Unit-2 ELECTRICAL FUNDAMENTALS

(SESSION-3)

Topics:

- Sources of electrical energy
- Electrical current, voltage, emf, potential difference, resistance with their SI units
- Meters used to measure different electrical quantities and it's identification
- Electrical Supply system – AC & DC

3.1 Sources of electrical energy:

The sources of energy can classified into renewable and non-renewable energy sources.

a) Renewable Energy Source:

A renewable energy source is any natural resource that can replace it quickly and dependably. These energy sources are plentiful, sustainable, naturally replenished and good to the environment.

The major types or sources of **renewable energy** are:

- ✓ Solar energy from the sun
- ✓ Wind energy
- ✓ Geothermal energy from the heat inside the earth
- ✓ Hydropower from flowing water
- ✓ Ocean energy in the form of wave, tidal current energy and ocean thermal energy.
- ✓ Biomass from plants

b) **Non-renewable Energy Source:**

A non-renewable energy source is a source with a limited supply that we can extract from the earth, and it'll eventually run out. These are formed over thousands of years from the buried remains of ancient sea plants and animals that lived millions of years ago. Most of these energy sources are "dirty" fossil fuels, which are generally bad for the environment.

The major types or sources of **non-renewable energy** are:

- ✓ Petroleum
- ✓ Hydrocarbon gas liquids
- ✓ Natural gas
- ✓ Coal
- ✓ Nuclear energy

Another type of classification of electrical energy sources is conventional and non conventional energy source.

Conventional energy sources are;

- ✓ Hydro energy (water)
- ✓ Thermal energy
- ✓ Nuclear energy
- ✓ Diesel power

Non conventional energy sources are

- ✓ Solar energy
- ✓ Wind energy
- ✓ Tidal energy
- ✓ Geothermal energy

3.2 Electrical terms:

a) Electrical current: The flow of **electric** charges (Electrons) through a conductor in a particular direction is called electric current. It is denoted by "I".

It is also defined as the rate of flow of charges (Q) in an electrical circuit.

I = Q/t where t = time in seconds

The **SI unit** of **electric current** is **Ampere** (symbol: A)

b) Voltage: Voltage is defined as the potential difference between two points in an electrical circuit.

SI unit of **voltage** is **Volt** (symbol: **V**)

c) Potential difference is the difference in the amount of energy that charge carriers have between two points in a circuit. In other words it is the difference in electrical pressure between two points in a circuit.

Potential difference (pd) is measured in Volt (V)

d) Resistance: Resistance is a measure of the opposition to current flow in an electrical circuit. **Resistance** is measured in ohms, symbolized by the Greek letter omega (Ω)

SI unit of **resistance** is Ohm (Ω) (symbol: **R)**

e) EMF (electro motive force): It is the force which circulates or tends to circulate electric current in an electrical circuit. It is analogous to the Pump motor that circulates water.

The SI unit of emf is Volt (V).

3.3 Meters used to measure different electrical quantities:

1. **Ammeter**: An ammeter (from ampere meter) is a measuring instrument used to **measure the current** in a circuit. Electric currents are measured in amperes (A), hence the name. The ammeter is always **connected in series** with the circuit in which the current is to be measured.

2. **Voltmeter**: It is an instrument used for measuring **electric potential difference (voltage)** between two points in an electric circuit. It is always **connected in parallel**. It usually has a high resistance so that it takes negligible current from the circuit

3. **Wattmeter**: An electrical instrument used to **measure electric power** in watts of any circuit is called Wattmeter. It consists of two coils like the current coil and voltage coil.

4. Ohmmeter -The instrument, which is used to **measure the value of resistance** between any two points in an electric circuit, is called ohmmeter. It can also be used to find the value of an unknown resistor. **Multimeter** can also be used to measure resistance.

5. Digital Multimeter: A digital multimeter is a test tool used to measure two or more electrical value - principally voltage (volts), current (amps) and resistance (ohms). Digital multimeters combine the testing capabilities of single-task meters - the voltmeter (for measuring volts), ammeter (amps) and ohmmeter (ohms).

6. Megger: An instrument that is used to measure **insulation resistance** is a Megger. It is also known as meg-ohm-meter.

7. Tong tester: A Clamp meter is often known as Tong Tester. It is easy to use test equipment and is useful in the **measurement of current in a live-conductor** without damaging / powering down the circuit.

Identification of different measuring devices:

AMMETER

VOLTMETER

WATT METER

MEGGER

OHM METER

DIGITAL MULTI METER

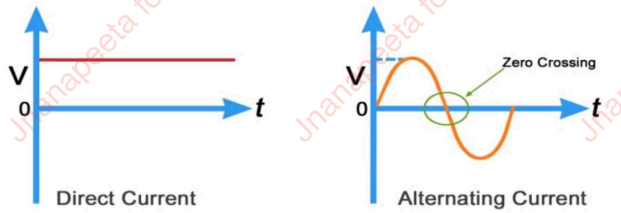
TONG TESTER

3.4 Electric supply systems AC & DC:

AC means Alternating Current and DC means Direct Current. Both AC and DC describe types of current flow in a circuit.

In direct current (DC), the electric charge (current) flows in only one direction.

Charges in alternating current (AC), on the other hand, changes direction periodically. The voltage in AC circuits also periodically reverses because the current changes direction.



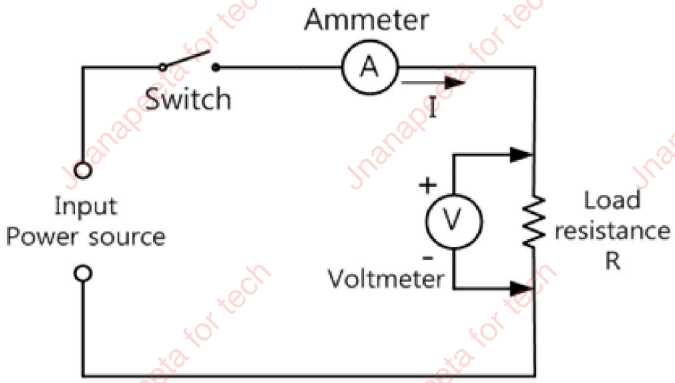
- DC Supply have + ve & - ve Terminals
- AC Supply have no polarities but have Phase and Neutral

Practice:

Experiment 3:

1. Connect voltmeter and ammeter in a simple circuit. (Practicing identification and connection of different meters)

Circuit diagram:



S.No	Voltmeter reading V (in volts)	Ammeter reading I (in amperes)
1		
2		
3		
4		

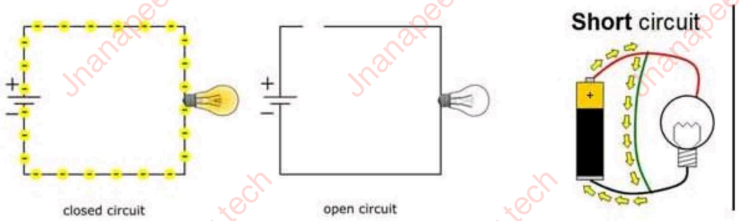
Procedure:

1. Connection are made as shown in circuit diagram
2. Connect ammeter in series with circuit and voltmeter parallel with load
3. Switch on power supply and close switch and observe the reading of ammeter and volt meter by varying load
4. Open the switch and switch off power supply

Result: Voltmeter and Ammeter are connected in the circuit and readings are observed and noted.

Experiment 4:

Demonstrate effects of shorts and opens in a circuit



Open circuit: an electrical circuit in which the continuity is broken so that current does not flow (I = 0)

Closed circuit: a circuit without interruption, providing a continuous path through which a current can flow (I depends on load)

Short Circuit: A low-resistance connection between two points in an electric circuit through which the current tends to flow rather than along the intended path. A short circuit can damage the circuit by overheating (I is very high)