BASIC OF ELECTRICAL

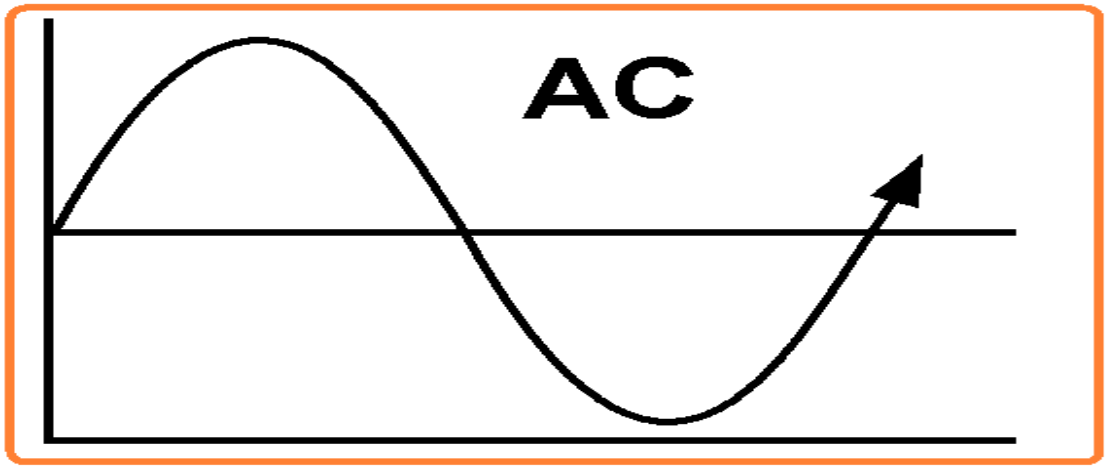
- **Current**
- Current is the flow of charge Or
- Flow of electrical charge is referred to as electrical current
- There are to type of current

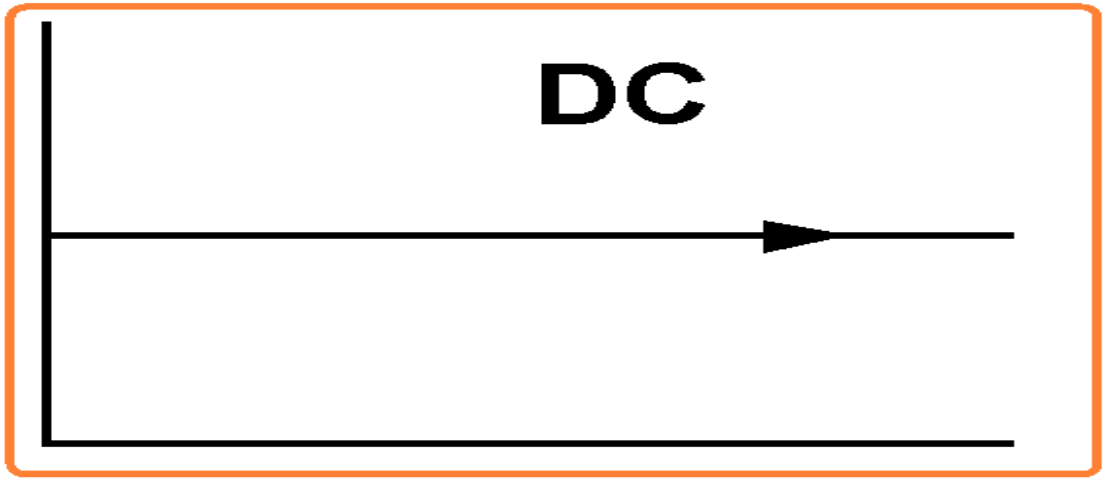
  direct current (dc)

  alternative current (ac)
- **Direct current**

  Direct current is current that flows in one direction with a constant voltage polarity
- **Alternative current**

  This is the current that changes direction periodically along with it voltage polarity





Comparison between AC and DC Transmission System (With their advantages and disadvantages)

VOLTAGE

- Voltage is the change in Electric Potential between two places
  or the change in Electric Potential Energy per coulomb between two places.
- $v = \Delta(EPE/q) = (EPE/q)_2 - (EPE/q)_1$
- Where *V*=Voltage, EPE=Electric Potential Energy, *q*=charge, Δ=difference in.
- The tools for measuring the voltage are the voltmeter and the oscilloscope

ELECTRIC POWER

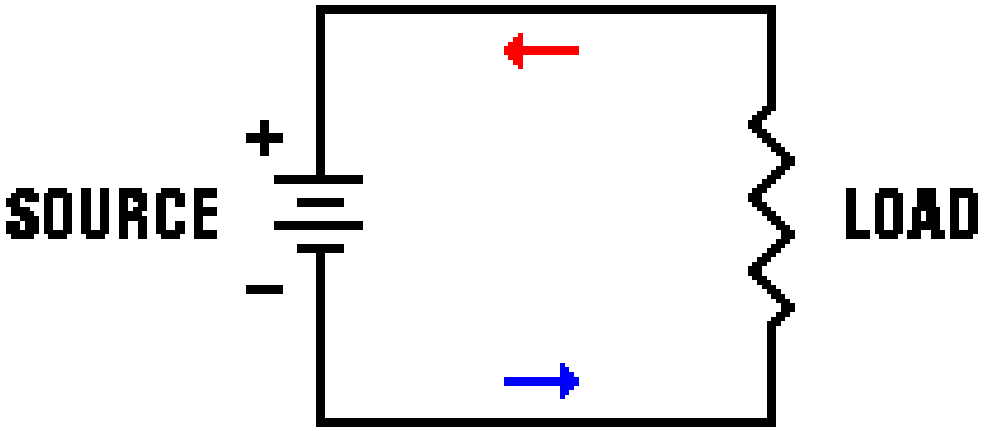
- The rate at which the work is being done in an electrical circuit is called an electric power.
- The electric power is produced by the generator and can also be supplied by the electrical batteries.
- The electric power is divided into two types, i.e., the AC power and the DC power. The classification of the electric power depends on the nature of the current.
- Where **V** is the voltage in volts, **I** is the current in amperes, **R** is the resistance offered by the powered devices, **T** is the time in seconds and the **P** is the power measured in watts.

$$Electrical\ Power = \frac{Work\ done\ in\ an\ electrical\ current}{time}$$

$$P = \frac{VIt}{t} = VI = IR^2 = \frac{V^2}{R}$$

ELECTRIC CIRCUIT

- An electric circuit is a closed path formed by various electric elements (resistor, inductor, capacitor , etc).
- the circuit is made up of a source V_S which provide a voltage across its terminals and a resistor R_L as load



Circuit elements are classified in many aspects

- **Passive element ;**

  An element which receives energy (or absorbs energy).They dissipate (in the form of heat) or store energy in an electric or magnetic field .

  Eg ; resistor ,capacitor, etc

- **Active element ;**

  An element that supplies energy to the circuit

  Eg ; voltage and current sources ,generators,etc

Battery

Generator

Transistor

Tunnel Diode

Triode Valve

Passive Elements

Resistor

Capacitor

Inductor

Diode

Transformer

- **Bilateral element ;**

  An element which conduct current in both direction

  Eg ; resistor, inductor and capacitor

- **Unilateral element**

  An element or a device in which current conduction is possible only in one direction

  Eg ; diode

RESISTANCE

- Electrical resistance is the property of a material by which it opposes the flow of current.
- Energy is dissipated across a resistor in the form of heat.
- Resistance is denoted by R
- the unit of resistance is ohm (Ω).

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

CONDUCTANCE

- It is the reciprocal of resistance (R) and is the measure of the ease to the flow of current through substances.
- It is denoted by G.
- Its unit is mho

$$G=1/R$$

BASIC ELECTRICAL LAWS

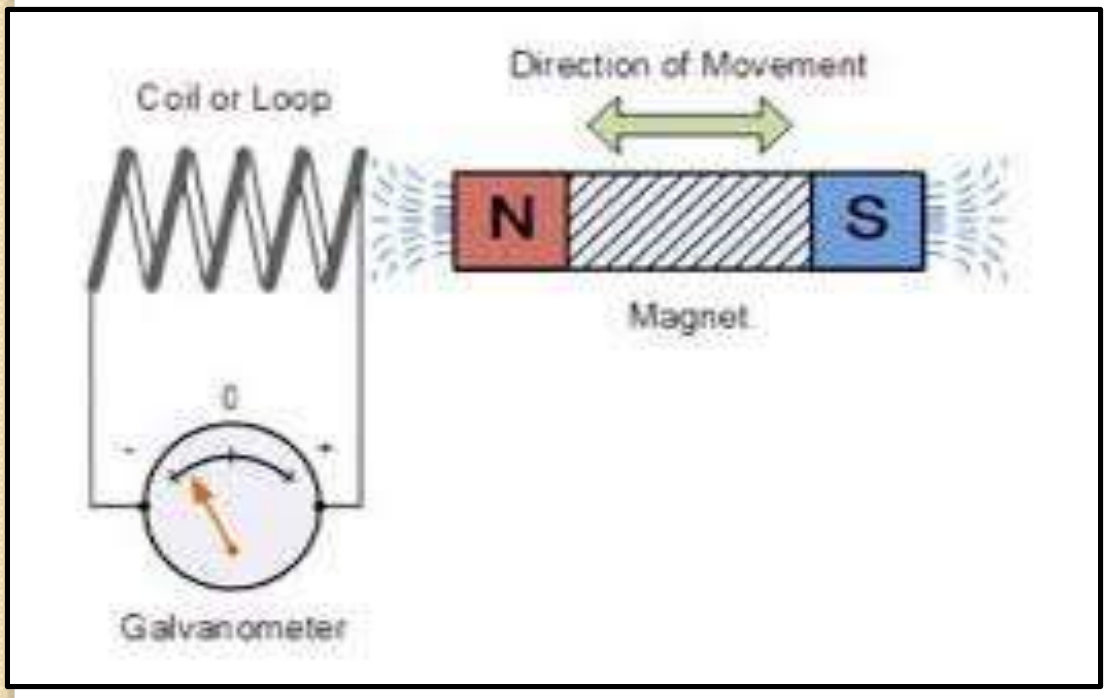
- **Ohms Law:**
  Ohm's law states that the current I flowing in a circuit is directly proportional to the applied voltage V and inversely proportional to the resistance R, provided the temperature remains constant.
- $V \alpha I$

  OR $V=IR$

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

FARADAYS LAWS OF ELECTROMAGNETIC INDUCTION

- faradays laws describe the voltage induced in conductor due to electro magnetic induction . consider a stationary coil whose ends are connected to galvanometer .when a magnet is moved the magnetic field cuts the coil and induces an emf which is indicated by the galvanometer .



Faradays first law

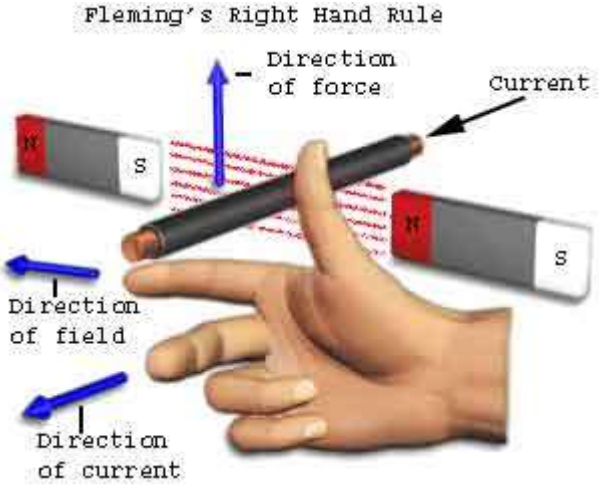
Wherever a conductor cut the magnetic flux lines ,an emf is induced in the conductor .

Faradays second law

- The magnitude of the induced emf is directly proportional to the rate of change of flux linkage
- Suppose a coil has N turns and flux through it changes from Φ_1 weber to Φ_2 weber in t seconds .
- Then $$e = N \times \left(\frac{\Phi_2 - \Phi_1}{t} \right)$$

Fleming's Right-hand rule:

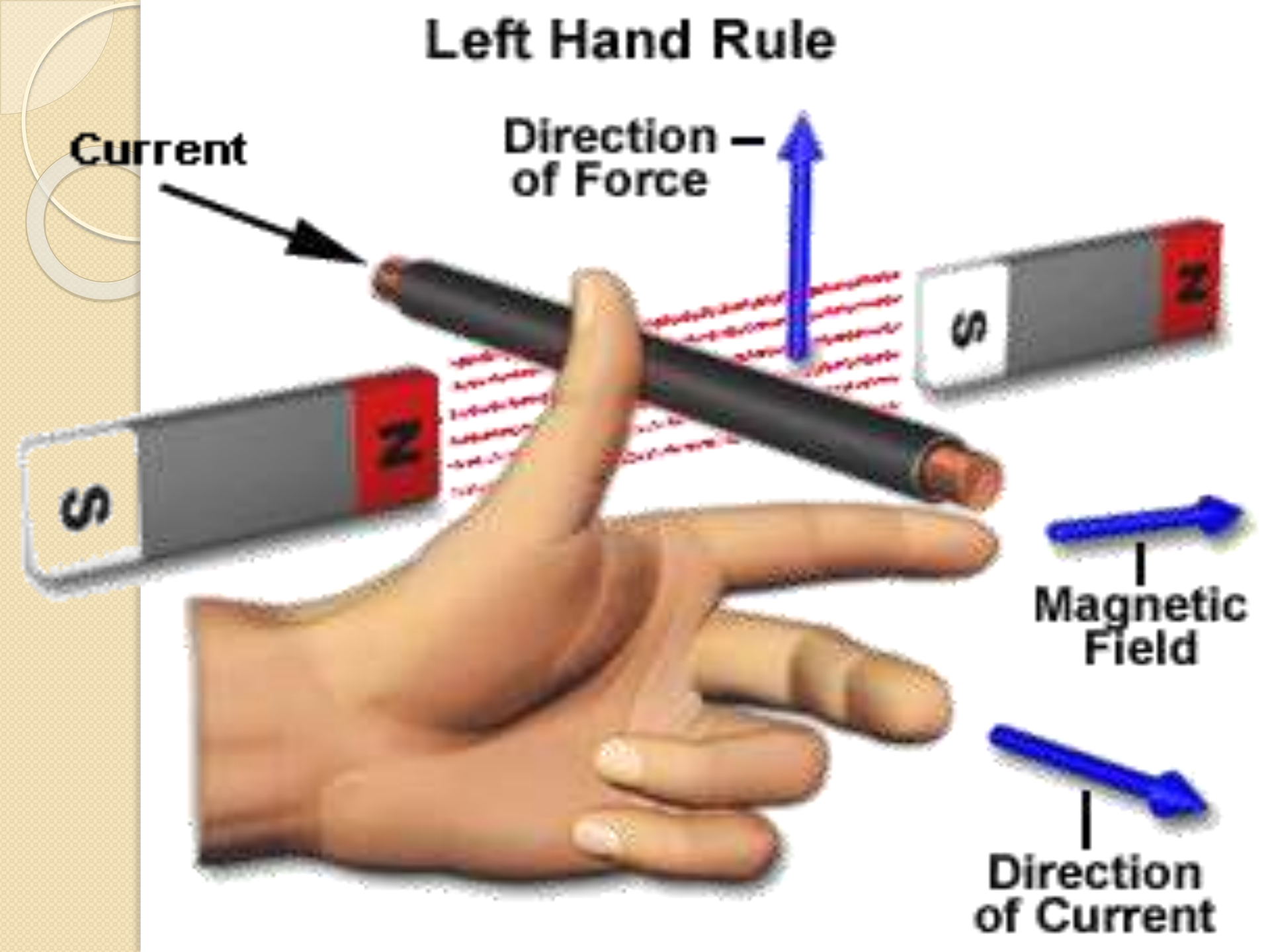
- Let the thumb, first finger and second finger of the right hand be extended such that they are all at right angles to each other. If the first finger points in the direction of the magnetic field, the thumb points in the direction of motion of the conductor relative to the magnetic field, then the second finger will point in the direction of the induced e.m.f.
- This rule is used to determine the direction of the induced emf in a conductor
- This laws is used for generators


Fleming's Right Hand Rule
Direction of force
Current
N
S
N
S
Direction of field
Direction of current

Fleming's left-hand rule

- Let the thumb, first finger and second finger of the left hand be extended such that they are all at right-angles to each other. If the first finger points in the direction of the magnetic field, the second finger points in the direction of the current, then the thumb will point in the direction of the motion of the conductor.
- This is user determine the direction of force acting on a current carrying conductor placed in a magnetic filed .
- This law is used for motors

Left Hand Rule



DC Circuit Theory Theorems:

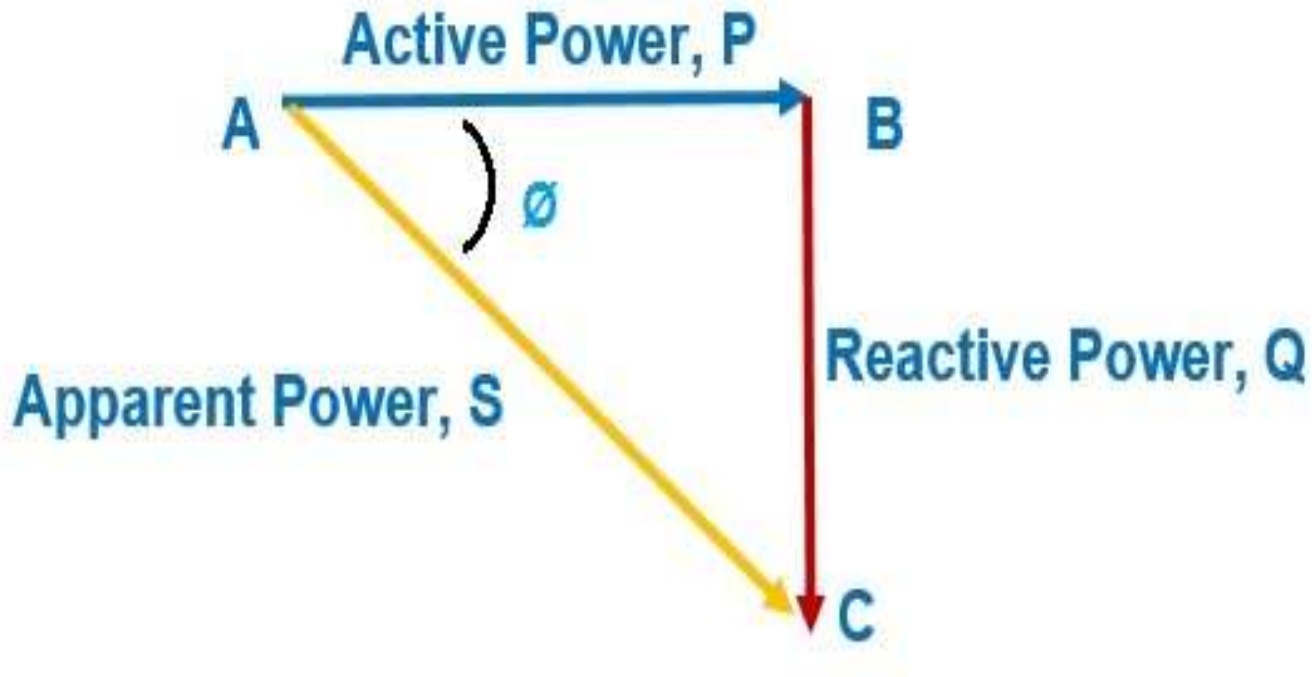
- **KIRCHHOFF'S LAWS:**

- **(a) Current Law:**
  At any junction in an electric circuit the total current flowing towards that junction is equal to the total current flowing away from the junction.

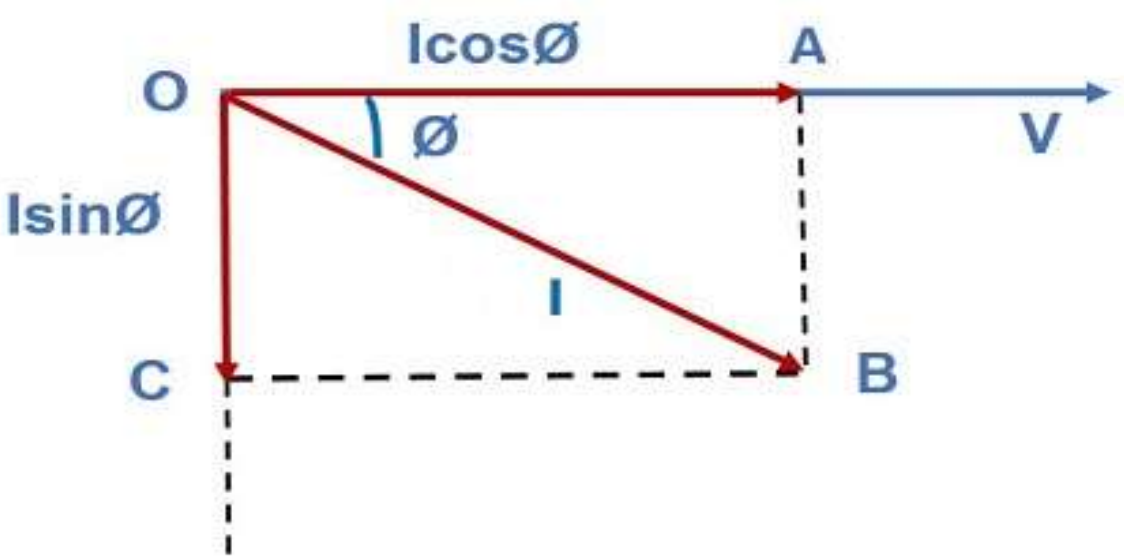
- **(b) Voltage Law:**
  states that the algebraic sum of voltages around a closed path at any instant of time is zero

POWER TRIANGLE AND POWER FACTOR

- Power Triangle is a right angled triangle whose sides represent the active, reactive and apparent power. Base, Perpendicular and Hypogenous of this right angled triangle denotes the Active, Reactive and Apparent power respectively.



- The above figure shows a Power Triangle. Side AB, BC and AC represents P, Q and S respectively. The above triangle is obtained from the below phasor diagram



- OA = Active Current
- OC = Reactive Current
- OB = Circuit Current

ACTIVE POWER

- Power to do the useful work in the circuit
- $P=VI\ COS\Phi = I^2 R$ watts
- Measuring instrument: wattmeter

REACTIVE POWER (Q)

- Power which moves back and froth between the load and source .
- $Q = V\ I\ SIN\Phi$
- Measuring unit : volt ampere reactive (var)
- Instrument : var meter

APPARENT POWER(S)

- The combination of reactive power and true power is called *apparent power* Apparent power is measured in the unit of *Volt-Amps* (VA) and is symbolized by the capital letter S.

Power factor

- it is ratio working power divided by total power

$$\text{Power factor} = \frac{\text{working power (KV)}}{\text{total power (KVA)}}$$

DIFFERENT CODES AND STANDARDS

- **A code** is a model, a set of rules that knowledgeable people recommend for others to follow. It is not a law, but can be adopted into law.
- **A standard** is a more detailed elaboration than a code. May be defined as level of quality, achievement that is considered acceptable or desirable.

- Code and standards gives the benchmark for safety electrical design, installation and inspection to protect people and property from electric hazards
- National electric code (NEC)
- Indian electricity rules (IER)
- Energy conservation act
- Indian standard codes (IS)
- IEC(international electro technical commission) codes

National electrical codes (NEC)

- Produced by national fire protection association(NFPA)
- NFPA 70 is called the national electric code
- NEC is considered as the legal criterion of safe electrical design and installation
- All electrical designers and installers should be familiar with every part of the code
- The purpose of this code is the practical safe guarding of persons and property from hazards arising from the use of electricity

INDIAN ELECTRICITY RULES

- Safeguard consumers of electrical energy from shock
- Minimize fire risks
- Ensure as far as possible ,satisfactory operation of equipments and apparatus used
- No person shall transmit electricity or distribute electricity
- Metering of electricity supplied made mandatory
- The rural and remote area stand alone license free system for generation and distribution permitted

Energy conservation act

- An act to provide for efficient use of energy and its conservation
- The IEC also certify whether equipment, system or components conform to its international standards
- IEC standards are used by exporters and importers involved in engineering ,desing, production and construction
- IEC standards have numbers in the range 60000 – 79999 and their titles take a form such as IEC 60417 :graphical symbols for use on equipments

International electro technical commission (IEC)

- IEC prepares and publishes international standards for all electrical ,electronic and related technologies
- IEC Standards cover a vast range of technologies from power generation ,transmission and distribution to home appliances and office equipment ,semiconductors ,fiber optics ,batteries , solar energy , nanotechnology and marine energy as well as many others.
- The IEC also certify whether equipment ,system or components to its international standards
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