concerns are mechanical, extreme heat and cold, electrical, radiation.

Many of the devices in the physics lab require mechanical motion and use significant amounts of mass. Students should be careful to place themselves and sensitive electronics out of the path of these masses in case a string or other holding device was to fail. This does happen from time-to-time in introductory laboratories.

In the heat and thermodynamics experiment two different heat mechanisms are used: boiler and stove, hot plate. Care should be taken while heating the objects by either method. Use insulating gloves and large tongs to transfer the object in and out of the furnace or hotplate. Check the electric furnace with tester for any leakage current before touching it.

A He-Ne laser (633nm, 3mW) is being used in optics experiment. Direct staring into the beam will damage the retina of the eye. Safety goggles should always be worn while working at the level of the laser beam. Extra precautions are needed while working with cryogenics in the lab.

In the Liquid Nitrogen L-N2 experiment, cryogenics gloves and safety goggle should be worn. There's always a chance of accidental spillage of L-N2 which can avoided by caution and common sense. Always avoid direct contact with L-N2 as it will cause frost bite and, in some cases, irreversible damage to skin.

The variac (variable transformer) is rated at 5KVA, 20A. High voltage /current can be lethal so rubber gloves should be used while working with it. Always check for leakage current in the magnetic phase transition apparatus prior to operation and operate the variac with one hand.

2. Introduction:

A wide range of instruments and tools related to power are being used in physics laboratories from high voltage power supplies. The risks involved include power shocks, radiation hazards, injuries and adverse health effects. This calls for utmost care in handling of physical, and power instruments from the time of start to end of each experiment during physics electronics practical. Before entering the lab, Wear closed shoes. Long pants are a must, avoid loose sleeves, as they are impractical when working. The objective is to prevent any type of mishaps inside laboratory which requires a proactive approach in identifying problems and putting control measures in laboratory while performing the experiments.

3. Purpose and Scope:

This explains the general rules and regulation guidelines involved in Physics laboratory for the students of academic and research.

4. Responsibility:

❖ Students, subjected technical Staff and professors are responsible for the laboratory safety guidelines

process.

❖ Department Head and Professors will ensure the implementation of this safety measures.

❖ Department Head and Principal will monitor compliance to this safety measures.

5. Procedure:

This Physics laboratory safety manual is compiled to be used as a binding document for all the students and staff of Physics to ensure safe work conduct and practices inside the laboratory.

Procedures and Rules within this Manual are formulated for three reasons:

1) To avoid health risks and accidents for our personnel.

2) To be in a position to act appropriately in case of emergencies.

3) To minimize the environmental burden and risks caused by our work.

This manual cannot cover all circumstances where safety procedures must be applied. it is intended to set up a framework of how should work in physics laboratories. The avoidance of safety risks for the personnel at the institutional level requires knowledge of possible hazards in our environment; chemicals, power or radioactivity. In this regard students and staff of physics are required to familiarize themselves with safe practices for applied laboratory operations.

Laboratory Rules and Regulations:

Students in physics laboratory must have an orientation before starting the practical's. They should be given instructions as to how to operate major equipment including microscope, analytical balance and pH meter. The orientation should also include potentials for short circuit, fire, spill of chemicals, handling heavy instruments.

Good laboratory work habits will help you a grand success. Follow the following guide lines very strictly. These will protect you and your experiments.

Dos and Don'ts inside laboratory:

1. Student should wear clean lab-coat every time before you enter a laboratory.

2. Student should not deviate the instructions given by the instructor inside laboratory.

3. Shouting, playing and running inside the laboratory is strictly prohibited.

4. Using mobile phones in lab is strictly prohibited.

5. Do not smoke, drink or eat in the laboratory.

6. Before starting work, clean the working table with disinfectants like 70% alcohol or dilute detergents
   like dettol or lyzol.

7. The table should have a notebook and equipment that are needed.

8. In case of any incident or injury inform your instructor immediately.

9. Without the instruction and supervision of instructor one should not touch any equipment.

10. Ensure the entries in respective log book records before taking chemicals or using instruments.

11. Discard organic solvents (phenol and chloroform) in waste containers.

12.. Materials like chemicals, stains, reagent bottles, unused glass-wares, etc. must be replaced in their
original place.

13. Clean microscope lens before and after use.

14. Toxic chemicals should be handled with precaution and while discarding used ones they should be discarded in labelled containers. Toxic chemicals, besides organic solvents, include mercury compounds, some halogens, mutagenic chemicals, radioactive substances, etc.

15. Broken blades, sharp instruments and broken glass pieces should be disposed in separate containers.

16. First aid kits must be placed in each laboratory.

17. Portable fire extinguishers should be kept ready.

18. Use specific toxic and mutagenic chemicals under fume hood.

19. Wear safety glasses, masks, hot gloves and rubber aprons while handling concentrated acids and bases.

A laboratory report should be prepared for each experiment in the following format:

1. Experiment number and title of the experiment.

2. Date of experiment.

3. Introduction and principle of the experiment.

4. Method/Procedure followed.

(Do not copy methods from manual directly. Refer to manual and write the method on your own, the way you have conducted the experiment)

5. Place a flow chart at the end.

6. Results and discussion/conclusions.

Complete description of what you have observed, include circuit diagram, graphs, tables, etc. Each graph, table, figure, etc. should bear a title, a number and legend that contains all information needed to interpret data.

Vernier Microscope

1. The parallax in a microscope should be removed properly.
2. To avoid backlash error, the microscope should be moved upward.
3. The scale used in the microscope might not be calibrated properly.
4. Crosswire should be in proper position

Vernier Calliper

1. Make sure the instrument is clean and make sure it works (no forced friction between Vernier scale and main scale)
2. Check for Zero error (error resulting in the wrong collaboration of the instrument)

Spectrometer

1. Allowing the lamps and electronics to warm up
2. Using the correct wavelength
3. wiping fingerprints and spilt sample off the outside of the cuvette before measuring
4. carrying out the set-up procedure in the correct order
5. performing calibration checks after set up
6. closing the door to the cuvette compartment before reading the result
7. cleaning up any spills inside the cuvette compartment

Sonometer

1. The wire should be of soft iron or of any other magnetic material.
2. Tip of electromagnet should be very close to the wire in its middle*
3. Length should be noted when the amplitude of vibration is maximum.
4. The wire should be of uniform cross-section and there should not be any twist or bend in it.
5. The pulley should rotate without friction.
6. Put that much weight in the pan so that the deformation produced in the wire should not exceed the elastic limit.

7. The stem of the tuning fork, not its prongs, should be placed on the sonometer box or on the support.

Lee's Disc

Be careful to avoid touching the hot surfaces of the steam generator, plastic tubing and the Lee's disk apparatus. Make sure that the steam outlet tube from the apparatus goes to a sink.

Boiler

1.Insulate or heat water pipes. Water pipes leading to and from your boiler can freeze just like the pipes in your house.

2.Make sure your fuel flows properly.

3.Drain when not in use.

4.Have your boiler serviced.

5.Combustion Air Temperature.

6. Water Levels.

Potentiometer

1.The positive terminal of the cells whose e.m.f. is to be compared must be connected to that end of potentiometer wire where positive terminal of the battery (driving cell) is connected. The potentiometer wire must be uniform.

Ballistic Galvanometer

1.Galvanometers are not normally risky to use. If you can find one anymore, the main danger is the high voltage circuit you may elect to measure with it, then there is the risk of shock to the user when connecting it.

e/m Apparatus

1.Before turning on any power supplies or plugging in any equipment, read all of the following instruction. Turn the 0-300V adjustment knob on the gun supply fully CCW before turning on power supply. Do not adjust the filament current knob for the 6.3VAC supply.

2.Let the filament of the e/m tube warm up about a minute before applying the accelerating voltage.
Reduce the accelerating voltage to zero before switching off the power supply.

3.Limit the accelerating voltage to 250 volts, although the supply will go higher.

4.Be very careful around the glass e/m tube. Hard knocks can cause the tube to implode, causing an expensive replacement as well as possible eye damage.

5.The mains voltages in the mains powered equipment is dangerous but is screened in normal use.
The fine beam tube requires dangerous contact voltages up to 300 V.

Stefan's Constant

1. Keep dimmer stat to zero-volt position before start.
2. Increase the voltage gradually.
3. Start the cooling circuit before switching ON the heaters and adjust the flow rate so that practically there is no temperature rise in the circuiting fluid.
4. Keep the heater plate undisturbed and adjust the cooling plates after keeping the samples with the help of nuts gently
5. Keep the loosely filled insulation (Glass wool) packets gently and remove them slowly so that they do not disturb the thermocouples terminals and heater wires.

Four probe apparatus

1.Unit is operated on 9V x 3 batteries. In case there is any problem in operation, please check the batteries also. Batteries are assessable after opening the Top Cover of the unit.

2.The surface on which the probes rest is flat with no surface leakage.

3.The diameter of the contact between the metallic probes and the semiconductor should be small

compared to the distance between probes.

Hall Effect

1.The magnet power supply can furnish large currents at dangerous voltage levels; do not touch exposed magnet coil contacts.

2.AC leads from Variac to oven can be dangerous; they should not be exposed.

3.Never suddenly interrupt or apply power to a large magnet. Large inductive voltage surges may damage the insulation. Start with controls set for zero current and gradually increase current. When turning off, smoothly decrease current to zero and then turn off.

4.Turn on water before turning on magnet coil.

5.Do not exceed magnet current of 10 A and Hall probe current of 0.4 A

6.Do not exceed an oven temperature of 100°C (a few degrees more for a brief time will do no harm).

7.Do not leave the magnet current at a high setting for any length of time beyond the minimum needed for data acquisition - it affects the monitor (obviously).

Box Furnace

1. Always wear safety glasses and protective clothing when working in oven room. Use gloves and tongs while handling the specimen. Keep flammable materials away from the furnace, including things like paper, flammable liquid, old rags, etc. Cover the quench tanks when not in use.

2. Due to the extremely high temperatures that lab furnaces operate at, there is always the increased risk of fire. Fires can be caused due to improper use of a lab furnace, for instance, if a flammable chemical or material is placed inside a furnace by mistake.

3. Fire resistant surfaces should also be available outside of the lab furnace for hot samples to be placed on after heat treatment. Proper ventilation is also vital for lab furnaces. If the room the lab furnace is situated in doesn't have sufficient ventilation, there can be a fire risk when the furnace is in operation.
4. A lab furnace should always be under observation when it is in operation, as faults may occur such as smoke or a strong odour, which could be an indication of a fire.
5. Protective clothing is essential when operating a lab furnace to prevent burns. Heat resistant gloves, overalls, and shoes should be provided to all individuals who operate the furnace to protect their skin. If employees come into extremely close contact with the lab furnace, goggles and face shields may also be necessary.
6. The outer shell of the lab furnace must have sufficient insulation to ensure that does not heat up too much to cause burns to operators when they are opening and closing it. The samples taken out of the furnace must also be clearly labelled as hot, to ensure that they are not handled before they have finished cooling down.
7. The samples within lab furnaces can often be hazardous, so spillage of these samples can be extremely dangerous for operators. Care should be taken when moving samples to try and avoid spillages, but when they do occur they should be cleaned quickly. Cleaning any spillages also helps to avoid any cross-contamination between samples.

pH meter

1.Before use, rinse the electrode with deionized water and blot dry with a soft, clean paper towel,

Rinse the electrode with deionized water and store according to the manufacturer's instructions

2.Select for calibration two buffer solutions that are within 3 pH units of the solution to be tested. Discard contaminated or cloudy standard buffers.

3.Replace the electrode filling solution on a regular basis, according to the manufacturer's instructions. Record in the logbook.

4. Repair and service of the pH meter should be done by a qualified service technician

Magnetic stirrer

1.Place the magnetic stirrer on a stable well-levelled surface.

2. Fill the glass container with the liquid to be stirred.

3. Plug the mains cable into a suitably earthed socket.

4. Check that the speed control knob is completely turned anti-clockwise.

5. Place the glass container on the centre of the magnetic stirrer.

6. Press the On /Off switch to turn the magnetic stirrer on. The switch will light green.

7.Continue to adjust the speed control knob until the desired stirring speed is achieved.

Centrifuge

1. To assure that the centrifuge rotor is balanced, insert the tubes so that they are across from each other. The tubes should have the same volume for balancing the rotor.

2. Add an additional tube with water if needed for balancing.

3. Close any lids before operating the centrifuge. Turn speed and time knobs to desired setting.

4. Wait for the centrifuge to come to a complete stop before trying to open it.

Electronic digital Balance

1. Plug in the balance and press the On button.

2. Make sure the weigh pan is clear and clean

3. Press the On/Zero button on the left to zero the balance. Make sure it is reporting in grams.

4.Using a clean, dry spatula or scoop, add chemicals to be weighted to the weigh paper/boat until the desired mass is obtained. Hold the chemical bottle directly over the weigh paper/boat to reduce mess from spill.

5. Remove weigh paper/boat from balance pan. Put lid back on chemical bottle and return it to its designated location. Clean any spilled chemicals.

Microwave bench

While microwave use in the laboratory is considered to be relatively safe, the following safety precautions should be taken to prevent high doses of exposure to microwaves and personal injury:

1. Keep all the knobs in minimum position before going to switch 'ON' the power supply of VSWR / Klystron power supplies. Note: For klystron power supply "HT" should be 'OFF' before switching 'ON' the main supply.

2. Beam knob should be completely in anticlockwise direction and repeller voltage knob should be completely clockwise direction.

3. Switch on the main supply and give some warm up time to get current / accurate reading. 5

4. After the completion of experiment, before going to switch off the mains keep all the knobs in minimum position (i.e.) as those are in rule 1.

5. If the main supply failed in the middle of the experiment, come to 1st condition (i.e.) keep all the knobs in minimum positions and switch off main switches.

6. Don't increase the repeller voltage more than -70V (i.e.) it should be between -70Vto - 270V.

7. Periodically inspect and clean door seals and hinges.

8. Use a microwave leakage detector to check for microwave leakage from the door seals on a regular basis.

9. Always handle containers with potholders or thermal mitts.

10. Never operate the microwave without a minimum volume of microwave-absorbing material inside the container.

11. Never heat food in a microwave oven used for laboratory procedures.

Microprocessor and Microcontroller kit:

1. Properly connect the 8085/8086/8051kit with power supply terminals.
2. Switch on the power supply after checking connections
3. Handle the Trainer kit carefully.
4.Make sure that all the machine codes should be as per specified in the program.

Ultrasonic interferometer:

Instrument is adjusted in the following manner:

1. Insert the cell in the square base socket and clamp it with the help of screw provided on one of its side.
2. Unscrew the knurled cap of cell and lift it away from double walled construction of the cell in the middle portion of it pour experimental liquid and screw the knurled caps
3. Two chutes in double wall construction are provided for water circulation to maintain desired temperature.
4. Connect the High Frequency Generator with cell by co-axial cable provided with the instrument.
5. In Multi Frequency Ultrasonic Interferometer frequency selector knows should be positional at desired frequency and cell should be used of the same frequency. For initial adjustment two knobs are provided on high frequency generator, one is marked with “Adj” the position of the needle on the Ammeter is adjusted and the knob marked “Gain ”is used to increase the sensitivity of the instrument for greater deflection if desired. The ammeter is used to notice the number of maximum deflections while micrometre is moved up and in liquid as described in “Measurement” of this Instruction Manual
6. Do not switch on the generator without filling the experimental liquid in the cell.
7. Remove experimental liquid out of cell after use. Keep it cleaned and dried.
8. Keep micrometre open at 25mm after use.
9. Avoid sudden rise or fall in temperature of circulated liquid to prevent thermal shock to the quartz crystal.
10. While cleaning the cell care should be taken not to spoil or scratch the gold plating on the quartz crystal.
11. Give your generator 15 seconds warning up time before the observation