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Internal Assessment Test III – MAY 2019

Sub:	INDUSTRIAL SAFETY				Sub Code:	15ME662	Branch:	MECHANICAL
Date:	15/05/2019	Duration:	90 min's	Max Marks:	50	Sem/Sec	6th Sem A &B	OBE

	Answer any FIVE FULL Questions	MARKS	CO	RBT
1.	Explain the factors which influence effect of electric current on human body.	[10]	CO2	L2
2.	Give the checklist for LPG installation.	[10]	CO3	L1
3.	Explain the prevention of electrical accident.	[10]	CO3	L2
4.	Write a note on (a) Risk assessment	[05]	CO1	L1
	(b) AC and DC current shock.	[05]	CO1	L1
5.	Write safety precaution while using CNG	[10]	CO3	L1
6.	Write safety precaution for the installation of electrical equipment in small and residential building.	[10]	CO3	L1

Solution of IAT-3

1.

The effects of electric shock on the human body depend on several factors. The major factors 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 and more 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.

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. The higher the resistance is the higher production of the heat is ($Q = I2 . R .t_2$ heat = $amperage_2$* resistance*time). If there is an element with high resistance in the circuit, it is usually hot, depending on the value of electric current (amperage) in the circuit and the resistance of the element.

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 when you consider that a small light duty portable electric drill draws about 30 times as much. At relatively high currents, death is inevitable if the shock is of appreciable duration; however, if the shock is of short duration, and if the heart has not been damaged, interruption of the current may be followed by a spontaneous resumption of its normal rhythmic contractions

2.

- Check the plans and additional data
- LPG Containers shall be located outside of the building
- Cylinders under 125 gallons filled on site shall be a minimum of 3’ from windows or openings and a minimum of10’ from window AC
- Cylinders under 125 gallons filled on site shall be a minimum of 5’ from Central AC
- Cylinders over 125 gallons shall be located 10’ from building and property line
- Cylinders over 500 gallons shall be located 25’ from building and property line
- Underground cylinders under 2,000 gallons shall be located 10’ from building and property line
- Loose or piled combustible material , weeds, long grass shall be separated by a minimum distance of 10’
- Containers shall be readily identifiable. approved and listed
- Cylinders that are expired shall not be used
- Vertical containers over 125 gallons shall be designed with steel supports and secured per NFPA
- Valves, regulators, gauges and other containers shall be protected from physical damage

- LPG shall not be installed in prohibited locations such as elevator shafts. Clothes chutes, ducts
- Pressure relief valves shall be installed so that gas is vented away from container to open atmosphere
- Verify that all piping in the ground is suitably protected
- Flexible connectors must be designed for LPG
- Any gas fired appliance located within a garage shall be locate 18” above the floor
- Provide combustion air requirements in confined spaces
- Pipe shall be wrought iron, steel, brass, copper or other approved materials
- Provide CO/gas detector

3.

1. Have only licensed electricians install, repair and dismantle jobsite wiring: That way, everything will be completed according to electrical safety codes, ensuring greater protection for the workers who will be using the wiring to power tools and equipment. Bringing in a professional electrician also prevents the injuries that result when less-qualified individuals attempt electrical jobs that they aren't properly trained to do.

2. **Always plug into a GFCI:** Ground Fault Circuit Interrupter protection is required at every plug-in point associated with your jobsite's temporary electrical supply - right down to extension cords. Make sure that only GFCI receptacles are installed, and that portable GFCIs are kept on hand in case additional grounding needs arise.
3. **Check each extension cord before use:** Ensure that insulation is completely intact (free from cracks, tears, or abrasion) and that power extension cables haven't been knotted, which can cause conductor damage and increase the risko fire
4. **Do a thorough check for electrical wiring before cutting through any wall, floor or ceiling:** Any time that a tool inadvertently makes contact with an unseen electrical line, the person holding that tool is likely to be shocked or electrocuted. Always size up the situation before you get started to reduce your risk of injury.
5. **Inspect power tools on a regular basis:** Look over the tools' power cords and plugs for any sign of damage to the insulation, blades, or grounding pin. If you find signs of excessive wear and tear, take tools out of commission until they've been properly repaired. Maintain awareness during electrical tool use as well; if a tool starts to overheat, smoke, give off a burning smell, or shock you on contact, discontinue use immediately.
6. **Check insulated tools for damage before each use:** Once the insulation layer of an insulated hand tool becomes nicked, cracked or cut, the tool is no longer effectively insulated - it actually becomes more of an electrical conductor, and can increase your risk

of injury. If a tool has damaged insulation, it is no longer safe to use - destroy and replace it right away.

7. **Never modify electrical plugs:** Under no circumstances should you ever file down the blades, remove the ground pin, or otherwise modify an electrical plug so that it will fit into a socket - doing so only increases the likelihood of shock, electrocution, and fire. Either have a certified electrician change the device's plug, or replace outdated two-prong receptacles with grounded outlets that can accommodate a ground pin.
8. **Keep extension cords in a safe place where they won't be stepped on or driven over:** The force of a vehicle - or even repeated treading by pedestrians - can cause an extension cord's conductor to become misshapen or break, a problems that can lead to electrical fires. Because it occurs in the core of the cable, conductor damage isn't always obvious to the eye, so play it safe from the start by guarding jobsite extension cords with heavy-duty cord covers.
9. **Ensure that all electrical components stay dry:** It's one of the cardinal rules of electrical safety: don't mix electricity and water. Store power tools and cables above water level when not in use, cover outdoor receptacles, and never use electrically powered tools in a wet environment.
10. **Use the right extension cord for the job:** Before you plug in, make sure that the wattage rating of the extension cord you're using is greater than the pull (or power requirement) of the equipment it's powering. Using an extension cord to supply more wattage than it's rated for can cause conductor strain, overheating, and possibly even fire.

4. (a)

Once a hazard has been identified, the likelihood and possible severity of injury or harm will need to be assessed before determining how best to minimize the risk. High risk hazards will need to be addressed more urgently than low risk situations. You may decide that the same hazard could lead to several different possible outcomes. For each hazard consider how likely each possible outcome is, and record the highest priority. Make the changes Consider the following control measures, listed in order of importance:

1. Remove the hazard at the source - e.g. get rid of it or replace it.
2. Substitute it with something less hazardous.
3. Isolate the hazardous process, item or substance from people.
4. Add engineering controls, such as safety barriers or exhaust ventilation.
5. Adopt safe work procedures, training and supervision to minimize the risk.
6. Where other means are not sufficient or practicable, provide personal protective equipment.

7. Implement and monitor the controls you decide upon.

(b)

No matter what, if either AC or DC comes in contact with the human body, it can be hazardous. The actual effect varies, though, as it depends upon several different factors, including the amount of current administered, duration of which it was in contact with the body, pathway of the current, voltage applied, and impedance of the body itself. All of that being said, if it comes down to one or the other, AC can generally be viewed as the more dangerous of the two currents — here's why:

1) To start off, in order for both currents to have the same effect on the human body, the magnitude of DC flow of constant strength needs to be two to four times great than AC; that is, more DC current is needed to induce the same amount of physical damage as AC current. This is because the effect of the currents on the body is a direct result of the excitatory actions of its magnitude — specifically, the actual making and breaking of the current itself. Such excitatory actions include nerve / muscle stimulation, induction of cardiac atrial or ventricular fibrillation, and more. For DC to produce the same effect as AC on the human body, its flow of constant strength must be two to four times that being administered by the AC.

2) When death by electric shock occurs, it's typically due to ventricular fibrillation, and the likelihood of a human suffering this sort of life-ending injury is much higher when coming in contact with an AC than a DC due to the fact that the human body's threshold of DC-caused ventricular fibrillation is several times higher than for AC.

3) Generally speaking, the human body's impedance is higher for DC, and it only decreases when the frequency increase. As such, the severity of electric shock is less when in contact with DC than it is with AC.

5.

Safety issues in CNG filling stations

When CNG buses are filled at filling stations, normal precautionary measures are implemented according to Indian and international standards. But there is scope for improving the layout of the existing gas filling stations to ensure better approachability and safety. In a number of gas filling stations catering to non-DTC vehicles in Delhi, there is a minor risk of damaging the gas pump. This is because there is too tight radius for a bus to approach the pump easily. The lay-out of filling stations should give the privately operated buses plenty of room for a safe approach. If there is not enough room, the "island" either where the pump is located could be made larger or a steel barrier could be anchored in a suitable way for protection of the pump.

Nozzles and safety: These are prone to frequent o-ring failures – an item in nozzles. We are informed that they occur on an average about once every 20 fills. This failure not only interrupts fueling and requires replacement of the o-ring, it also creates a fire hazard due to the release of a significant amount of high-pressure gas.

Safety of CNG cylinders

As of today, the cylinders meet the common standards set for all high pressure gas cylinders from oxygen to hydrogen by the Bureau of Indian Standards and approved by the Chief of Comptroller of Explosives. However, these standards do not take into account on-board high-pressure gas cylinders mounted on moving vehicles. International standards have been specially set for on-board cylinders. There is a need for enforcement of these safety regulations as well.

Need for more stringent emissions standards for future

MRTH may be asked to notify Euro IV equivalent standards for new CNG buses from 2005 and simultaneously provide fiscal incentives for achieving European Environmentally Enhanced Vehicles standards

Safety Aspects in CNG Refilling Stations

a) Ministry of Petroleum and Natural Gas may be asked to review the layout of the dispensing stations to ensure easy approachability to dispensers and protection of the installed pumps.

b) Standardize all vehicle-refueling receptacles or nozzles on the NGV-1 standard to reduce filling time, minimize safety risk posed by leakage of gas due to O-ring failure, and allow more efficient use of existing compression capacity.

High-pressure Cylinders and Piping for Storage of CNG on Board Motorized Vehicles

The Bureau of Indian Standards may be asked to lay down standards for high-pressure cylinders and piping for the on board storage of CNG as a fuel for automotive vehicles on the lines of prevailing international standards such as ISO 11439 Gas cylinders – “High-pressure Cylinders for the On-board Storage of Natural Gas as a Fuel for Automotive Vehicles”.

6.

— 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.