LESSON 1

# Introduction to Electricity

YHERS

## LEARNING OBJECTIVES

The objective of this lesson is to know about electricity, the methods of power generation. fundamentals of AC and DC, electric circuit and laws.

## Table of Content



## 1.1 INTRODUCTION

The Basic Electrical Engineering subject is introduced in the higher secondary level for students. In this subject, students learn that the basic concepts in Electrical Engneering, maintenace and repair of electrical appliances.

## 1.2 ORIGIN OF ELECTRICITY

### 1.2.1 History of electricity

In 1752, an American Scientist Benjamin Franklin wanted to do a small experiment in lightning. He took a kite during a thunder storm and he got the string of the kite. Then he put a

metal key at the end and then he made the kite to float up into the storm. At that time he felt a small electric shock. During this experiment, he felt that lightning contains electricity. Scientists felt that electricity can be produced from lightning.

### 1.2.2. Basic of Electricity

Everything in the world is made up of atoms (even human body). It cannot be destroyed. It consists of three particles namely,

1.Protons
2.Electrons
3.Neutrons

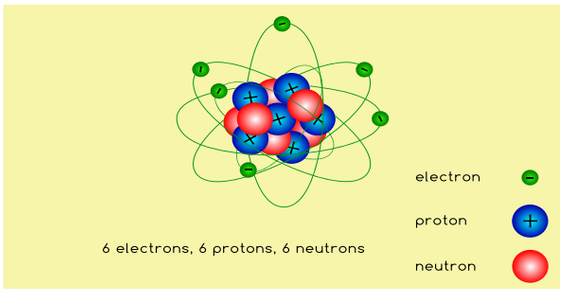



Fig 1.1 Atomic Structure

Protons are the positively charged particle, the electron is a negatively charged particle and the neutron is a neutral charged particle which has no charge. The protons and neutrons are bound together to form the central part called Nucleus as shown in the fig 1.1. Electrons are revolving around the nucleus in a definite path called orbit.

If the balancing force between protons and electrons are disturbed by an external force, an atom may gain or lose an electron. When electrons are lost from an atom, the free movement of these electrons constitutes an electric current.

The flow of free electrons due to the voltage applied is said to be electric current.

### 1.2.3. Classification of materials based on the conductivity

Based on the conductivity, the materials are classified into three types, namely,

#### Conductors

Conductors are the materials that allow an electric current to pass through it easily. Example gold, silver, copper etc, are good conductors of electricity.

#### Insulators

Insulators are the materials that does not allow an electric current to pass through it. Example are rubber, glass, plastic, etc.

#### Semiconductors

The semiconductors are the materials that have the electrical conductivity which lies between the conductors and insulators. Example: Silicon and germanium.

## 1.3 FUNDAMENTAL TERMS IN ELECTRICAL CIRCUITS

Understanding the concepts of electricity requires knowledge in the following electrical terms.

#### Current

Flow of electron in a conductor is called as current. It is represented by the letter 'I' and the unit is called ampere(A). Current can be measured by ammeter.

1 Ampere: "One coulomb charge crossing over the area of cross section of the conductor in one second is called 1 ampere.

1 Coulomb: A collection of $\mathbf{2\pi} \times 10^{18}$ electrons has a charge of one coulomb.

## Voltage

The electric pressure which is used to move electrons from one end to another end is called as voltage. It is represented by the letter 'V' and the unit is volt. It is measured by voltmeter. The other parameters termed as volts are EMF, Potential and Potential Difference.

### Electro Motive Force (EMF)

It is the force which causes the flow of electrons in any closed circuit. It is represented by volt.

### Potential and Potential Difference

The work done in bringing unit positive charge from infinity to that point against the application of electric field is called potential. It is also represented in volt.

The difference of potential between any two points in a electrical circuit is called potential difference and is expressed in volt.

## Resistance

Resistance may be defined as the property of a substance to oppose the flow of current through it. It is represented by the letter R and the unit is ohm(Ω). It is measured by ohm meter. Mega ohms value is measured by using megger.

## Laws of resistance

The resistance of a conductor in a circuit depends upon the following:

- It depends upon the resistivity of the material used (ρ)
- The value of resistance directly proportional to the length of the conductor.(R)
- It is inversely proportional to the area of cross section of the conductor.(A)
- Temperature of the conductor.

$$R=\frac{\rho l}{A}$$

## Work, Power and Energy

Here we are going to study about the work, power and energy and their relationship.

### Work

Work is said to be done by Force 'F' when the point of its application moves through a distance 'S'.

Mathematically, Work = Force × distance = F × S =FS.

The unit of force is Newton (N). If 1 Newton force moves a body to a distance of 1 metre, then the work done is 1Nm (Newton - metre)

In an electric circuit, if 1 volt electric potential causes 1 coulomb of electric charge to pass through it, then the work done is equal to 1 joule.

1 joule = 1 volt × 1 coulomb

Coulomb = Ampere × time

i.e $J = V \times I \times t$

### Power

Power is rate of doing work. The power is obtained by the following expressions.

P = V × I.
P = Power
V = Applied voltage
I = Current

Its unit is watt (W).

$$\text{Power} = \frac{\text{Work done}}{\text{time}} = \frac{\text{Joule}}{\text{time}} = \frac{V \times I \times t}{t}$$

Power $P$ = VI watt [$V = IR$, $P = I^2R$]

1 KW = 1000 watt

1 HP = 746 watt

**iii) Energy**

The amount of work done by an equipment during a time period of 't' seconds. The unit of energy is joule.

Energy = Power × time / watt sec

The energy spent for the appliances in 1 kwh is called as one unit i.e

**1 unit = 1 kwh**

The power of iron box is 1000 watt. when used for 1 hour, the energy consumed is, 1000 watts × 1 hour = 1000Wh = 1kwh = 1unit.

**Example: 1**

The resistance of a lamp is 10Ω and 2A current is flowing through it. Calculate the power of the lamp.

**Solution:**

Resistance (R) = 10Ω

Current (I) = 2A

Power = $I^2.R$

$=2^2 \times 10 = 40W$

**Example: 2**

In a factory, the following appliances are used:

a) 3Hp motor works 5 hours per day.
b) 100W capacity of 40 lamps glow 8 hours per day.
c) 1500W capacity of heater works 6 hours per day.

Calculate the cost of energy consumed in 30 days. (1unit cost is Rs. 6.00)

**Solution:**

a) 3Hp motor works 5 hours per day

$$\text{Energy} = \frac{3 \times 746 \times 5}{1000} = \frac{11190}{1000} \text{Wh}$$
$$= 11.190 \text{ kwh} = 11.190 \text{ unit}$$

b) 100w capacity of 40 lamps glow 8 hours per day

$$\text{Energy} = \frac{100 \times 40 \times 8}{1000} = \frac{32000}{1000} \text{Wh}$$
$$= 32\text{kWh} = 32 \text{ units per day}$$

c) 1500w heater works 6 hours per day

$$\text{Energy} = \frac{1500 \times 6}{1000} = \frac{9000}{1000} \text{Wh}$$
$$= 9\text{kWh} = 9 \text{ units per day}$$

The total number of units consumed in 30 days

$-(11.190 + 32 + 9) \times 30$

$-52.19 \times 30$

$-1565.7$units

Cost of electricity by for 30 days (1 unit=Rs.6)

-1565.7×6

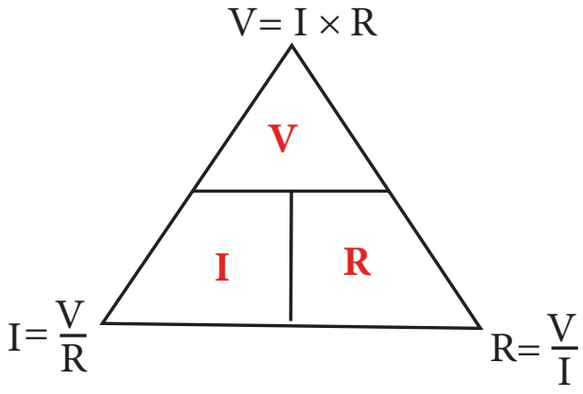
-9394.2

Cost-Rs.9394

## 1.3.1. Ohm's law

In an electrical circuit the current, voltage, and resistance are related to one another. The relationship was derived by the scientist ***Georg Simon Ohm***, called Ohm's Law.

Ohm's law states that, *"At a constant* temperature *in any closed circuit, the current is directly proportional to the voltage applied and inversely proportional to the resistance of the circuit."*




$$\text{i.e} \quad I = \frac{V}{R}$$

$$\therefore \; V = I\,R \text{ and } R = \frac{V}{I}$$

Where, V = Voltage in volts. I = current in ampere and R = Resistance in ohm

Problems

1) *Supply voltage of the circuit is 240V. The resistance value is 60Ω. Calculate the current flowing through this circuit.*

Voltage (V) = 240V
Resistance (R) = 60Ω
Current (I) = ?
According to ohm's law, $I = \frac{V}{R}$
Current $I = \frac{240}{60} = 4A$

2) *Voltage of the circuit is 230V and current 10A is flowing through it. Find the value of Resistance.*

Voltage (V) = 230V
Current (I) = 10 A
Resistance (R) =?

According to ohm's law, $I = \frac{V}{R}$

i.e $10 = \frac{230}{R}$

$R = \frac{230}{10} = 23\Omega$

### 1.3.2 Kirchhoff's laws

Kirchhoff derived laws based,

Kirchhoffs laws describes current in a node and voltage around a loop. These two laws are foundation of circuit analysis. They are

i) Kirchhoff's Current Law (KCL)
ii) Kirchhoff's Voltage Law (KVL)

**i) Kirchhoff's Current Law (KCL)**

The sum of the current flowing towards a point (i.e junction) is equal to the sum of the current flowing away from the point. In other words, the algebraic sum of the currents at any junction of a network is zero.

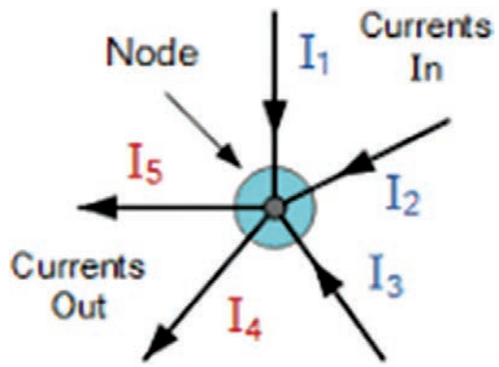



Fig 1.2 Kirchoff's current law

Fig 1.2 represents Kirchhoff's current law. In this, $I_1$, $I_2$ and $I_3$ represent the current flowing towards the junction point $I_4$ and $I_5$ represent the current flowing away from the junction point.

$I_1 + I_2 + I_3 = I_4 + I_5$
$I_1 + I_2 + I_3 - I_4 - I_5 = 0$

**ii) Kirchhoff's voltage law (KVL)**

In any closed electric circuit, the algebraic sum of the potential drop is equal to the supply voltage.

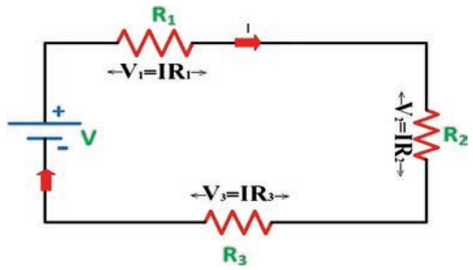



**Fig 1.3 Kirchoff's Voltage Law**

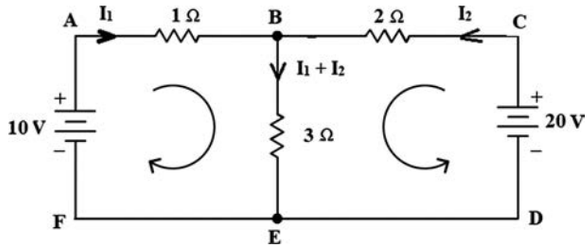
Fig 1.3 represents, loads $R_1$, $R_2$, and $R_3$ connected in series. Potential drop across $R_1$ is $IR_1$, potential drop across $R_2$ is $IR_2$ and potential drop across $R_3$ is $IR_3$.

$$V_1 = IR_1$$
$$V_2 = IR_2$$
$$V_3 = IR_3$$
$$V = V_1 + V_2 + V_3$$
$$IR = IR_1 + IR_2 + IR_3$$

**Problems:**

**Example:**

Find the current in the 3Ω resistor in the circuit as shown.




In the closed loop ABEFA

$$I_1 + 3\,(I_1 + I_2) = 10V$$
$$I_1 + 3I_1 + 3I_2 = 10$$
$$4I_1 + 3I_2 = 10 \qquad (1)$$

In the closed loop BCDEB

$$2I_2 + 3\,(I_1 + I_2) = 20V$$
$$2I_2 + 3I_1 + 3I_2 = 20$$
$$3I_1 + 5I_2 = 20 \qquad (2)$$

$$3 \Rightarrow 12I_1 + 9I_2 = 30$$
$$4 \Rightarrow 12I_1 + 20I_2 = 80 \qquad (4)$$
$$\Rightarrow -11I_2 = -30$$
$$= \frac{-50}{-11} = 4.545\,A = 4.55A$$

Substituting the value of $I_2$ in equation (2) to get

$$3I_1 + 5I_2 = 20$$
$$3I_1 + 5 \times 4.55 = 20$$
$$3I_1 = 20 - 22.75$$
$$= -2.75$$
$$I_1 = -\frac{2.75}{3}$$
$$= -0.916A$$
$$I_1 = -0.916A$$

The value of current $I_1$ is negative, So the current flow in the circuit, is in opposite direction.

The current in 3Ω resistor is $I_1 + I_2$ = −0.92 + 4.55 = 3.63A

## 1.4 TYPES OF ELECTRIC CIRCUIT

An electric circuit is defined as the current flowing from the supply points through the load to complete the path. In this chapter, we will study about the types

of the electrical circuits. There are three types of electrical circuit namely;

i) Closed circuit,
ii) Open circuit and
iii) Short circuit.

**i) Closed circuit**

When loads are connected in series between two terminals of electric supply, then the current passing through the load is called as closed circuit.

For example, it the switch is OFF, the circuit is open and the lamp will not glow. If the switch is ON, the circuit is closed and the lamp will glow.

**ii) Open circuit**

In this circuit, if there is no way to the flow of current due to disconnection of wire or the switch is in OFF condition, then the circuit is called open circuit.

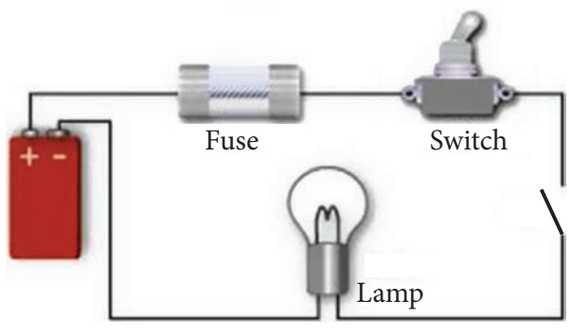



Fig 1.4 *Open circuit*

Ex: In lighting circuit, if the switch is in OFF condition, the circuit is open and the lamp will not glow and it is called an open circuit.

**iii) Short circuit**

In this circuit, the two terminals of the supply is connected directly without a load and the current flow is infinite because of very low resistance. Then the circuit is called as short circuit. It causes heavy damage to the load.

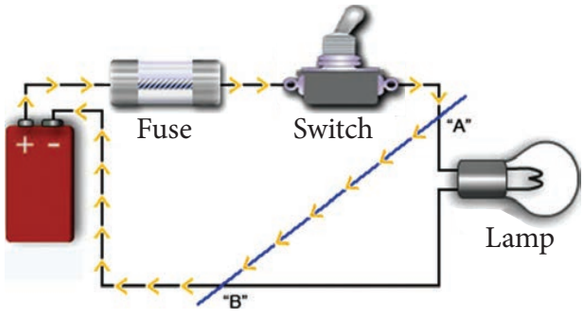



Fig 1.5 Short circuit

## 1.4.1 Classification of Electric circuits

Here we will study about the classification of the electrical circuits in terms of resistances. They are,

i) Series circuit
ii) Parallel circuit
iii) Series-parallel circuit

**i) Series circuit**

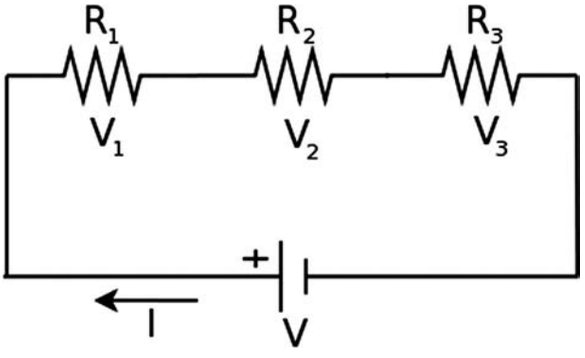



Fig 1.6 Series circuit

When three resistors are connected in series with each other as shown in Figure 1.6, so that the same current passes through all of them is called series circuit.

Here the resistors $R_1$, $R_2$ and $R_3$ are connected in series. The current flowing in all three resistors is same as that of supply current. But across each resistor, it

has a potential drop depending on their resistance value.

According to Ohm's law

$V_1 = IR_1$, $V_2 = IR_2$, $V_3 = IR_3$

The sum of the three potential drops in equal to the supply voltage V

$I = I_1 = I_2 = I_3$

$V = V_1 + V_2 + V_3$

$V = IR_1 + IR_2 + IR_3$

$V = I (R_1 + R_2 + R_3)$

$\frac{V}{I} = R_1 + R_2 + R_3$

Where $R = R_1 + R_2 + R_3$

$\frac{V}{I} = R.$

### ❖ Important points for series circuit

1. In series circuit, the current flows through only one path.
2. If one more resistance is to be added, the total value of resistance is increased. Total resistance is equal to the sum of all the resistance connected to this circuit.

i.e $R = R_1 + R_2 + R_3 + \ldots\ldots$

3. The current flows in all resistor is same

i.e, $I = I_1 = I_2 = I_3$

4. The sum of the potential drop across each resistor is equal to the supply voltage i.e $V = V_1 + V_2 + V_3$
5. If there is a fault in any place of the circuit, the total circuit will be inactive.

**Example:-** In many of the places like temple functions, malls, theatres and marriage halls, serial sets are used to make different decorative items using serial bulbs. In serial circuit, the path of the current flow is only one. So if any fault (brake in wire connection) occurs in any one place of the circuit, then the total circuit (serial set) will be inactive.

### ii) Parallel circuit

When resistors are connected across supply so that the same voltage (supply voltage ) is applied between the end point of each resistor, then this type of connection is said to be parallel connection as in figure 1.7.

In this circuit, the voltage across each resistor is same as supply voltage but the current in each resistor is different. In this circuit, the sum of the current $I_1$, $I_2$ and $I_3$ is equal to supply current I, i.e $I = I_1 + I_2 + I_3$

According to ohm's law

$$I = \frac{V}{R}$$

$$I_1 = \frac{V}{R_1}, I_2 = \frac{V}{R_2}, I_3 = \frac{V}{R_3}$$

But total current $I = I_1 + I_2 + I_3$

$$I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{I}{V} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

But $\frac{I}{V} = \frac{1}{R}$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

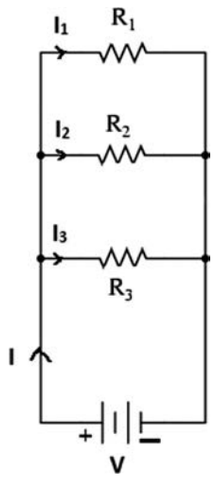


Fig 1.7 Parallel circuit

$$\frac{1}{R} = \frac{R_2R_3 + R_1R_3 + R_1R_2}{R_1R_2R_3}$$

$$R = \frac{R_1R_2R_3}{R_2R_3 + R_1R_3 + R_1R_2}$$

**Important points of a parallel circuit**

i) In parallel circuit, the current flows through two or more parallel paths at a junction.

ii) Current varies in different resistances i.e The sum of the current is equal to supply current.

$$I = I_1 + I_2 + I_3 + \ldots$$

$$I = \frac{V}{R}, \quad I_1 = \frac{V}{R_1}, I_2 = \frac{V}{R_2}, I_3 = \frac{V}{R_3}$$

iii) The voltage is same across all resistors as supply voltage.

$$V = V_1 = V_2 = V_3 = \ldots$$

iv) The total value of the resistance is reduced by adding one or more resistor in the circuit. If three resistances are connected in parallel then the total resistance is

$$R = \frac{R_1R_2R_3}{R_2R_3 + R_1R_3 + R_1R_2}$$

v) If there is a fault in any one resistor, the other two resistors will work, the current will flow through the remaining resistors.

**Example:** In our house or factories, different types of electrical appliances are used, i.e., fan, bulb, television, motor, heater, etc., Each one has a separate circuit. For example, if there is a fault in fan circuit, the fan circuit alone is inactive. Other circuits like bulb, television etc will work as usual. So, in parallel circuits there are number of current paths available.

**Problems – (Series circuit)**

1) ***10Ω, 20Ω and 30Ω resistances are connected in series. The circuit voltage is 240V. Calculate i) Total resistance ii) current through the circuit.***

$R_1 = 10\Omega, R_2 = 20\Omega, R_3 = 30\Omega$
$V = 240V$
$R = ?$
$I = ?$

When the resistors are connected in series
$R = R_1 + R_2 + R_3$
$= 10 + 20 + 30 = 60\Omega$

Total Resistance $R = 60\Omega$
According to Ohm's law

$$I = \frac{V}{R}$$
$$= \frac{240}{60} = 4A$$

Current I = 4A.

**Problem – (Parallel circuit)**

1) ***Two resistances 8Ω and 2Ω are connected in parallel. Voltage of this circuit is 240V. Find the value of***
***i) Total resistance***
***ii) Current.***

$R_1 = 8\Omega, R_2 = \Omega$
$R = ?$

In parallel circuit, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

$$= \frac{8 \times 2}{8+2} = \frac{16}{10} = 1.6\Omega$$

According to ohm's law

$$I = \frac{V}{R}, I = \frac{240}{1.6} = 150A$$

2) ***Three resistors 6Ω, 3Ω and 2Ω are connected in parallel. The current flow of this circuit is 2A. Find out the value of***
***i) Total resistance***
***ii) Voltage.***

$R_1 = 6\Omega$, $R_2 = 3\Omega$, $R_3 = 2\Omega$, $I = 2A$
$R = ?$ $V = ?$

When they are connected in parallel,

$$R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Then
$$R = \frac{R_1 R_2 R_3}{R_2 R_3 + R_1 R_3 + R_1 R_2}$$

$$= \frac{6 \times 3 \times 2}{(3 \times 2) + (6 \times 2) + (6 \times 3)}$$

$$R = \frac{36}{6+12+18} = \frac{36}{36} = 1\Omega$$

According to Ohm's law

$$I = \frac{V}{R}$$

$$2 = \frac{V}{1}, V = 2V$$

### iii) Series - Parallel circuit

In series parallel circuit, one or more resistors are connected in series with more resistors connected in parallel. This is the combination of series parallel circuit.

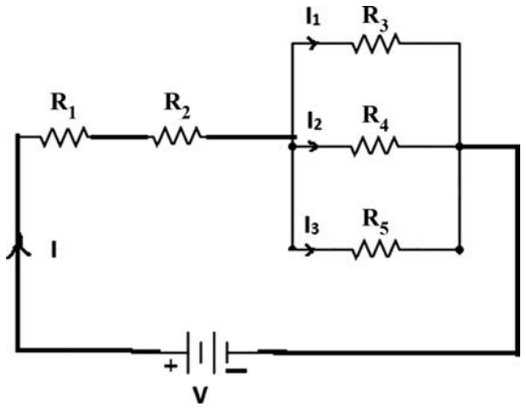



Fig. 1.8 Series-parallel circuit

Fig 1.8 represents, five resistors connected in series parallel circuit. Here $R_1$, $R_2$ are connected in series and $R_3$, $R_4$, and $R_5$ are connected in parallel. These parallelly connected resistors are connected in series with $R_1$ and $R_2$.

Hence the total resistance of the circuit is

$$R = R_1 + R_2 + \left[ \frac{R_3 \times R_4 \times R_5}{R_4 R_5 + R_3 R_5 + R_3 R_4} \right]$$

## 1.5 POWER GENERATING PLANTS

The electrical power is generated power generating plants. They are genarally.

a) Hydroelectric power plant
b) Thermal power plant
c) Atomic power plant
d) Gas power plant
e) Diesel power plant
f) Solar power plant
g) Wind power plant

**a) Hydroelectric power plant**

From the water reservoir, the water is taken through the penstock pipes to the water turbine. For the rotation of turbine, the kinetic energy of water is used and mechanical energy of the turbine is converted into electrical energy by generator coupled with the turbine.

This type of plants are located in Mettur, Kunda, Pykara, Suruliyaru and Kadamparai.

**b) Thermal power plant**

In thermal power plants heat energy is converted into electrical energy by burning coal or lignite in boiler plant. Water in the boiler is converted into high pressure steam by heat energy. This steam is flown through the steam turbine which is coupled to the generator. This energy is converted into mechanical energy by the rotation of turbine. The mechanical energy is again converted into electrical energy by the generator.

This type of plants are located at Ennore, Neyveli, Tuticorin and Mettur in Tamil Nadu.

**c) Atomic power plant**

By the diffusion of an atom of Uranium or Thorium, more heat is produced. The atomic power plant is working based on this principle. The heat energy produced is used to rotate the steam turbine and this energy is converted into mechanical energy. The generator converts the mechanical energy into electrical energy.

This type of plants are located in Kalpakkam near Chennai, Koodangulam in Tirunelveli District and Tharapur in Rajasthan.

**d) Gas power plant**

The process of generating electrical energy with the help of gas turbine (which acts as a prime mover) is known as Gas power plant. It is available in Ramanathapuram and Nagapattinam districts.

**e) Diesel power plant**

Diesel power plant is used in places where continuous supply of electricity is needed i.e., in industries. Electricity is produced by the generator which is connected to a big diesel engine which acts as prime moves.

Depending upon the requirements, different capacities of small or large diesel generators are used in hotels, hospitals, jewellery shops, cinema theatres, shipyards, etc.

**f) Solar power plant**

Now a days solar panels are used to generate electrical power in many places. Solar panels are made out of photovoltaic cells that convert the sun radiative energy into electrical energy.

**g) Wind power plant**

A wind turbine is a deivce that converts kinatic energy of wind is conducted into electrical energy. Wind power plant is a group of wind turbines in the same location to produce electricity.

Hydro Power Plant

Thermal Power Plant

Atomic Power Plant

Gas Power Plant

Diesel Power Plant

Solar and Wind Plant

Fig 1.9 *Types of power plants*

## 1.6 INTRODUCTION OF LT/HT LINE

Generated power from power station is transmitted and distributed through transformers, overhead lines and cables to the end users.

### 1.6.1 LT Lines

In India, low Tension (LT) supply is 440 volts for three-phase connections and 230 volts for single-phase connection.

Fig 1.10 *LT Line*

Consumer of electricity like individual houses, shops, small offices and smaller manufacturing units get their electricity on LT connection.

### 1.6.2 HT Line voltage

High tension (HT) supply is applicable for bulk power purchase which needs 11 kV or above. Major industries are operating at High tension supply only.

Fig 1.11 *HT Lines*

## Activities

1. Produce electricity by any two materials applying friction method.
2. How the supply leakage electric shock can be eradicated?

## GLOSSARY

| | | |
|---|---|---|
| Hydroelectric power plant | — | நீர் மின் நிலையம் |
| Thermal power plant | — | அனல் மின் நிலையம் |
| Gas power plant | — | வாயு மின் நிலையம் |
| Diesel power plant | — | டீசல் மின் நிலையம் |
| Solar power plant | — | சூரிய ஒளி மின் நிலையம் |
| Wind power plant | — | காற்றாலை மின் நிலையம் |
| LT – Low tension line | — | குறைவழுத்த மின்சாரம் |
| HT – High tension line | — | உயர்வழுத்த மின்சாரம் |

## PART A

Mark 1

WSBFR

**Choose the correct answer:**

1. The smallest particle of an element is known as
   a) Atom
   b) Molecule
   c) Nucleus
   d) Electron
2. An atom is composed of
   a) Electrons only
   b) Protons only
   c) Neutrons only
   d) Electrons, Protons and Neutrons
3. HT line means
   a) 230V
   b) 440V
   c) Above 11 Kv
   d) Below 11 Kv
4. LT lines means
   a) 230 volts or 440 volts
   b) 440 Kv
   c) Above 11 Kv
   d) Below 11 Kv
5. The number of electrons in an atom are
   a) equal to the neutrons
   b) equal to protons
   c) equal to the atomic structure
   d) equal to molecules
6. The supply voltage used for single phase domestic purpose is
   a) 110–120V
   b) 120–130V
   c) 220–230V
   d) 400–440V
7. Switch should always be connected with
   a) neutral wire
   b) earth wire
   c) phase wire
   d) line wire
8. The charge of an electron is --------
   a) positive
   b) negative
   c) positive and negative
   d) no charge
9. Neutrons are ---------- charged particle.
   a) positive
   b) positive and negative
   c) negative
   d) no charge
10. Electrons revolving around the nucleus in a definite path is called ----------
    a) orbit.
    b) track
    c) route
    d) neutrons
11. Which is a good conductor?
    a) Gold
    b) Silver
    c) Copper
    d) Aluminium
12. The most commonly used semi conducting material is
    a) silicon and germanium

b) rubber
c) copper
d) iron

13. Single-phase AC power supply is commonly used in
a) industries
b) domestic purposes.
c) cinema theatre
d) hotels

14. The material that does not conduct current is
a) conductor
b) insulator
c) semiconductor
d) mercury

15. Good conductor is having the property of
a) low resistance
b) high resistance
c) medium of these two
d) low voltage

16. EMF is measured by
a) volt
b) ohm
c) ampere
d) watt

17. Unit of power is
a) volt
b) ampere
c) watt
d) ohm

18. The instrument used to measure the power is _____
a) wattmeter
b) ammeter
c) voltmeter
d) tacho meter

19. According to ohm's law I is equal to
a) $V^2/R$
b) $I^2R$
c) V/I
d) V/R

20. Unit of force is _____
a) newton
b) ampere
c) volt
d) joule

## Q A PART B

Mark 3

### Answer the questions in brief

1. Define an atom.
2. What is called electricity?
3. Define LT & HT line.
4. Write about atomic theory of electricity.
5. Define a conductor.
6. Write short note on insulator.
7. Write briefly about semiconductor.
8. Define Ohm's law.

9. Voltage of circuit is 240V and 12 A current is flowing through it. Find the value of resistance.
10. Explain 'open circuit'. and "closed circuit'.
11. Two resistance 3Ω and 6Ω are connected in parallel Voltage of the circuit in 240V. Find the value of total resistance.

## Q A PART C

Mark 5

**Answer the questions not exceeding one page**

1. Explain the properties of conductors.
2. Explain the properties of insulators.
3. What are the important rules for series circuit?
4. What are the important rules for parallel circuit?
5. Three resistors 3Ω, 6Ω and 18Ω are connected in parallel. The current flow of the circuit is 3A. Find the value of i) Total resistance ii) voltage.
6. Explain the laws of resistance.

## Q A PART D

Mark 10

**Answer the questions not exceeding two page**

1. Explain the various methods adopted in power generation.
2. Explain the construction and working principle of series and parallel circuit.
3. Explain kirchhoff's laws with neat diagram.