Safety Manual

School of Physical Sciences

National Institute of Science Education and Research (NISER), Bhubaneswar

February 2013

Compiled by

Physical Sciences Safety Committee

Common Safety Symbols

Caution

Warning

High Voltage

Radio activity/X-ray Radiation

Laser Radiation

Magnetic field

Harmful or irritant

<u>Zero watt bulb glowing in front of the Lab: Laser is switched on inside.</u>

Safety in the Lab

The following are important safety issues and warnings:

Electrical safety:

1. Dry your hands before touching any electrical sockets & equipments.

2. Before use, always perform a visual check on equipments run by electricity, looking for obvious wear and defects.

3. Whenever dealing with electronics or electrical circuits, make sure there is no power going to the circuit when modifying it.

4. To prevent shock (especially on high voltage devices) use only one hand to touch the circuit whenever possible.

5. Do not touch the metallic (conducting) parts of the equipments when the electrical power is on or the experiment is being performed.

6. In case of laying electrical cords on ground, make sure that no one trips on them and gets caught in them.

7. Ensure that you unplug the device by pulling the plug & not the cord.

8. If any circuit you are working with begins generating an excessive amount of heat, it could be due to a short circuit in the wiring. Immediately stop the supply of power and search for leads that are unintentionally touching. Immediately report to the lab instructor and technical staff nearby.

9. Capacitors & photo detectors even when disconnected from a circuit may retain static charge for a long period of time. They may deliver a painful shock even without power. If you are unsure of whether a capacitor is still charged, hold a resistor against the two contacts to discharge it.

10. Take extreme precaution while working with electromagnets as they carry very high magnitude of current.

Heating safety & handling cryogenics:

1. Let the hot plates/steam baths cool down before you touch them.

2. Use protective gloves and tongs to handle/touch hot objects in the experiment. Take help of the instructor & lab operators for handling hot objects

3. In case of any fire outbreak, immediately alert everyone who is near you. Locate the fire-extinguishers and other fire-fighting objects near you. Immediately inform the instructor & lab operator.

4. In case of burns, immediately flush with cold water until burning sensation is lessened.

5. Liquid gases like liquid nitrogen are extremely cold (much below 0° C) and cause burns. You must have special training to use them.

6. Liquid gases evaporate and may cause asphyxiation. Inform the instructor in that case.

7. If you need to take cryogens in a lift, there are special procedures to follow – speak to your instructor or a senior member of technical staff

8. While using immersion heaters, ensure that heater is immersed in water properly. Do not remove the immersion heater before disconnecting it from the power supply.

Laser radiation safety:

1. The devices emitting laser radiation will have a symbol 

2. The detailed specification of power level, wavelength etc. will be mentioned adjacent to the symbol shown above. Take note of it and consult the instructor before using the device.

3. Never bring your eyes in the path of ANY LASER beam in the visible ($400\ nm < \lambda < 750\ nm$) and near-infrared ($750\ nm < \lambda < 1450\ nm$). It could **permanently damage** your eyes.

4. Take extra precaution while handling near-infrared laser as they are damaging to eye but invisible to us.

5. Avoid exposing any part of your body to direct laser beam.

6. In laser based experiments, it is important to know where the beam is getting focused. Do not insert any part of your body close to that region.

7. Take the help on manual or the instructor to know the power level or power rating of the laser. For high-power lasers (> 100 milliwatt), avoid looking at the scattered beam and wear appropriate eyewear.

8. In case your eye accidentally comes in the direct beam path, stop the experiment & inform the instructor. Visit an ophthalmologist (eye-specialist) soon and get an eye-check up.

9. In case your body-parts (other than eye) accidentally come in the direct beam path and you are having some burning sensation, immediately stop the experiment. Keep the exposed part of body in cold-water and wait till the burning sensation reduces. Consult a doctor at the earliest.

Radiation safety for radioactive sources:

1. The radioactive areas (used for storage and handling) in the lab are marked with the label - 

2. Avoid unnecessary movement in the labeled areas. Unauthorized access to radioactive sources is strictly prohibited.

3. Handling of radioactive sources is to be done under strict supervision of an authorized person trained for radiation safety. You need to fill up the log book meant for usage of radioactive sources without fail.

4. **External exposure** to radiations (i.e. when radioactive source is outside your body) is controlled by TIME, DISTANCE and SHIELDING concept:
   (i) Limited TIME of exposure to the sources.
   (ii) Maintaining maximum practicable DISTANCE from the sources using gloves/tongs.
   (iii) Using suitable shielding materials (such as Perspex for β and lead blocks for γ radiations).
   NOTE: γ, X and neutron radiations are most serious as external radiation hazards due to their ability to traverse large distances.

5. **Internal exposure** (i.e. when radioactive source is inside your body) to radiations can cause potential radiation hazards if inhaled, ingested or absorbed through the skin, leading to dangerous exposure to internal organs. So use protective clothing (gloves, masks) and maintain clean working conditions while handling liquid unsealed sources.
   NOTE: α- rays are most serious as internal radiation hazards due to their inability to come out of the body.

6. In labs, you will mostly use sealed sources which are small in size and portable. So extra care must be taken to secure them. DO NOT MOVE OUT OF THE EXPERIMENT AREA CARRYING THE SOURCE WITH YOU. Place the sources back in their cases after finishing your experiment.

7. Avoid tampering the sealed sources. Please inform the instructor & lab-operators immediately if you suspect any tampering or leakage from the source. IN CASE OF LOSS OF A SOURCE INFORM THE INSTRUCTOR/LAB-OPERATOR IMMEDIATELY TO TAKE PRECAUTIONARY ACTION TO AVOID RADIATION EXPOSURE.

8. If you are using unsealed liquid radio nuclides, work shall be carried out in a double container or over trays lined with absorbent paper to restrict the spread of any spilt liquid. The bench of the work area shall be covered with absorbent paper.

9. In the event of a spill verbally warn others, restrict unnecessary movement into and through the area, report the spill immediately to the instructor or Radiation Safety Officer (**Dr. S. Prusty**) for further action.

10. Any kind of contaminated waste (gloves, masks, absorbent papers, containers etc) is to be disposed ONLY into the trash containers designated for radioactive waste.

Chemical Safety Instructions

Safety Glasses. All Users must wear *Safety Glasses* while using Chemicals.

Contact lenses wear should be restricted while using chemicals.
Chemicals used in physics labs, isopropyl alcohol (isopropanol) and Ethyl Alcohol (Ethanol) react with contact lenses.

Hand Gloves. Appropriate Hand Gloves should be used while using Chemicals**.**

Acids and Synthesis. Concentrated acids should be handled carefully and fume hoods should be used to carry out preparation reaction which involves emission of gases**.**