Basic Rural Technology

4

SECTION - B
BASICS OF ELECTRICITY

COURSE CONTENT

1

ELECTRIC SAFETY

1.1 INTRODUCTION

Electricity is used everywhere. Electricity is an essential part of our life. Though, the advantages are plenty, dangers also their. Particularly when not safely handled, numerous accidents take place. This is due to several reasons, so we are going to study of safety rules, as per IS-5216 General safety.

1.2 OBJECTIVES

After reading this lesson, you should be able to:

1. Explain the Electric Shock.
2. Provide the First Aid.
3. Learn the methods of Artificial Respiration.
4. Know the Electric Fire.
5. Understand the Workshop Safety Rules.

1.3 ELECTRIC SHOCK

Electric shock is sudden or unexpected and stimulates the body's nervous system. When a current passes through the body, the effect is involuntary muscular contraction. If it is of low intensity, the victim is easily release, if it is high the victim can't release himself from the supply. If the chest becomes the path of the current the muscles which control breathing will paralyzed. The victim may still be in contact with the power supply, and may be in an unconscious state. If someone else touches the victim in order to save him, that person will also get a shock.

SEVERITY OF SHOCK

The severity of shock depends on:

a) Contact area of the body with the supply wire or appliance.

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b) Electric pressure with the supply wire or appliance.
c) Path of current through the body.
d) Whether it is AC or DC.
e) Wet condition.
f) Mental stress at the time of accident.
g) AC is more dangerous than DC.

REASONS OF SHOCK

a) Touching a bare live conductor.
b) Touching a poorly insulated conductor.
c) Open or short circuit due to equipment failure.
d) Static electricity.
e) Use of non-standard material.
f) Not following the Safety Rules

1.4 NECESSITY TO KNOW FIRST AID

Dear friends, we don't know how to treat the electrical accident to somebody, may be at home, office, industry or anywhere. It is always better and necessary to know how to give first aid to such victims before sending him to the doctor. To pull him other side use any non - metallic tool or any instrument.

First Aid:

1) Immediately lay down the victim on a soft blanket. Allow fresh air to reach him.
2) Apply some cold cream or coconut oil on the burn parts.
3) Artificial respiration procedure should be applied gently.
4) Sprinkle his face with water.
5) Smell any scent or scented thing regularly to victim.
6) Do not give any food or liquid to the victim without consult with the doctor.
7) The victim should always be kept warm.

INTEXT QUESTIONS 1.1

1) What is electric shock?

2) On what factor severity of shock depends?

3) What are the reasons of shock?

4) Define the first aid?

1.5 ARTIFICIAL RESPIRATION

There are two different methods of applying artificial respiration -

a) Schaffer's Method.

b) Sylvestr's Method.

a) Schaffer's Method - Lay the victim on his belly with one arm extended directly overhead and the other arm bent at elbow, with the face turned outward and resting on hand or forearm, so that the nose and mouth are free for breathing, pull the tongue forward, but do not hold it.

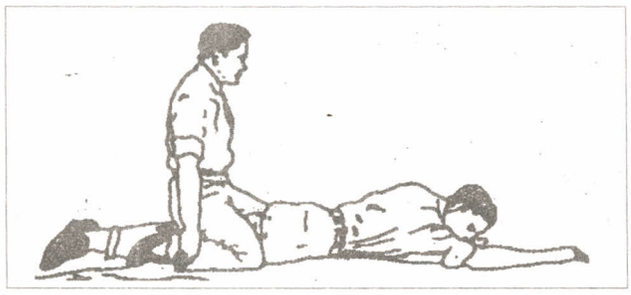


Fig.1.1 : Schaffer's Method-step 1.

Kneel, straddling on the victim's thighs, with your hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position and the tips of the fingers just out of sight.

Keep your arms straight, lean forward slowly over the victim bringing the weight of your body gradually to bear on the victim for about 2–3 seconds, release the pressure slowly and return to the first position by sliding your palms sideways as shown in fig 1.2

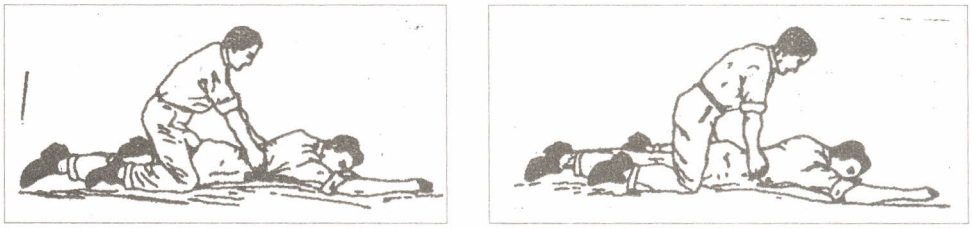


Fig.1.2 : Schaffer's Method-step 2 and 3.

Repeat this procedure about 12–15 times a minute. It will help victim to restore breathing gradually. A victim may require 1–3 hours to re-establish the natural breathing.

After the victim starts natural breathing, the artificial respiration should be stopped, keep a watch on the victim till he breaths naturally.

b) Sylvester's Method - Place the victim on his back. First loosen his clothes around the chest and stomach. Remove false teeth, if any and put a pillow under the shoulders, so that his chest will be rise up and head will titled backward. The tongue should be drawn forward.

Fig.1.3 : Sylvester's Method-Step 1.

The rescuer must stand beside the victim in the position shown in fig 1.4. Grasp the victim just below the elbows. Draw his arm over his head until horizontal, retaining them for two seconds.

Next, bring the victim's arms down on each side of his chest and pressing inwards upon it. Leaning upon his arm so as to compress his chest.

Remain in his position for two seconds and then again keep repeating the two motions at the same rate.

If one more person is present, he should be asked to draw out victims tongue at each action of the victim's lungs inflating and deflating.

Be careful in this method to avoid any injury to internal organs resulting from excessive and sudden pressures. Do not give any thing to drink to a victim until he is conscious.

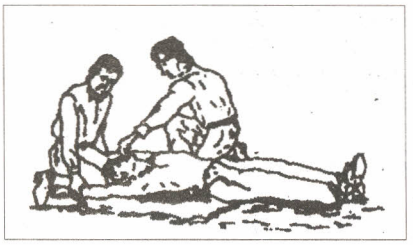


Fig 1.4:Sylvester's Method-Step 2.

1.6 ELECTRICAL FIRE

Causes of Fire

Following are the main causes of fire:

1) Use of incorrect size of fuse wire.
2) Overloading.
3) Poor or loose joints.
4) Combustible material stored near the fuse board.

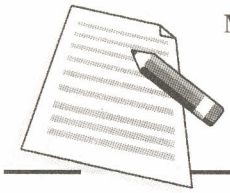
Precautions to be taken during Electrical Fire

Following precautions are to be taken in case of electrical fire -

1) Switch off the main switch.
2) Extinguish the fire by throwing dry sand on it.
3) Before using a fire extinguisher make sure that it is not out-dated and it is of Carbon-di-Oxide type.
4) Don't use water to extinguish the fire if the main-line is live.

Dear friends, you are welcome to this workshop, where the electrical appliances or machines are tested & repaired. This place is known as electricity workshop/lab. While doing the work you should know the safety to prevent minor or major accidents. Following are the safety rules which are based on Indian Standard Safety procedure:

(1) Always use PVC or wooden table & stool for repairing job.
(2) Connect any instrument /appliance in the presence of a supervisor.
(3) Always obey the safety instructions given by instructor.
(4) Do not renew a blown fuse until the switch is off?
(5) Keep the workshop floor clean & tools in good condition.
(6) While working on live circuits always use rubber gloves rubber mat & insulated tools.
(7) Replace fuses only after switching off the circuit off the circuit switches.



(8) Use accessories in good conditioned.

(9) Always use 3 pin plug socket, plug top 3 core wire for appliances.

(10) Connection in electrical apparatus should be tight.

(11) After switching off the supply, grip the plug top carefully & pull it.

(12) Always used plug pin top for connecting appliances to the supply.

1.7 WHAT YOU HAVE LEARNT

In this lesson you have learnt about an Electric Shock, Severity of Shock, Reasons of Shock, Necessity to know First Aid and Artificial Respiration.

1.8 TERMINAL QUESTIONS

1) Explain the Schaffer's method of artificial respiration?

2) Describe the Sylvester's method of artificial respiration?

1.9 ANSWER TO INTEXT QUESTIONS

1) Electric shock is sudden or unexpected and stimulates the body's nervous system.

2) It depends upon-

   a) Contact area

   b) Supply pressure

   c) Path of current

   d) Type of current

   e) Whether condition

   f) Duration

3) Reasons of electric shock-

   a) Touching a bare live conductor.

   b) Touching a poorly insulated conductor.

   c) Open or short circuit due to equipment failure.

d) Static electricity

e) Use of non-standard material.

4) First aid means an action which is instant to a victim to cure from any accident.

2

BASIC TOOLS

2.1 INTRODUCTION

In previous lesson, we studied safety rules for electrical workers. Now we are going to study the useful wiring tools. We need many tools to start electrical installation. Here is a list of those tools you can add as you feel the need for them. Do not confuse by many brands, sizes, makes and kinds that you see in market. As a thumb rule one reliable make is as good as another and size is generally not very important providing that you do not get a tool which is too large or too heavy for you. The great thing is to buy good quality tools. You may not need super quality tools, but those you do get must be reliable.

2.2 OBJECTIVES

After reading this lesson, you will be able to:

1) State how tools are specified.
2) Identify the different types of tools.
3) State the application of each tool.
4) Explain the maintenance of the tools.

2.3 LIST OF BASIC TOOLS

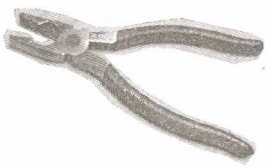
S.No.	Name of tools
1.	Pliers
2.	Wire Stripper OR Electrician Knife
3.	Push Pull Steel Tape
4.	Try Square

5. Plumb Bob with Nylon thread
6. Tenon Saw (Back Saw, Devetail Saw)
7. Hack Saw (Adjustable Frame type)
8. Firmer Chisel
9. Cold Chisel
10. Trimming Knife
11. Hammer
12. Hand drill machine with twist drill & Masonry drill
13. Electrician's Screwdriver
14. Test Lamp
15. Tester

1. PLIER

There are different types of pliers. Pliers specified by its length of legs, its type, insulation material. Here Electricians plier, Diagonal Cutting Pliers, Long Nosed Plier is discuss.

(a) Electrician's Plier



Name : Electrician's Plier, Lineman's Plier, Combination Plier etc.

Material : Steel, Plastic hand covers.

Use : To cut, to grip and twist the wires.

Care : Always keep the plier properly insulated. Do not cut hard substance with it. Never use it as a hammer.

(b) Diagonal Cutting Plier

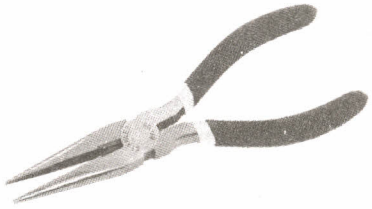
Name : Diagonal cutting plier, Side cutting plier

Material : Steel, Plastic hand covers

Use : To crop metal wire close to a surface.

Care : Diagonal cutting pliers are designed for cropping metal only. They should not be used as standard pliers to grip wire.

(c) Long Nosed Plier



Name : Long Nosed Plier

Material : Steel, Plastic hand covers

Use : To grip small objects in confined spaces; to crop soft wire

Care : Long nosed pliers are manufactured in a variety of shapes and proportions but they all have serrated tapering jaws to work in confined spaces. Some models have side cutters to crop soft wire.

2. ELECTRICIAN'S KNIFE

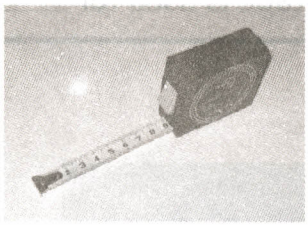
Name : Electrician's Knife

Material : Handle - Plastic, Rosewood Blade - Stainless Steel

Use : Removing insulation of wires and cables.

Care : Used it properly without touching the blade.

3. PUSH PULL STEEL TAPE



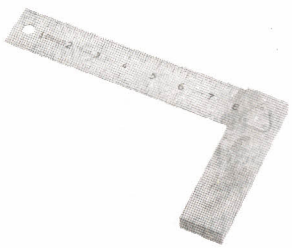
Name : Push Pull Steel Tape OR Flexible Rule

Material : Tape - Steel, Fiber Glass Case - Steel, Plastic

Use : To determine the size of a work piece or to survey an area.

Care : Check periodically that the hook has not become too loose.

4. TRY SQUARE



Name : Try Square

Material : Blade - Steel Stock - Cast Iron, Hard-wood

Use : To work out or check the work for square.

Care : Never try and use the stock of a square as a hammer.

INTEXT QUESTIONS 2.1

Fill in the blanks:

1) Electrician's plier is used for _____.

2) Always keep the plier properly _____.

3) The tool used for crop metal wire close to a surface is _____.

4) The tool used to grip small objects in confined space is _____.

5) The push pull steel tape is used for _____.

5. PLUMB BOB

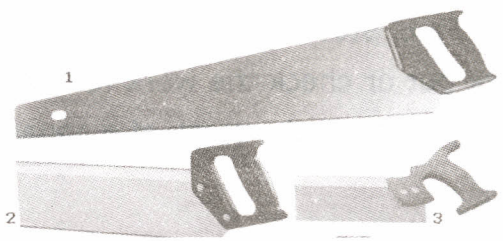
Name : Plumb Bob

Material : Bob - Brass, Plastic, Lead, Steel Line(Cord) Nylon, Silk

Use : To line out electrical installations on the walls & ceilings of the buildings

Care : Before marking lines the thread should be rubbed or the red ochre or same colored material to get a clean line out. The thread must not be free while lining out the thread must be stretched fully to avoid the sag. For marking purpose grip the thread at the centre with your pinch and then leave it at once for getting straight and clear marking.

6. TENON SAW



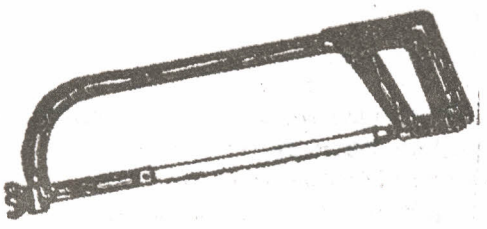
Name : Tenon Saw, Back Saw

Material : Blade - Steel, Handle - Beech, Plastic

Use : To cut joints.

Care : Great care should be taken to start the cut correctly. The teeth of the tenon saw must be kept very sharp. For the purpose of sharpening the teeth always use a triangular file. The cutting angle of each tooth must be the same as the previous one. After resharpening set the saw properly saw set is used for springing the set.

7. HACK SAW



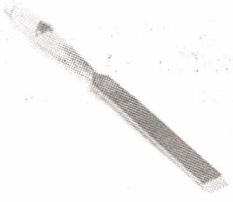
Name : Hack Saw

Material : Blade - Steel, Handle - Alloy, Plastic, Wooden

Use : To cut the metals

Care : While working with the hack saw see that cuts are very straight otherwise due to the bending the blade may break causing the unnecessary delay in the work. Before starting the work the blade should be cleaned and placed properly in the proper position.

8. FIRMER CHISEL



Name : Firmer Chisel

Material : Blade - Steel Handle - Wood, Plastic

Use : To trim and chop wood

Care : When a chisel becomes stubby in must be reground and resharpened.

9. COLD CHISEL

Name : Cold Chisel

Material : Steel

Use : To cut metal

Care : When a chisel becomes stubby it must be reground and resharpened.

10. TRIMMING KNIFE

Name : Trimming Knife

Material : Blade - Specifically treated carbon Steel Case - Alloy body with blade store

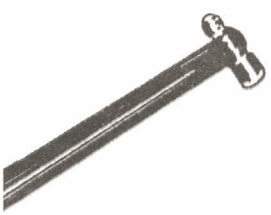
Use : To remove insulation from heavy duty cables.

Care : To cut the cable properly.

11. HAMMER

Hammers are used in various parts of the world under different names and a variety of shapes and sizes. They are Hammer Ball Pein, Hammer Cross Pein, and Hammer Club Pein etc.

a) Hammer Ball Pein



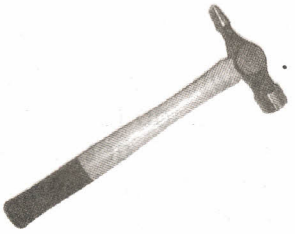
Name : Hammer Ball Pein

Material : Head - Steel
Shaft - Wood, Bamboo

Use : To drive punches and cold chisels to form metal

Care : To hammer that object only which you have to stuck it.

b) Hammer Cross Pein



Name : Hammer Cross Pein

Material : Blade - Steel
Handle - Wood, Bamboo

Use : To drive punches and cold chisels to form metal

Care : To hammer that object only which you have to stuck it.

c) Hammer Claw

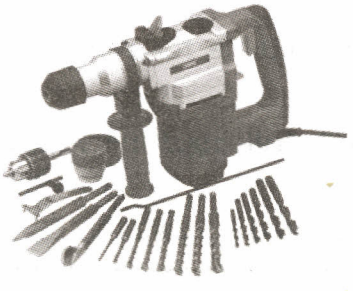
Name : Hammer Claw

Material : Blade - Steel
Handle - Wood, Bamboo

Use : To reopen the screws and to drive the punches.

Care : To hammer that object only which you have to reopen it.

12. HAND DRILL MACHINE WITH TWIST DRILL AND MASONRY DRILL (8)



Name : Hand Drill machine

Material : Body - Cast iron Aluminum

Use : To drill holes in wood & metal.

Care : Do not jerk while drilling. Always place a wooden piece below the job to be drilled, Otherwise the bit will hit the floor & get damaged. Hand drill combines hand driven and gear ratio to provide a convenient speed. A larger gear wheel drives one or two pinions which apply torque to the chuck. The chuck has usually 3 self centering jaws.

13. ELECTRICAL SCREW DRIVER

Name : Ele

Material : Blade - Steel;
Handle - Plastic.

Use : To tight or loose slotted screws.

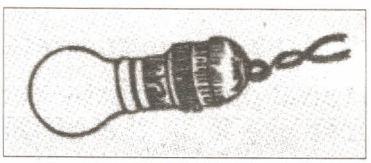
Care : Always use a Screw driver of proper size for a particular work. Never sharpen the blunt edge.

INTEXT QUESTIONS 2.2

Fill in the blanks:

1. To lineout electrical installation on the wall _____ is used.
2. The Hack saw is used to _____.
3. Trimming knife is suitable for removing the installation from _____.
4. The body of hand drill machine is made up of _____, _____ & _____.
5. To tight or loose slotted screws _____ are used.

14. TEST LAMP



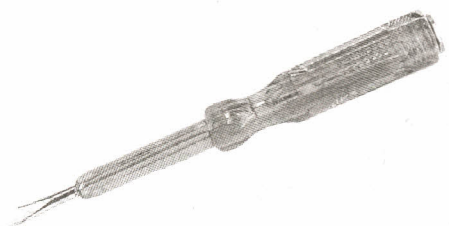
Name : Test Lamp

Material : Bakelite pendent holder, wires and lamp.

Use : To test the electrical circuits i.e. to find out short circuits, open circuits and to test earthing.

Care : Do not keep the test lamp along with the other tools. Never test supply voltage between two lines with single lamp.

15. LINE TESTER



Name : Line Tester

Material : Case - plastic
Blade - Steel

Use : To test the phase or live wire only.

Care : Generally do not use the line tester as a screw driver. Never test high voltage by the line tester.

16. RAVAL PUNCH

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Notes

Name : Raval punch

Material : Iron

Use : It is use to dig a hole in concrete wall.

Care : Hold the rawal punch exactly perpendicular to the wall. Do not use it on the metallic parts to avoid breakage.

2.4 GENERAL TOOL CARE

The simplest & best way to care for hand tools & hand power tools is to use them in the proper way & only for their intended purposes. e.g. the proper size of conventional screw-driver should be used to apply torque to a slotted screw; the screw driver should not be used to open paint pans, bang holes in a lid, pry out bent nails or to chip rock proper use ensures that the tool is always in the best condition to enable its use, completion of a job accurately, rapidly & precisely. It also ensures longetivity of the tool.

Tools should be kept clean & sharp at all times. Burrs & dirt or other foreign matters should be removed immediately. Tools should be stored either by hanging or by placing them in drawers. If tools with cutting edges such as chisels, files, punches, knives or saws are kept in drawers or a toolbox. They should be kept from touching each other. Keep metallic tools thinly coated with light oil. If tools are to be stored for a long period of time (more than one month) apply a rust preventative, such as a light grease, to all metal parts. If one of your tools because worn or dull the most practical solution is usually to buy a new one. Keep the old tool to use for a task for which you would rather not employ a good tool. Some tools such as screwdrivers, punches, chisels & pliers, cutters can be reground. Specific procedures are discussed in the applicable care of each tool.

When tool such as screw-driver, punches, chisels or plier cutters are ground to resharpened or resharp them, the tool should be dipped frequently in cold water to keep it cool. Too much heat can cause loss of temper of the metal; this condition is usually indicated by the appearance of a blue color on the metal.

GENERAL SAFETY

Always concern yourself and others with safety. Hand & power tools can be very harmful and can harm a person permanently. Sharp tools are the easiest to use and the safest.

DO'S AND DON'TS

Do's

1. Do take your time in working with all tools.
2. Do plan ahead.

3. Do wear rubber soled shoes when working on electrical work, cutting metal and chiseling.
4. Do take work breaks to reduce Fatigue.
5. Do follow the manufacturer's recommendations.
6. Do store your tools properly.
7. Do keep your tools sharp.

Don'ts

1. Don't wear neckties, long sleeved shirts or shorts while working in the shop.
2. Don't work when you are tired.
3. Don't allow your children to use sharp tools or power tools unless you are supervising them closely.

2.5 WHAT YOU HAVE LEARNT

In this lesson you have learnt description of tool,uses and how to care of them which tools used in electrical field.

2.6 TERMINAL QUESTIONS

1. List the basic tools. Describe any two tools with approproate Figure.
2. Write an essay on Basic tools.

3

ELECTRICAL / GRAPHICAL SYMBOLS

3.1 INTRODUCTION

Dear students in last lesson, we learned about wiring tools, their specification and their uses. Whenever we want to start electrical installation work at houses, shops, malls, small scale industries & big industries we need electrical wiring drawing. After discussion with customer, electrical engineer makes drawing while uses ISI symbols. He start work at site, he uses electrical plan which is finally designed by engineer. Symbols are represented by Bureau of Indian Standard (B.I.S.) which are recognized. Actually, there are many electrical symbols. Now, we learn symbols which are recommended in our syllabus.

3.2 OBJECTIVES

After reading this lesson you will be able to:

- Learn the electrical/graphical symbol.
- Understand how these symbols are used.

3.3 SYMBOLS

Symbols use in wiring are given below.

Items	Symbols
Switches & switch Outlets	
1. a) Single Pole	
b) Two Pole (Double pole switch)	
c) Three Pole (Triple pole switch)	

2. Single Pole Pull Switch 

3. Multiposition Switch 

4. Two Way Switch 

5. Intermediate Switch 

6. Pendent Switch 

7. Push Button or Bell Push 

Socket Outlet:

1. Socket Outlet, 6A 

2. Socket Outlet, 16A 

3. Combined Switch & Socket Outlet, 6A 

4. Combined Switch & Socket Outlet, 16A 

5. Interlocking Switch & Socket Outlet, 6A 

6. Interlocking Switch & Socket Outlet, 16A 

Lamps:

1. a) Lamp or Outlet for lamp 

   b) Group of Three 40W lamps 

2. Lamp, mounted on a wall or light bracket 

3. Lamp, mounted on ceiling 

4. Bulk-head lamp 

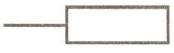
5. Watertight light fitting 

6. Batten lamp holder (mounted on the wall) 

7. Floodlight 

8. Fluorescent lamp 

Electrical Appliances

1. General, if necessary use designation to specify 

2. Heater 

Bells, Buzzers & Sirens

1. Bell 

2. Buzzer 

3. Siren 

4. Horn or Hooter 

5. Indicator (at 'N' insert number of ways) 

Fans

1. Ceiling Fan 

2. Bracket Fan 

3. Exhaust Fan 

4. Fan Regulator 

Earthing

1. Earth Point 

2. Fuse 

3.4 WHAT YOU HAVE LEARNT

In this lesson we learnt the graphical symbols of electrical field. Now we can prepare any drawing or diagram for the wiring purpose. These symbols are standardized by Bureau of Indian Standard (B.I.S.).

3.5 TERMINAL QUESTIONS

Answer the following questions and draw the Figures also.

1. Which symbols are used in electrical technology?
2. Draw the symbols according to IS for following -
   a) Single pole push switch
   b) Bell push
   c) Plug socket
   d) Lamp
   e) Fluorescent lamp
   f) Heater
   g) Fan regulator
3. State the names of symbols:
   a) 
   b) 
   c) 
   d) 

4

BASIC ELECTRICITY

4.1 INTRODUCTION

In previous lesson we have studied symbols and their uses in electrical theory. In this lesson, we are going to learn about basic electricity. Your entire study of electricity is based on electron's theory. The electron theory assumes that all electrical & electronic effects are due to movements of electrons from one place to another place.

All effects of electricity take place because of the existence of tiny particle called the 'Electron'. Since no one actually has seen an electron, but only the effects it produces, we call the laws governing its behavior, the electron theory. Before working with electricity we must know what is an electron & causes in the material for movement.

4.2 OBJECTIVES

After the reading this lesson, you will be able to understand:

- Atomic structure of matter,
- Electricity,
- Current,
- EMF,
- Resistance,
- Electrical power,
- Electrical energy
- Simple examples of power & energy

4.3 MATTER

A body which has a definite weight and which occupies some space is called 'Matter'. It is found in 3 states: solid, liquid & gas.

Matter is made up of tiny particles.

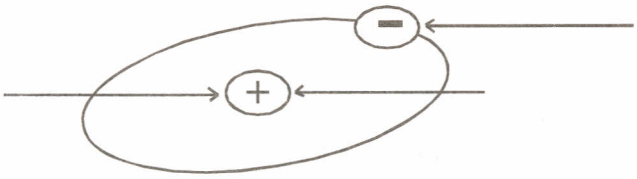
MOLECULE

Matter can be divided into tiny particles. The smallest particle of a matter which contains all the physical & chemical properties of the matter is called molecule.

ATOM

The smallest particle of a matter which can take part in a chemical reaction but cannot exist freely is called an atom.

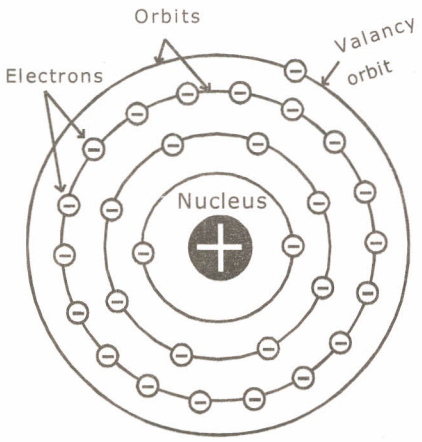
The Atom is consisting of electrons, protons and neutrons.



In an atom, a nucleus surrounded by electrons.

ATOMIC STRUCTURE

In an atom the total number of negatively charged electrons circling around the nucleus exactly equals the number of extra positive charges in the nucleus. The positive charges are called protons. Besides the protons, the nucleus also contains electrical neutral particles called neutron. These are like a proton & an electron bonded together.



Atoms of different elements contain different number of neutrons within the nucleus, but the number of electrons spinning about the nucleus. Always equals the number of free protons (or positive charges) within the nucleus.

Electrons in the outer orbits of an atom are attracted to the nucleus by comparatively less force than electrons whose orbits are near the nucleus. These outer electrons are called 'Free electrons' and may be easily forced from their orbits, while electrons in the inner orbits are called 'bound' electrons. Since they cannot be forced out of their orbits easily. It is the motion of the free electrons that makes up an electric current.

Nucleus

The nucleus is the central part of the atom. It contains the protons and neutrons of an atom. The number of protons & neutrons in the nucleus varies. For the different elements depends on the particular atom involved.

Proton

The proton has a positive electrical charge. It is almost 1840 times heavier than the electron & it is the permanent part of the nucleus. Protons do not take an active part in the flow or transfer of electrical energy. Protons repeal each other but have a force of attraction for the negative electron.

Electron

It is a small particle revolving around the nucleus in an atom. The electron is three times larger in diameter than the protons. Protons = no. of electron, due to its orbital speed, around the nucleus, carrying a considerable amount of energy.

Since all electrons are negative in charge, they will repeal other electron & have a force of attraction for the positively charged protons.

Neutron

A neutron is actually a particle by itself and it is generally thought of as an electron & proton combined. It is electrically neutral. Since neutrons are electrically neutral, they are not important to the electrical nature of atoms.

Electricity

The effect of electrons is moving from point to point in a material is called electricity.

Negative Charge

The excess of electrons in one material is known as a negative charge.