CHAPTER TWENTY ONE
ELECTRICITY - PART ONE

Introduction to electricity:

- Electricity is the most versatile and useful form of energy due to a number of reasons.
- Firstly it is easy to change electricity into other forms of energy such as heat, light and sound.
- Secondly, many types of modern equipments such as radio, television and the telephone use it.
- Apart from that, many important industries such as Valco depend on electricity for its opeartion.
- Electricity has a wide usage and is used in our homes to operate household items such as the electric iron, the refrigerator and the electric stove.
- Within the field of business and industries, electricity us used to ran machinery such as drills and milling machines.
- In the transport field, electrical energy is used in the electric street cars and the diesel-electric engines which pulls many railways trains.
- With reference to the area of science and communication, it is also used to operate communication devices such as the television and the telephone.
- Lastly, withn the agricultural sector, electricity is used to operate farm machinery.

Types of electricity:

TThere are two types and these are:

(i) Static electricity.

(ii) Current electricity.

(a) Static electricity consists of electrons or ions which are not in motion or moving, and can be produced by rubbing appriopriate materials together.

(b) By so doing, one material will attract electrons from the other and become nagatively charged, while the other becomes positively charged.

- When two materials are rubbed together, it must be noted that it is only electrons which are transferred from one unto the other, since protons are not transferable.
- Current electricity on the other hand consists of moving electrons or ions or in other words, it is due ti the flow of ions or electrons.

- In order to be able to conduct electricity, the atoms of an electrical conductor such as a metal must have free electrons or electrons, which are free to move from one atom to the other.
- In liquids and gases which conduct electric current, it is the ions which they contain which conduct the electric current but not electrons.
- In certain materials such as rubber and glass, the electrons are so tightly bound to their atoms that it is only a few which can move.
- Such materials are referred to as insulators or dielectrics.
- Lying in between the conductors and insulators are a group of materials call semiconductors, which are neither good conductors nor good insulators.
- Examples are silicon and germanium.

Types of current and electrical circuit:

- There are two main types of current and these are
(I) direct current (d.c)
(II) alternating current (a.c).
- Direct current flows only in one direction, while alternate current rapidly reverses it direction of flow many times a second.
- The path along which an electric current flows is called an electric circuit or a circuit.
- A simple circuit may consists of a battery and bulb, which are joined to the two terminals of a battery by means of a wire.
- A circuit may also include other electrical devices and components, and may be an open one or a closed one.
- A switch can be used to break a circuit by moving two contacts apart, so as to prevent the flow of current in the circuit.
- An open circuit is one in which there is a break in its conducting path, so that there is no flow of current in it.
- A closed circuit is one in which there is no break in its conducting path, which enables current to flow in it.

The unit of electricity (coulumb):

- The coulomb is the quantity of electricity which passes any point in a second, when a steady current of one ampere is flowing.
- The quantity of electricity which passes any point in a circuit, depends on the strength of the current and the time for which it flows.
- The coulomb is the unit of the quantity of electricity used, when current is measured in amperes.
- The ammeter is the instrument used to measure current.

- The quantity of electricity (or charges) = current x time, where the quantity of electricity or the quantity of the charges is in coulombs, the current is in amperes and time is in seconds.

(Q1) A current of 5A flows through a wire for 10 seconds. Calculate the quantity of electricity.

Soln:

Quantity of electricity = current x time = 5 x 10 = 50coulombs.

(Q2) A current of 3A flows through a conductor for 2 minutes. Determine the charge or the quantity of electricity.

Soln:

Current = 3A.

Time = 2 minutes = 2 x 60 = 120seconds.

The charge = current x time = 3 x 120 = 360coulomb.

The electromotive force and voltage:

- The electromotive force or the e.m.f, is the force which turns to casue the flow of electricity around a circuit.
- In an electrical circuit, there must be a source of energy which makes it possible for chages to be pumped or forced round the circuit.
- Cells and batteriies provide this electromotive force or volltage for this pumping action.
- The e.m.f of a cell or a battery is its ability to give energy to the electrons, and the greater this e.m.f or voltage, the greater becomes the amount of energy given to the electrons.
- Both e.m.f and voltage are measured in vollts (V), and the e.m.f of a cell in volts is defined as the total work done in joules per coulomb of electricity, conveyed in a circut in which the cell is connected.

The potential difference: The potential difference (p.d), is the difference between the energy of the electrons pumped out from a battery and the energy of the electrons arriving back into the battery, after travelling round the circuit.The potential difference is measured in volts, and since there is a small difference between the values of the

e.m.f and the p.d of a battery, we use the term battery voltage to describe either of them.

The resistance:

- This refers to the opposition to the easy flow of current within an electric circuit.
- It is as a result of resistance within a circuit, which calls for the need of a bettery to push the electrons round the circuit.
- Even though resistance is experienced in all the components connected in a circuit, some components offer less resistance than others.
- The resistance is measured in ohms (Ω), when the current is in ampres (A) and the voltage is in volts.
- Also R = $\frac{V}{I}$,

Where R = resistance.

V = voltage.

I = current.

(Q1)Find the resistance if a battery of voltage 12V, which drives a current of 4 amperes through a circuit.

Soln:

R = ?, V = 12V, I = 4A.

From R = $\frac{V}{J} => R = \frac{12}{4}$ = 3Ω.

- It must also be noted that the higher the resistance, the lower will be the current that can flow for the same battery voltage.

Resistors:

- These are specialy made devices which are used to reduce the current within a circuit.
- In radio and telivision circuits, resistors are used to keep currents and voltages at levels needed to make other parts work properly.

(e) Variable resitors are used when there is the need to be changing the resistances within a current.

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The heating effect of current:

When current is passed through a conductor, there is a resistance to the flow of the current which results in the production of heat and the subsequent heating of the conductor.

Conductors and non-conductors:

The resistance of any conductor depends on two factors and these are
(a) its dimensions.
(b) the material of which it is made.

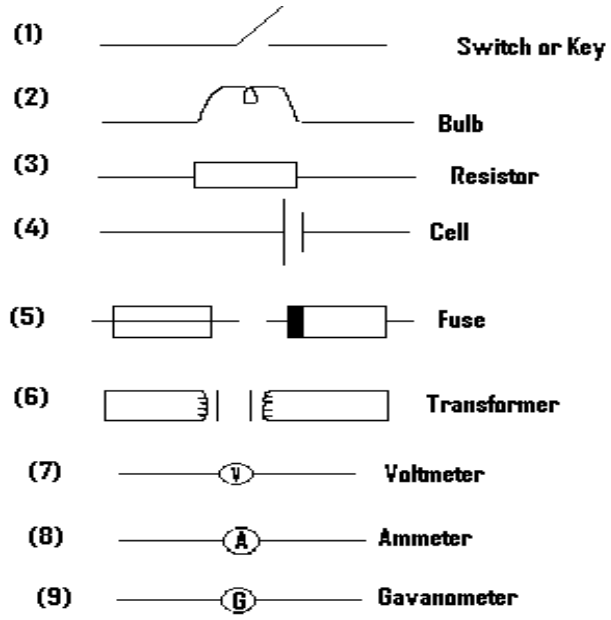
- It must be noted that the longer a conductor such as a wire, the higher its resitance and for this reason, long wires have higher resistance than short ones.

- Also, the thinner a conductor such as a wire, the higher its resistance. if these wires or conductors are made from the same material.

- Because copper has a low resistance, it is usually used to connect components within a circuit and also for the transmission of current.

- Because current cannot pass through insulatoors, they can be used to cover electrical wiires so as to protect the users of electricity from electric shock.

Electrical and electronic symbols:



Power transmission:

- One important advantage of electrical power or energy is that is it easy to carry it from place to place, and transmission is the term used to refer to the carrying of electric power from one place to another.
- This transmission is done by elelctrical cables, and power stations which generate electricty are connected by cables to all the places where the power is needed.
- Since the cables are made of good conductors, they offer low resistance to the flow of current and as such, the energy lost which is associated with transmission is made very small.
- In order to reduce the energy lost further, the electrical power is carried at very low current and high voltage.
- Apart from the fact that the transmission of current at high voltage reduces energy loses, it enables the current to be transmitted over long distances.
- Large transformers called step-up transformers in power plants or station, increase the voltage to the level needed for transmission.
- Power from the step up transformers are then fed into thick electrical cables and carried on top high steel towers called pylons.
- Since trasmission line voltages are too high for local or ordinary uses, step down transformers are used to lower these voltages to suitable levels when the electrical power reaches where it is needed.
- Along the transmission line, industries which need higher voltages take their power directly.