CBCS SCHEME

USN 1 CR 19 CS 11 K

18ME753

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Industrial Safety

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the term industrial safety. Explain its significance role in industry. **(10 Marks)**

b. Explain the following:
(i) MSDS
(ii) Slip
(iii) Trip
(iv) Fall **(10 Marks)**

OR

2 a. What is called locked out and tag out procedure? Explain with suitable example. **(10 Marks)**

b. Write a note on a case study about the road safety. **(10 Marks)**

Module-2

3 a. What is called Fire Triangle? Explain with suitable sketch. **(10 Marks)**

b. Explain different types of fire and its hazardous effect with some example. **(10 Marks)**

OR

4 a. What is called fire extinguisher and how it is operated? Explain with all its parts with sketch. **(10 Marks)**

b. Explain about the different types of fire hazards which are observed our surrounding. **(10 Marks)**

Module-3

5 a. Write short notes on the following:
(i) PPE
(ii) Machine Safety Tools **(10 Marks)**

b. What are various mechanical hazards in industry? Explain with example. **(10 Marks)**

OR

6 a. Write short notes on the following:
(i) Safety for compressed gas cylinder
(ii) Safety for lathe machine **(10 Marks)**

b. Discuss with a case study about the safety measure for construction industry. **(10 Marks)**

Module-4

7 a. Define electrical safety. What are the factors which ensure electrical safety in work place? **(10 Marks)**

b. List and explain various causes of electrical accident. **(10 Marks)**

OR

8 a. Explain about the various safety precaution against shock while residential building installation. (10 Marks)

b. With suitable case studies, explain the standard measure taken by local distribution system. (10 Marks)

Module-5

9 a. What is called chemical safety and explain its various chemical hazards. (10 Marks)

b. Write short notes on:
(i) Acid hoods
(ii) Eye washer (10 Marks)

OR

10 a. Explain the various methods for labeling of chemicals. (10 Marks)

b. Explain the various reason of accident in chemical industry with suitable case studies. (10 Marks)

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SOLUTION FOR VTU QUESTION PAPER 2022-2023(ODD SEM)

MODULE 1

1. a. **10M**

Solu:-

Industrial Safety is a multi-disciplinary approach to developing and ensuring compliance with regulatory agencies, safe working practices, and maintaining the health and well-being of those employed in a particular occupation or workplace.

Significance being:

A. Safety programs create productive work environments

B. Absenteeism drops when effective safety programs are introduced

C. Work premises are kept to higher standards

D. A safe work environment produces happier employees

E. Employee insurance claims decrease in safe work environments

F. A company's most valuable asset is protected — its people

G. Safety programs enable a company to win and retain business customers

H. Safety programs create an environment where safety improvements are considered, encouraged and implemented

I. Safe work environments enhance the brand value and goodwill for a company

J. Safety reduces business costs and disruption

Workplace safety promotes the wellness of employees and employers alike. Better safety equates to better health. Healthier employees do tasks more efficiently, and they are happier in general. There are very few accidents in a safe working environment.

When used to qualify an object, such as a system, structure, component, or accident sequence, this term identifies that object as having an impact on safety, whether determined through risk analysis or other means, which exceeds a predetermined significance criterion.

1. b. **10M**

Solu:-

MSDS: The Hazard Communication Standard (HCS) requires chemical manufacturers, distributors, or importers to provide Safety Data Sheets (SDSs) (formerly known as Material Safety Data Sheets or MSDSs) to communicate the hazards of hazardous chemical products.

Slip: An act of sliding unintentionally for a short distance or a fall to a lower level.

Trip: To hit something by foot while walking or running so that a person falls

Fall: Move something from a higher level to a lower level rapidly and with no control.

2. a. **10M**

Solu:-

LOCKOUT AND TAGOUT PROCEDURE

When machines or equipment are being prepared for service or maintenance, they often contain some form of "hazardous energy" that can cause harm to people in the area. When we talk about hazardous energy, we mean any type of energy that can be released and might harm a person. This could include energy of the following types:

- Chemical
- Electrical
- Hydraulic
- Mechanical
- Pneumatic
- Thermal
- Other sources of energy.

Without the use of proper LOTO safety procedures, the serviced equipment can unexpectedly start up or otherwise release these forms of energy. This can lead to injuries and even death to the people working on the machine and even to others working in the area or living in the community.

LOTO PROCEDURE

Step 1: Detailed procedures for equipment:

- Begin by making sure you've identified the equipment correctly and accurately.
- Determine the correct procedure for shutting down and restarting the equipment.
- Detail that procedure, step by step, in writing.

Step 2: Notify affected employees:

- When maintenance is going to be performed, all of the employees that may be affected should be notified.
- Let them know the timing of the work, and how long the equipment may be unavailable.

Step 3: Shut down equipment properly:

- It's not enough to say something like "disconnect the machine." To ensure everyone's safety and reduce the potential for damage.
- Ensure all electric supply are disconnected nothing but all primary sources of energy.
- Ensure there is no secondary source of energy that can harm employees or workers.

Step 4: Disconnect all primary energy sources:

- The primary energy sources include electricity, steam, water, gas, compressed air.

Step 5: Address all secondary sources:

- Sources of residual energy, such as trapped heat in a thermal system, fumes that may need to be vented or even tension in a spring assembly should be released.

Step 6: Verify the lockout:

- Once you've disconnected all primary and secondary sources of energy, attempt to start the equipment to verify that the lockout has been successful. Before you try to start it, verify that nobody is in a position where they could be hurt.

Step 7: Keep it in force during shift changes:

- The equipment must remain in lockout/tagout condition across shift changes, so that workers arriving at the site are aware that the equipment is out of service.

Step 8: Bring the equipment back on line:

- When the work is done and all tools and other materials have been removed, the machine can be brought back into operation.

2.b. **10M**

Solu:-

Case study on road safety

There is some instruction for road safety and traffic awareness rules which children should know. The ten road safety measures are as follows.

1. Always wear a helmet while riding and sitting on a two-wheeler..
2. Do not cross the speed limit.
3. Always follow traffic rules.
4. In India, we follow the right-hand drive. So, always overtake from the right side.
5. Never use a mobile phone while driving.
6. Always wear a seat belt.
7. While driving, your primary focus should be on the road. Always avoid distractions.
8. Always maintain a safe distance from other vehicles.
9. Never drink and drive.
10. Always keep discipline when you are walking in a lane.

MODULE 2

3. a. **10M**

Solu:-

Fire Triangle

The fire triangle is a model for conveying the components of a fire. The fire triangle's three sides illustrate the three elements of fire, which are heat, fuel and oxidization.

The three elements must be combined in the right proportions for a fire to occur. If any of the three elements are removed, the fire is extinguished.

The first element in the fire triangle is heat, which is perhaps the most essential of fire elements. A fire cannot ignite unless it has a certain amount of heat, and it cannot grow without heat either.

One of the first things firefighters do to extinguish a fire is to apply a cooling agent — usually water. Another cooling agent is a chemical fire retardant, such as the ones used in fire extinguishers.

Another method of diffusing heat from a fire is to scrape the embers from the fire source, such as wood embers on a burning building. Firefighters will also turn off the electricity in a burning building to remove a source of heat.

The second element in the fire triangle is fuel. A fire needs a fuel source in order to burn. The fuel source can be anything that is flammable, such as wood, paper, fabric, or chemicals. Once the fuel element of the fire triangle is removed, the fire will go out.

If a fire is allowed to burn without any attempt to extinguish it, as in the case of a controlled burn conducted by the Forest Service, it will extinguish on its own when it is consumed all of the fuel.

The final element of the fire triangle is oxygen, which is also an essential component of fire. A fire needs oxygen to start and continue. That is why one recommendation for extinguishing a small fire is to smother it with a non-flammable blanket, sand or dirt.

A decrease in the concentration of oxygen retards the combustion process. In large fires where firefighters are called in, decreasing the amount of oxygen is not usually an option because there os no effective way to make that happen in an extended area.

An alternative to the fire triangle model is the fire tetrahedron. The fire tetrahedron adds another element to the fire, which is chemical reaction. Fires involving metals such as titanium, lithium and magnesium have a chemical reaction that requires a different approach for firefighters.

This is called a class D fire and the application of water will exacerbate the combustion. Because of the chain reaction caused by the metals in class D fires, firefighters must use a different approach involving the introduction of inert agents like sand to smother it.

3b. **10M**

Solu:-

Classes of fire

- Class A Fires involving solid combustible materials of organic nature such as wood, paper, rubber and plastics where the cooling effect of water is essential.
- Class B Fires involving flammable liquids or liquefiable solids or the like where a blanketing effect is essential.
- Class C Fires involving flammable gases under pressure including liquefied gases, where it is necessary to inhibit the burning gas at fast rate with an inert gas, powder or vaporising liquid.
- Class D Fires involving combustible metals like magnesium, aluminium, zinc, sodium, and potassium where the burning metals are reactive to water containing agents and in certain cases carbon dioxide, halogenated hydrocarbons and ordinary dry powders. These fires require special media and techniques to extinguish.
- Class E Fire risks involving electrical apparatus/equipment.
- Class F/K Fires involving cooking oils, trans-fats or fats in cooking appliances. These typically occur in restaurant and cafeteria kitchens

Fire tetrahedron

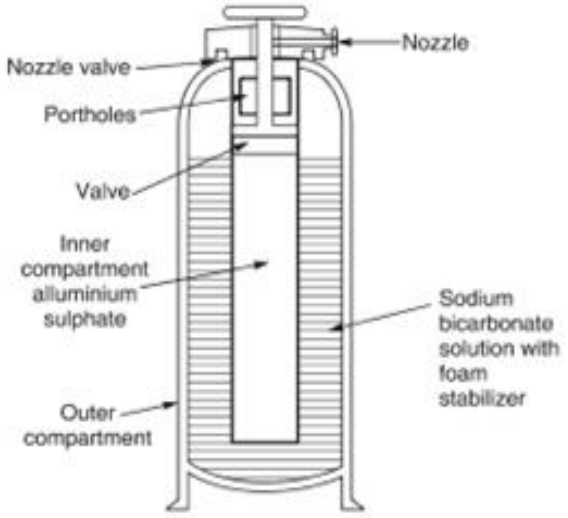
An alternative to the fire triangle model is the fire tetrahedron. The fire tetrahedron adds another element to the fire, which is chemical reaction. Fires involving metals such as titanium, lithium and magnesium have a chemical reaction that requires a different approach for firefighters.This is called a class D fire and the application of water will exacerbate the combustion. Because of the chain reaction caused by the metals in class D fires, firefighters must use a different approach involving the introduction of inert agents like sand to smother it.Learning about the fire triangle is a good way to understand the elements of fire and is an essential component of firefighting education.

Types of fire extinguisher

- Water fire extinguisher (Soda water acid type and gas pressure type fire extinguisher)
- Carbon di-oxide fire extinguisher

- Halons fire extinguisher
- Foam fire extinguisher
- Dry chemical fire extinguisher

➢ Foam fire extinguisher



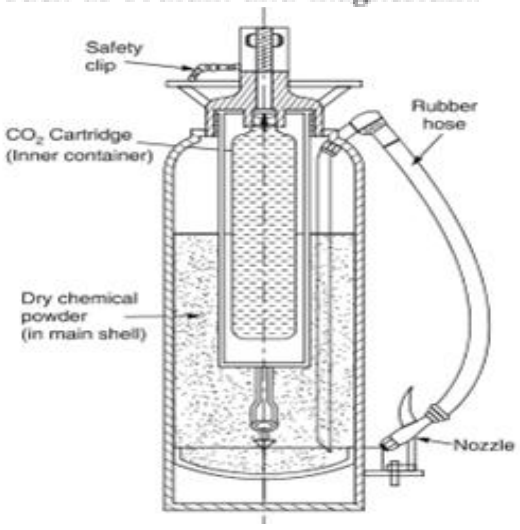
Portable extinguishers expelling foam are recommended for class B fires involving flammable liquids like oils, solvents, petroleum products, varnishes, paints, etc. The foam expelled by actuating the extinguishers forms a blanket over the surface.

➢ Dry chemical extinguisher

Dry Powder Fire Extinguishers are suitable for tackling petroleum fires, gas fires, fires in electrical equipments and for controlling surface fires in textile fibres. These extinguishers are noted for the speed with which they put out fires.

The chemical powders employed are usually sodium based and when applied to a fire, undergo chemical reaction. The free radicals which are responsible for sustaining any fire are out of action by the dry chemical powders and because of this, the fire dies out very fast.

Special dry powders containing sodium, potassium and barium compounds have been found useful in extinguishing fires in metals such as sodium and magnesium.



➢ Soda water acid type extinguisher

Construction : The various parts and contents of a soda acid extinguishers are shown in the Fig. 13.4.

The total liquid capacity of the body (or the solution containers) when filled to the specified level, should be 9 litres.

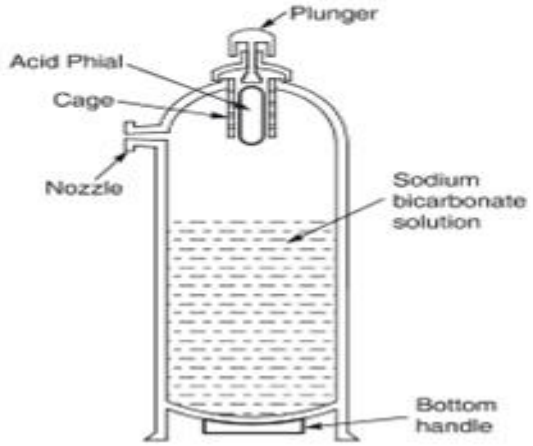
During manufacture, the body is required to be tested to an internal hydraulic pressure of 25 kgf/cm^2 for 5 minutes.

Method of operation : The operational instructions given on the body of the extinguishers should be read carefully. It should be confirmed whether soda acid extinguishers are of **up-right type** or **turn-over type** depending on their method of working. The type of the extinguishers provided at a given place must be known and method of operation must be practiced well in advance during training.

Principle of Operation. When the plunger is struck the acid phial (bottle) ruptures. The sulphuric acid and sodium bicarbonate solution react together to release carbondioxide (CO_2) gas.

The CO_2 generated creates internal pressure which forces the **water out of the extinguishers.**

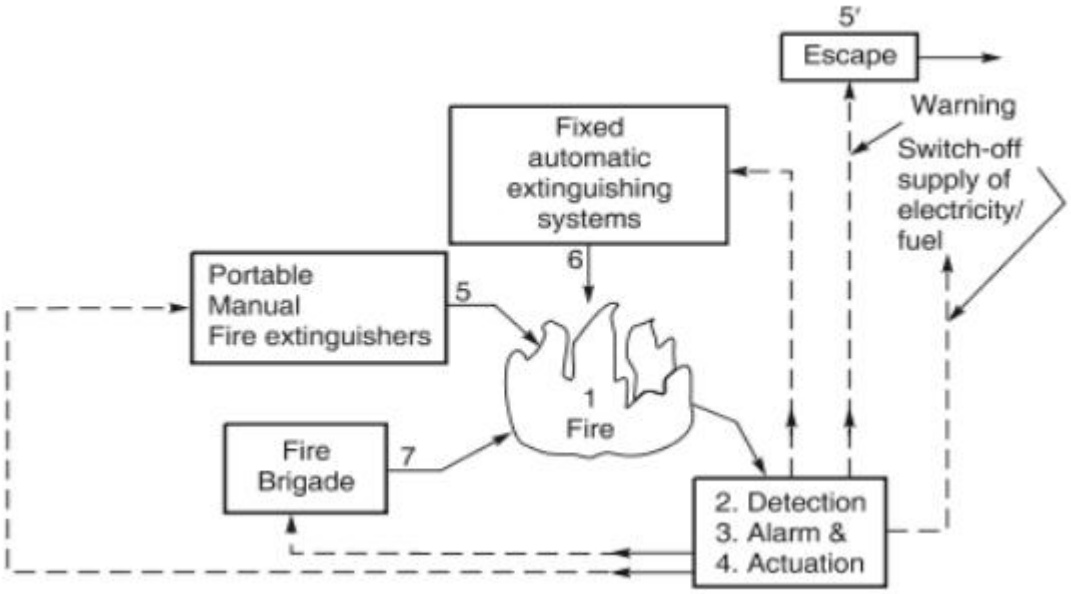
Note. The CO_2 gas acts only as a propellant and the water extinguishers the **fire by cooling effect.** Such extinguishers are recommended only for class A fires.



4a. **10M**

Solu:-

1. Fire Occurs
2. Fire is Detected by Observer or Detection System
3. Alarm is Sounded
4. Electric Power Supply and Other Fuel Supplies are Switched Off
5. Immediate Use of Portable Fire Extinguishers and Water/ Sand for Extinguishing Small Fires then and there
6. Automatic Fire Fighting System Gets Initiated
7. Call Fire Brigade.
8. Persons vacate the place.



4.b **10M**

Solu:-

Common fire hazards

- Alcohol and fire are a deadly combination: It's a fact that many fire deaths are caused by people attempting to cook or smoke while under the influence of alcohol. There's more to responsible drinking than taking a cab. Don't put yourself or your family at risk to fire.
- Cooking: Fires can easily start in your kitchen.
- Electrical fire safety: Unsafe use of electricity can be a ticking time bomb! An electrical fire can happen at any time.
- Matches and lighters: can be lethal weapons in the hands of children.
- Smoking Safety

Follow these safety precautions

- Drink responsibly!
- After a party or gathering where alcohol has been consumed, check furniture to ensure cigarette ashes haven't fallen into the cushions where it can smolder.
- Avoid smoking when you have been drinking heavily.
- Never Leave Cooking Unattended! Never leave home when a microwave oven, stove burner, or oven is on. Keep a close eye on what you're cooking.
- Keep Your Cooking Area Clean. Many items in the kitchen can catch fire easily including pot holders, dish towels, and product packaging. Keep curtains away from the stove and clean up all spills on the stove top or near by counters.
- Clean your oven regularly. Many kitchen fires start because of built up grease.
- Follow-up when a fuse or circuit breaker blows. Don't just reset the breaker or replace the fuse. Find out what caused the problem.
- Purchase appliances that are approved by the Canadian Standards Association or ULC. Appliances without CSA/ULC approval could be unsafe.
- Put lamps on level surfaces, away from curtains or other flammable items.
- Teach younger children to take lighters and matches to tell an adult when they find lighters and matches.
- Be aware of items that appear burnt around the home.

MODULE 3

5a. **10M**

Solu:-

i) PPE is equipment that will protect the user against health or safety risks at work. It can include items such as safety helmets and hard hats, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses. Hearing protection and respiratory protective equipment provided for most work situations are not covered by these Regulations because there are other more specific regulations that apply to them. However, these items need to be compatible with any other PPE provided.

Cycle helmets or crash helmets worn by employees on the roads are not covered by the Regulations. Motorcycle helmets are legally required under road traffic legislation. The Employment Act 1989 gives an exemption for turban-wearing Sikhs working on construction sites from the need to wear head protection.

Eyes

Hazards: Chemical or metal splash, dust, projectiles, gas and vapour, radiation.

Options: Safety spectacles, goggles, face-shields, visors.

Head

Hazards: Impact from falling or flying objects, risk of head bumping, hair entanglement.

Options: A range of helmets, hard hats and bump caps.

Breathing

Hazards: Dust, vapor, gas, oxygen-deficient atmospheres.

Options: Disposable filtering face-piece or respirator, half- or full-face respirators, airfed Helmets, breathing apparatus.

Protecting the body

Hazards: Temperature extremes, adverse weather, chemical or metal splash, spray from pressure leaks or spray guns, impact or penetration, contaminated dust, excessive wear or entanglement of own clothing.

Options: Conventional or disposable overalls, boiler suits, specialist protective **clothing**

eg chain-mail aprons, high-visibility clothing.

Hands and arms

Hazards: abrasion, temperature extremes, cuts and punctures, impact, chemicals, electric shock, skin infection, disease or contamination.

Options: Gloves, gauntlets, mitts, wrist-cuffs, armlets.

Feet and legs

Hazards: Wet, electrostatic build-up, slipping, cuts and punctures, falling objects, metal and chemical splash, abrasion.

Options: Safety boots and shoes with protective toe caps and penetration-resistant mid- sole, gaiters, leggings, spats.

ii) Some important safety precautions to follow when using lathes are:

a. Correct dress is important, remove rings and watches, and roll sleeves above elbows.
b. Always stop the lathe before making adjustments.
c. Do not change spindle speeds until the lathe comes to a complete stop
d. Handle sharp cutters, centers, and drills with care.
e. Remove chuck keys and wrenches before operating
f. Always wear protective eye protection.
g. Handle heavy chucks with care and protect the lathe ways with a block of wood when installing a chuck.
h. Know where the emergency stop is before operating the lathe.
i. Use pliers or a brush to remove chips and swarf, never your hands.
j. Never lean on the lathe.
k. Never lay tools directly on the lathe ways. If a separate table is not available, use a wide
l. board with a cleat on each side to lay on the ways.
m. Keep tools overhang as short as possible.
n. Never attempt to measure work while it is turning.
o. Never file lathe work unless the file has a handle.
p. File left-handed if possible.
q. Protect the lathe ways when grinding or filing.

5.b. **10 M**

Solu:-

This section discusses injuries that happen when parts of the body come into contact with moving machinery and other common hazards, and suggests how best practice design can eliminate these hazards.

Mechanical hazards include:

- Crushing
- Shearing
- Cutting or severing
- Entanglement
- Drawing-in or trapping
- Impact
- Stabbing or puncture
- Friction or abrasion
- High-pressure fluid injection
- Mobile machinery

Other common hazards include:

- Electricity
- Thermal hazard
- Noise
- Vibration
- Radiation
- Exposure to hazardous substances
- Slips, trips & falls
- Ergonomics
- Visibility

6.a. **10M**

Solu:-

i) The best way to protect workers from the hazards associated with compressed gas cylinders is to follow the five basic safety practices outlined here.

- Store cylinders properly. ...
- Keep cylinders secured. ...
- Inspect cylinders before moving or using. ...
- Open them carefully. ...
- Follow procedures for empty cylinders.

ii) Mechanical Safety Tools

All lathe operators must be constantly aware of the safety hazards that are associated with using the lathe and must know all safety precautions to avoid accidents and injuries. Carelessness and ignorance are two great menaces to personal safety. Other hazards can be mechanically related to working with the lathe, such as proper machine maintenance and setup.

Some important safety precautions to follow when using lathes are:

1. Correct dress is important, remove rings and watches, and roll sleeves above elbows.
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12. Keep tools overhang as short as possible.
13. Never attempt to measure work while it is turning.
14. Never file lathe work unless the file has a handle.
15. File left-handed if possible.

6. b **10M**

Solu:-

Construction sites, without a tinge of doubt, are dangerous places to work. It goes without saying that proper safety measures at the site are of utmost significance. So, every construction company should be well versed in the construction safety rules and regulations. Now, let's check out some of the most essential safety practices a contractor should be following.

1. Personal Protective Equipment (PPE)
2. Follow Environmental Guidelines
3. Keep the Work Area Clean
4. Ladder Safety
5. No Crowding inside the Site Perimeter
6. Lifting Precautions
7. Proper Site Training
8. Safety Programs and Culture
9. Risk Management System

Module-4

7.a. **10M**

Solu:-

Electrical safety is a system of organizational measures and technical means to prevent harmful and dangerous effects on workers from electric current, electric arc, electromagnetic field and static electricity.

The effects of electric shock on the human body depend on several factors. The majorfactors are:

1. Current and Voltage
2. Resistance
3. Path through body
4. Duration of shock

The muscular structure of the body is also a factor in that people having less musculature andmore fat typically show similar effects at lesser current values.

- **CURRENT AND VOLTAGE:**

Although high voltage often produces massive destruction of tissue at contact locations, it is generally believed that the detrimental effects of electric shock are due to the *current* actually flowing through the body. Even though Ohm's law (I=E/R) applies, it is often difficult to correlate voltage with damage to the body because of the large variations in contact resistance usually present in accidents. Any electrical device used on a house wiring circuit can, under certain conditions, transmit a fatal current. Although currents greater than 10 mA are capable of producing painful to severe shock, currents between 100 and 200 mA can be lethal. With increasing alternating current, the sensations of tingling give way to contractions of the muscles. The muscular contractions and accompanying sensations of heat increase as the current is increased. Sensations of pain develop, and voluntary control of the muscles that lie in the current pathway becomes increasingly difficult. As current approaches 15 mA, the victim cannot let go of the conductive surface being grasped. At this point, the individual is said to "freeze" to the circuit. This is frequently referred to as the "let-go" threshold. As current approaches 100 mA, ventricular fibrillation of the heart occurs.

Ventricular fibrillation is defined as "very rapid uncoordinated contractions of the ventricles of the heart resulting in loss of synchronization between heartbeat and pulse beat." Once ventricular fibrillation occurs, it will continue and death will ensue within a few minutes. Use of a special device called a de-fibrillator is required to save the victim. Heavy current flow can result in severe burns and heart paralysis. If shock is of short duration, the heart stops during current passage and usually re-starts normally on current interruption, improving the victim's chances for survival.

Current level (milliamperes)	Probable Effect on Human Body
1 mA	Perception level. Slight tingling sensation.
5 mA	Slight shock felt; not painful but disturbing. Average individual can let go.
6 – 16 mA	Painful shock. Loss of muscular control. Commonly referred to as the freezing current or "let-go" range.
17 – 99 mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go the source in contact with. Can cause ventricular fibrillation.
100 – 2000 mA	Ventricular fibrillation (uneven pumping of the heart.) Muscular contraction and nerve damage begins to occur. Death likely.
> 2,000 mA	Cardiac arrest, internal organ damage, and severe burns. Death probable.

- **RESISTANCE:**

Studies have shown that the electrical resistance of the human body varies with the amount of moisture on the skin, the pressure applied to the contact point, and the contact area. The outer layer of skin, the epidermis, has very high resistance when dry. Wet conditions, a cut or other break in the skin will drastically reduce resistance. Shock severity increases with an increase in pressure of contact. Also, the larger the contact area, the lower the resistance. Whatever protection is offered by skin resistance decreases rapidly with increase in voltage. Higher voltages have the capability of "breaking down" the outer layers of the skin, thereby reducing the resistance.

Body resistance (measured in ohms/cm2) is concentrated primarily in the skin and varies directly with the skin's condition. The resistance of dry well-keratinized intact skin is 20-30 kΩ /cm2. The resistance of moist thin skin is about 0,5kΩ/cm2. The resistance of punctured skin may be as low as 0,2-0,3 kΩ/cm2. The same resistance is in case of current applied to moist mucous membranes (e.g., mouth). If skin resistance is low, few, if any, burns occur, although cardiac arrest may occur if the current reaches the heart.If skin resistance is high, much energy may be dissipated at the surface as current passes through the skin, and large surface burns can result at the entry and exit points.

Internal tissues are burned depending on their resistance; nerves, blood vessels, and muscles conduct electricity more readily than denser tissues (e.g., fat, tendon, bone) and are preferentially damaged.

- **PATH THROUGH BODY:**

The path the current takes through the body affects the degree of injury. A small current that passes from one extremity through the heart to the other extremity is capable of causing severe injury or electrocution. There have been many cases where an arm or leg was almost burned off when the extremity came in contact with electrical current and the current only flowed through a portion of the limb before it went out into the other conductor without going through the trunk of the body. Had the current gone through the trunk of the body, the person would almost surely have been electrocuted. A large number of serious electrical accidents in industry involve current flow from hands to feet. Since such a path involves both the heart and the lungs, results can be fatal.

- **DURATION OF SHOCK**

The duration of the shock has a great bearing on the final outcome. If the shock is of short duration, it may only be a painful experience for the person. If the level of current flow

reaches the approximate ventricular fibrillation threshold of 100 mA, a shock duration of a few seconds could be fatal. This is not much current.

7 b. **10 M**

Solu:-

CAUSES OF ELECTRICAL ACCIDENT

Electrical accidents commonly occur whilst equipment is being maintained. This may be electrical equipment such as switchgear or equipment that uses electrical power. Most accidents happen because workers have not been adequately trained, are being poorly supervised, or because the risks of the work have not been properly assessed. The incidents are real.

Unsafe system of work

i. An employee was killed by 86 Volts when changing a welding electrode whilst working in a metal silo.
ii. An apprentice electrician was severely injured from contact with live equipment in a substation.
iii. An employee received an electric shock that broke both shoulders. An employee was trying to apply insulating tape to a live electrical cable but received an electric shock.
iv. Inadequate information: An employee received a fatal electric shock whilst examining a faulty air conditioning unit.
v. No training: A worker was injured when working in a live electrical panel. He had not been trained. Inadequate isolation: An electrician received a severe electric shock because he had not properly isolated the supply.
vi. Live working: An employee suffered brain damage following an electric shock he received whilst live working.
vii. Unsuitable test equipment: An employee was killed when setting up equipment to test printed circuit boards.
viii. Poor maintenance: A worker received a 240 Volt electric shock whilst using a pressure washer.
ix. Failure to manage work: A contractor's employee received an electric shock after confusion over isolation.
x. Person not competent: Person received a severe electric shock after he incorrectly wired a machine.
xi. Uninsulated electrical wiring: A worker was killed whilst attempting to clear a blockage in a wrapping machine. Electric shock can result in anything from a slight tingling sensation to immediate cardiac arrest.

8.a. **10M**

Solu:-

- Before carrying out repair work, Switch-off the main switch, take out the fuse-holders keep with you till completion of repair work.
- Use shock-proof appliances.
- Use Correct fuse wires.
- Miniature Circuit breakers are preferred.
- Do not use immersion water heater, exposed room heaters.
- Use good quality copper wires for wiring.
- Replace worn-out wiring.
- Do not allow water leakage, seepage in walls/over switch boards etc.
- Replace defective Switches immediately.
- While working on live wires, stand on a dry wooden stool, use insulated tools. However it is safer to switch-off the mains supply and then touch the wires under repair.
- Ensure that earthing system is healthy. Provide secured earthing to appliances *via*. 3 pin plug socket.

8. b **10M**

Solu:-

Safety. The installation, commissioning and maintenance work should be carried out with written permission of responsible authorized person. A scheme should be adopted to issue permit card authorising the maintenance work to be done. Steps should be taken by concerned authorities to ensure safety. These steps include :

1. Isolation of the part from live parts during the period of installation, testing and maintenance. No switching on by mistake.

2. Danger notices and safety notices should be placed at work place.

3. The neighbouring switches should be locked open to avoid switching by a third person.

4. **Earthing.** The work equipment and conductors should be isolated and then earthed by means of earthing connections, from all ends/incomers/outgoers.

5. Proper tools, safety devices should be provided to the electricians.

6. The electricians should be well trained.

7. First aid should be available.

8. Switching on should be allowed only after completion of work, after cancellation of the permit by the authority.

Death can be caused even on 400 V installations, because of negligence.

9. Follow the safety rules faithfully.

10. Take permission from authorised person for doing specific work. Fill up 'Work Permit' form, get signed. Work Permit form should be returned to issuing authority after completion of work.

11. Make sure to switch-off the supply from all the ends. The switching-off and switching-on should be as per safety rules and with prior permission of the authorised person.

The repair/maintenance work of High Voltage Apparatus should not be undertaken unless the apparatus is made DEAD and Isolators are open and locked, Earthing Switches closed and Locked. HV conductor should be discharged and connected security to earth.

12. Place caution notice and danger notices near the work place and near the switching terminals.

13. Use safety shoes, safety belt, gloves hat.

14. Do not use wet clothes, wet shoes, metal tapes.

MODULE- 5

9 a. **10M**

Solu:-

Chemicals may be classified as hazardous for several reasons. A chemical may cause injury or damage because of its toxic properties or because of some physical property. For instance, flammable chemicals are hazardous because they will catch fire and burn more readily than other chemicals and a chemical that is a poison causes an adverse health effect on some organ or organ system.

Chemical Hazards

A chemical hazard is any substance that can cause a health problem when ingested or inhaled. They include toxins, dangerous chemicals, residue of excess chemicals used in processing food products. If your facility follows Good Manufacturing Practices (GMPs), you can prevent chemical hazards.

Types of Hazards

- **Naturally occurring** – These are toxins produced by plants, animals or microorganisms (ex: aflatoxins in peanuts, poisonous neurotoxins in mushrooms, scrombotoxins in fish).
- **Intentionally added** – These are chemicals added to food that are beyond the acceptable limits established by the Food and Drugs Act and its regulations (ex: food additives like sodium nitrate).

Potential Hazards

There are many potential sources of chemical hazards in food processing. Regular, formal hazard analysis will help you determine the risk levels that could affect your product. A proper analysis will consider potential hazards, including:

- **Incoming materials** – Contaminated with toxins producing bacteria or mould, pesticides, veterinary drugs, non-food grade chemicals/ink used in

- **Unintentionally added** – These are chemicals that accidentally contaminate food being processed (ex: sanitation or maintenance chemicals, pesticides or environmental pollutants).
- **Food allergens** – These substances in food can cause a dangerous reaction in people who are allergic (ex: peanuts, fish, dairy products).

Risk of Hazards

Chemical hazards may lead to acute foodborne illness, or chemical poisoning. These illnesses can be caused when abnormally high doses of chemicals are consumed (ex: nitrites). Risk factors include:

- **Exposure** – The amount of chemical concentration in food and the amount of the food ingested will determine the exposure risk.

Toxicity–The amount of chemical or toxin that is consumed affects the risk level.

packaging materials.

- **Allergens** – Undeclared allergens on ingredient labels or cross-contamination with allergens are a potential risk.
- **Food contact surfaces** – Use of unapproved materials may lead to migration of chemical to food.
- **Non-food chemicals** – Sanitation or maintenance chemicals (used or stored near food contact surfaces), dyes or inks from coding machines, water treatment chemicals, etc. are all potential risks.
- **Employees** – Employee errors in adding excessive food additives or unapproved ingredients into the process are a potential risk.

9.b **10M**

Solu:-

i) Acid Hoods

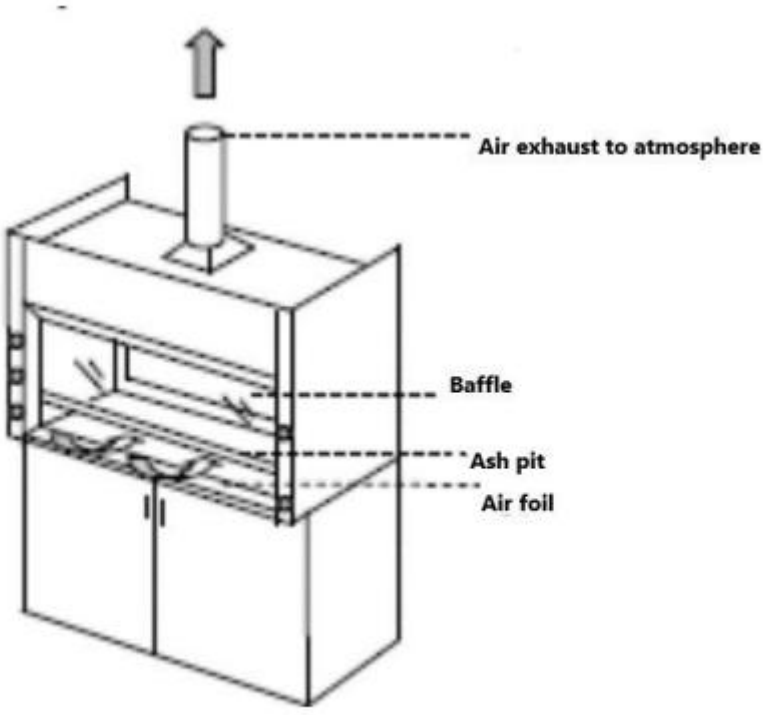

Fig. 5.2: Acid Hood / Fume hood

Be aware of the proper methodology of working with fume hood.

- Do not use perchloric acid in an ordinary hood. A wash down hood must be used for handling of perchloric acid.

- Keep all apparatus at least six inches inside from the sash.

- Maintain good housekeeping in the hood at all times. Clean up the hood and remove unwanted materials at the end of the work.

- Avoid making rapid movements while operating the hood. This may cause the vapours inside the hood to escape out. The sash must be lowered and raised slowly.

- Do not place electrical receptacles inside the hood.

- A safety shield can be placed inside the hood as an additional precaution if there is a chance of runaway reaction.

- Keep only materials required for immediate use inside the hood.

- Never use fume hood as a place for storing chemical bottles or containers.

- Flammable chemicals must not be stored inside the fume hood.

- Use personal protective equipment while working with fume hood, depending upon the type of chemical used and its hazard.

ii) Eye Washer

If there is an accident, two of the most important pieces of safety equipment you have are the emergency shower and the eye wash station. If you contaminate yourself over a large part of your body or over a part of your body that you cannot rinse off in the sink, immediately go to the emergency shower, strip off any contaminated clothing, and stay under the water for at least 15 minutes. If something splashes into your eye, immediately flush with water for as long as possible. The general rule is to flush with water for 15 minutes.

- Eyes must be immediately flushed with copious amount of water for at least 15 minutes.

- Certain chemicals like sodium hydroxide, phenol, aniline, hydrofluoric acid, etc, penetrates deep into the tissues.

- An eye wash fountain must be used for the same.

- During a chemical splash, a spasm may develop in eye lids and keep them firmly shut. So while flushing, the eye lids must be raised with fingers to ensure that no chemical remains in the space below the eye lid.

- Medical attention must be sought only after thorough flushing of the eyes. Failure to flush the eyes can result in partial or permanent loss of vision.

10. a **10 M**

Solu:-

- Chemicals when transferred to secondary bottles/cans must be provided with proper labels.
- Chemical formulae or short forms must not be used for labelling of the containers.

The label must contain

i. The full name of the chemical,
ii. Its hazards,
iii. Information for safe handling and
iv. The signage/pictogram indicating the hazard class.

- Labels of bottles which got deteriorated or worn off must be replaced immediately.
- Chemical bottles without labels or improper labelling can result in the wrong chemical being used.
- Further it will also cause difficulty in case of a spill or body contact or at the time of disposal of the chemical. The Lab Standard requires that all chemicals be labelled. If you transfer a chemical from the original container to a new container, you need to also label that new container with the name of the chemical. This is very important because in the event of an emergency you need to know the exact chemical name or chemical formulation you are working with so that you will know which MSDS to consult.

Containers must be labelled with:

i. Chemical name
ii. Manufacturer's name
iii. Health hazards
iv. Physical hazards
v. Long & short term health effects

For frequently used chemicals, you can create your own labels for secondary containers using
a word processing program and standard labels so that you can print them out as they are needed. All hazardous chemicals must be clearly labelled for the benefit of current users, emergency personnel, and future users. Unknown chemicals can be expensive to dispose of.

Make sure all labels are legible and in good condition. Repair or replace damaged or missing Labels. Manufacturers' Labels Cal/OSHA requires that manufacturers provide labels with the following information:

• Contents of the container
• Physical and health hazard information
• Name, address, and emergency phone number of the manufacturer or other responsible

Party Original manufacturers' labels must not be removed or defaced. Material Safety Data Sheets (MSDSs) must be accessible to anyone working with these chemicals.

10. b. **10M**

Solu:-

Compressed natural gases can be hazardous because each cylinder contains large amounts of energy and may also have high flammability and toxicity potential. The following is a list of recommendations for storage, maintenance, and handling of compressed gas cylinders:

- Make sure the contents of the compressed gas cylinder are clearly stenciled or stamped on the cylinder or on a durable label.
- Do not identify a gas cylinder by the manufacturer's color code.
- Never use cylinders with missing or unreadable labels.
- Check all cylinders for damage before use.
- Be familiar with the properties and hazards of the gas in the cylinder before using.
- Wear appropriate protective eyewear when handling or using compressed gases.
- Use the proper regulator for each gas cylinder.
- Do not tamper with or attempt to repair a gas cylinder regulator.
- Never lubricate, modify, or force cylinder valves.
- Open valves slowly using only wrenches or tools provided by the cylinder supplier directing the cylinder opening away from people.
- Check for leaks around the valve and handle using a soap solution, "snoop" liquid, or an electronic leak detector.
- Close valves and relieve pressure on cylinder regulators when cylinders are not in use.
- Label empty cylinders "EMPTY" or "MT" and date the tag; treat in the same manner that you would if it were full.
- Always attach valve safety caps when storing or moving cylinders.
- Transport cylinders with an approved cart with a safety chain; never move or roll gas cylinders by hand.
- Securely attach all gas cylinders (empty or full) to a wall or laboratory bench with a clamp or chain, or secure in a metal base in an upright position.
- Store cylinders by gas type, separating oxidizing gases from flammable gases by either 20 feet or a 30-minute firewall that is 5 feet high.
- Store gas cylinders in cool, dry, well-ventilated areas away from incompatible materials and ignition sources.
- Do not subject any part of a cylinder to a temperature higher than 125 °F or below 50 °F.
- Store empty cylinders separately from full cylinders.