SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

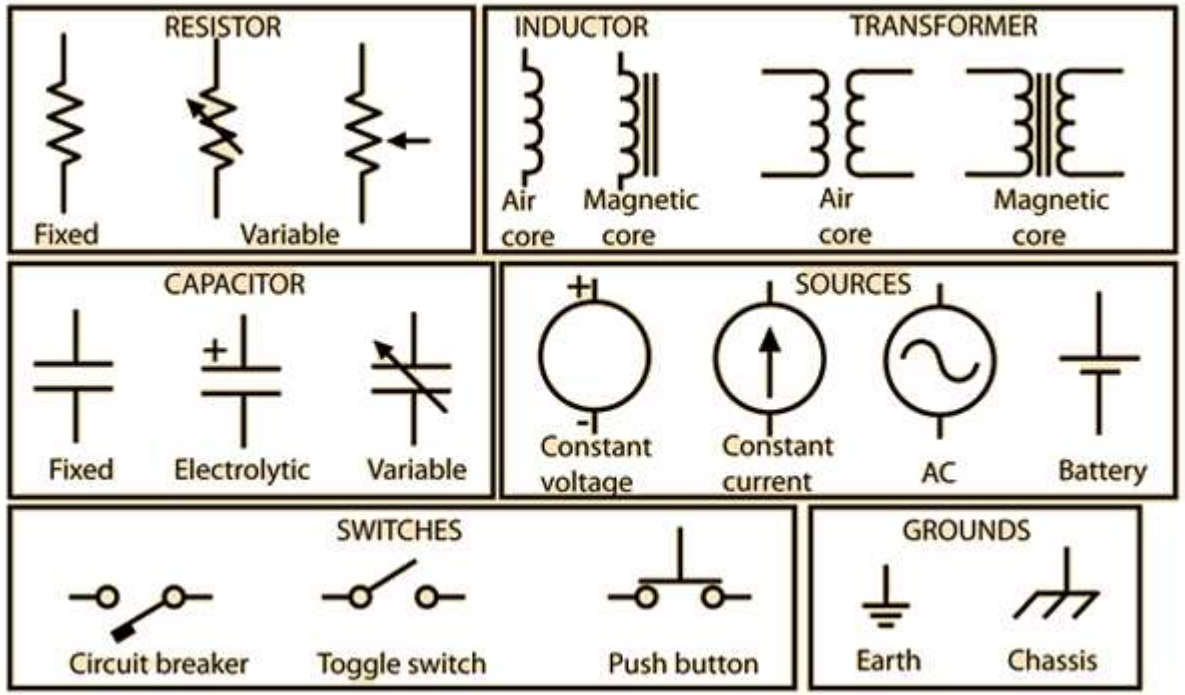
COURSE NAME : 19EE01 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I YEAR /I SEMESTER MECHANICAL ENGINEERING

Unit 1 – Electrical Circuits and Measurements

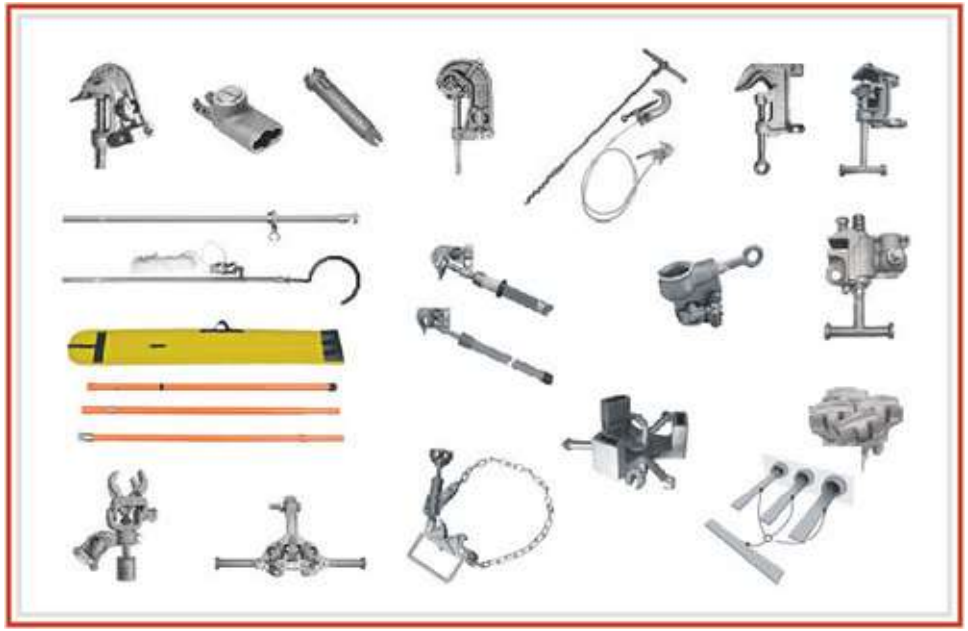
Topic 1 : Introduction to Course

UNIT-1 : ELECTRICAL CIRCUITS &MEASUREMENTS

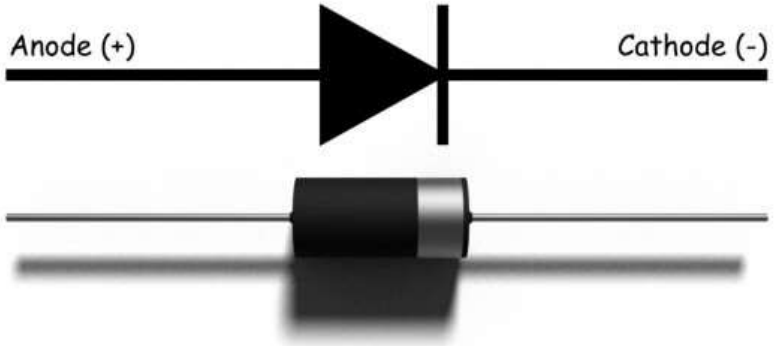


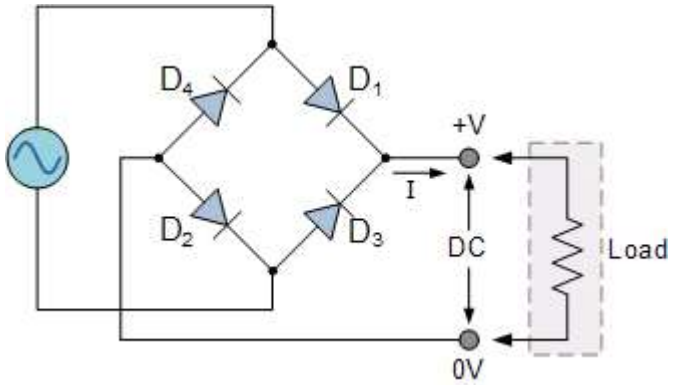
UNIT-II ELECTRICAL MACHINES

UNIT-III WIRING, GROUNDING AND SAFETY

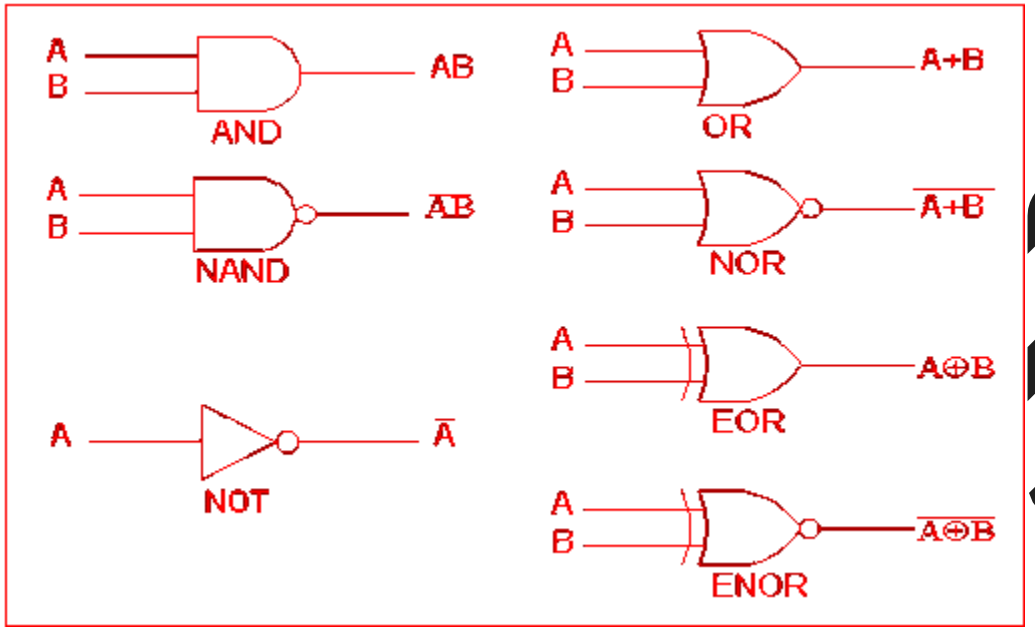


UNIT-IV ANALOG ELECTRONICS





UNIT-V LINEAR AND DIGITAL ELECTRONICS



ESSENTIALS FOR THE LEARNING THE COURSE

1. Industrial Visit
2. Industrial Case study
3. Demo Model Creation
4. Industry Specific Question Paper
5. Top Contest Participation
6. PPT Preparation
7. Assessment
8. Feedback Mode
9. Seminar Presentation

REFERENCES

1. Bhattacharya. S.K, “Basic Electrical and Electronics Engineering”, Pearson Education , (2017)
2. Muthu Subramanian R, Salivahanan S,“ Basic Electrical and Electronics Engineering”, Tata McGraw Hill Publishers, (2009)
3. V.Mittle“ Basic Electrical Engineering”, Tata McGraw Hill Publishers, (2017)
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Unit 1 – Electrical Circuits and Measurements

Topic 2 : Introduction to Electrical parameters

FEEL THE ELECTRICITY

How it looks?

What color it is?

How it smells?

How it weighs?

How bigger is that?

How it is taste?

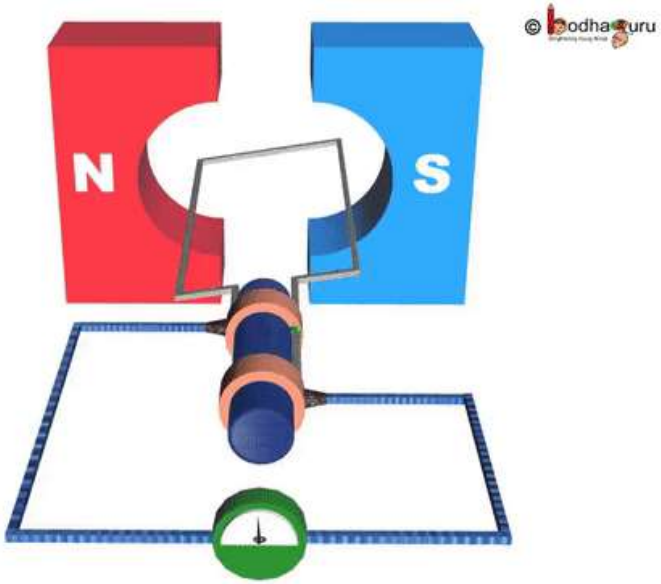
Any answers?

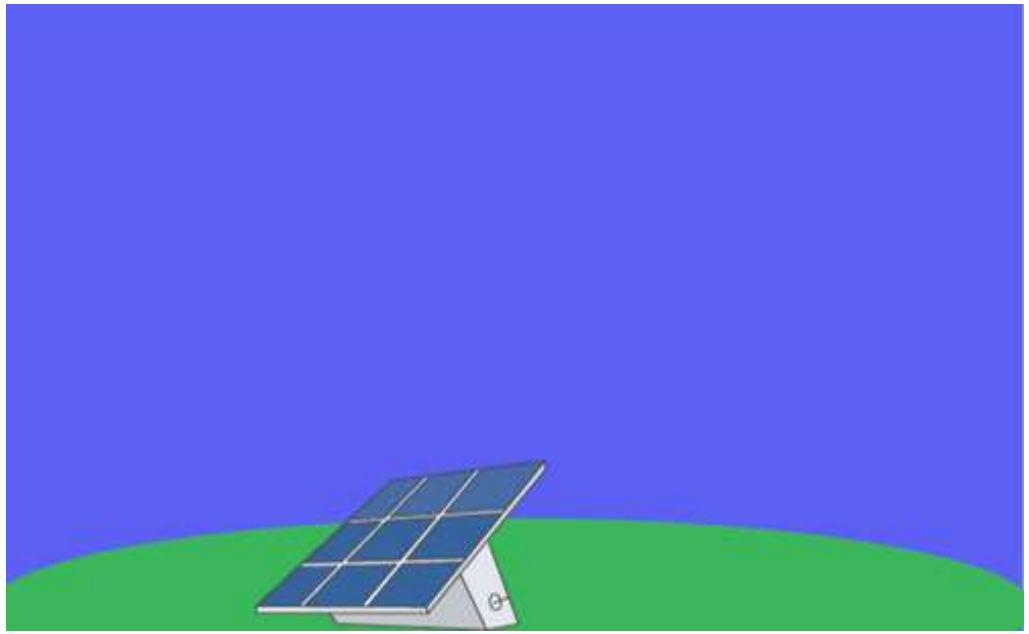
How do you know about Electricity?

How do you feel if Electricity passes on u?

HOW DOES ELECTRICITY PRODUCED?

FARADAY'S LAW OF ELECTROMAGENETIC INDUCTION

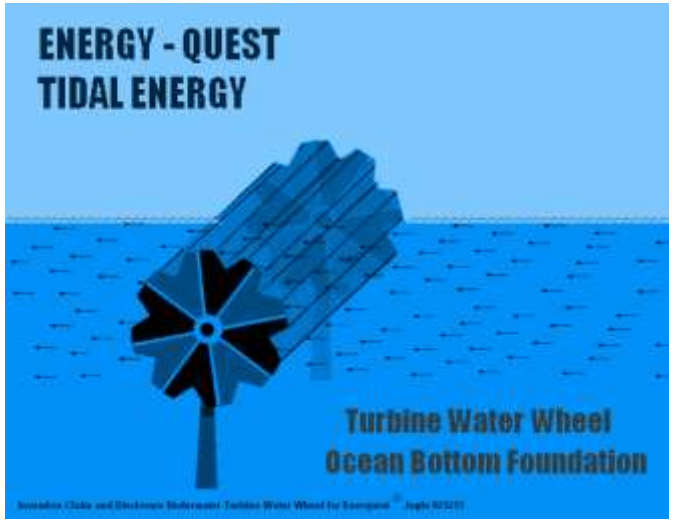


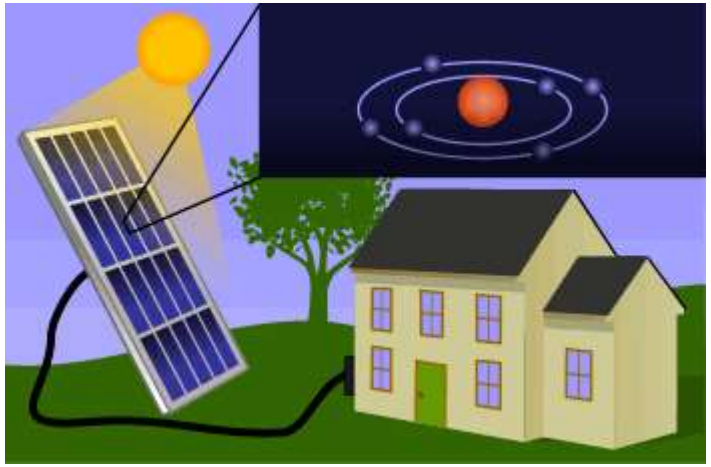


SOLAR PV-CELL

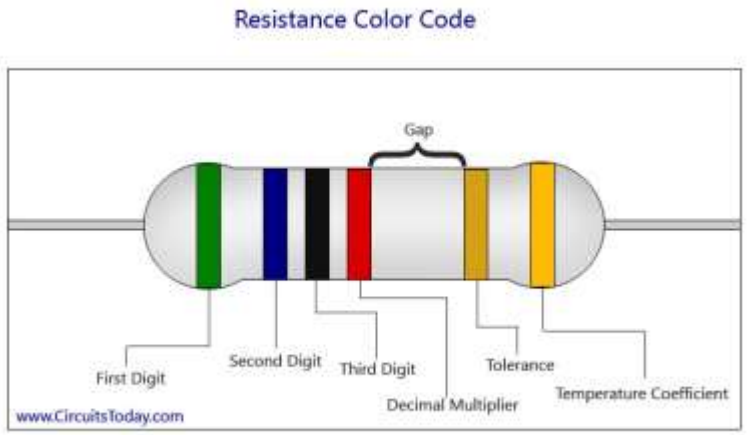
GENERATOR

ELECTRICITY GENERATION METHODS





ELECTRICAL PARAMETERS & QUANITITES



UNITS?

VOLTAGE

ELECTRICITY PARAMETERS

Current (I)-It is a flow of electrons in the line. It passes only in the closed path. Unit of the current is Ampere .

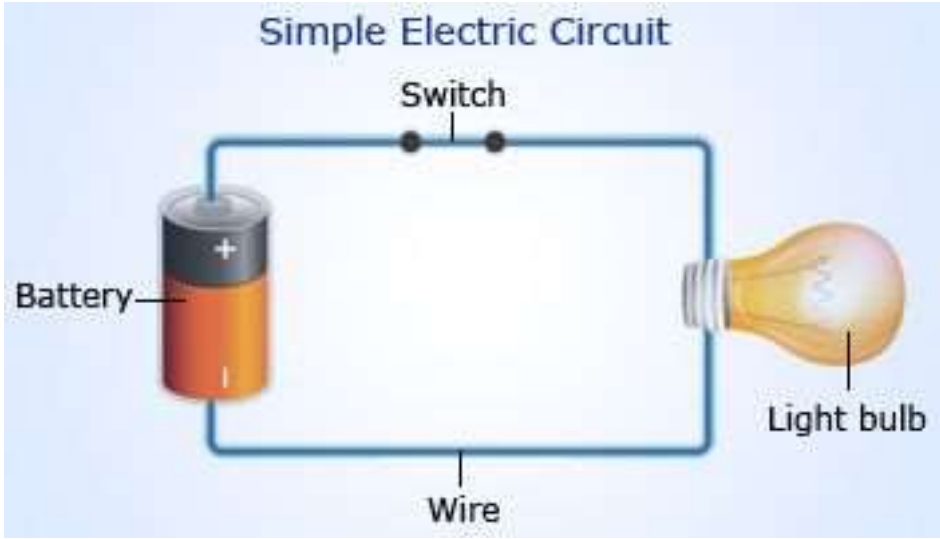
For example Current =2 Ampere

Voltage (V)- It is the potential difference between two ends. Unit of the Voltage is Volts .

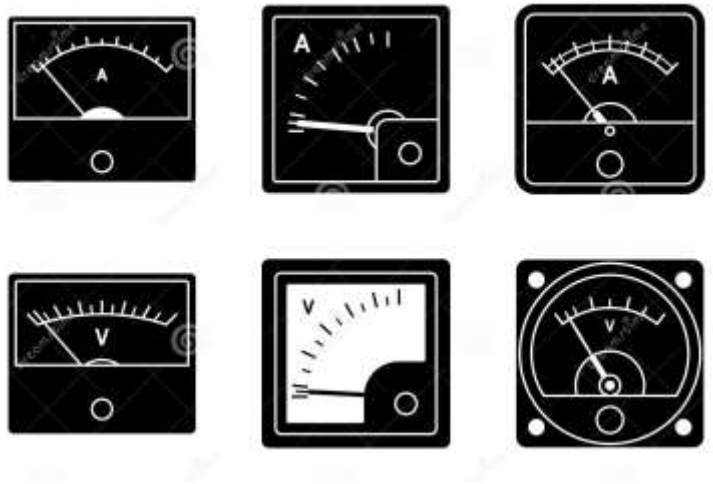
For example Voltage V= 20 Volts

Resistance (R)- It is the property to oppose the flow of current. Unit of the Resistance is Ohms .

For example Resistance R=20 Ohms

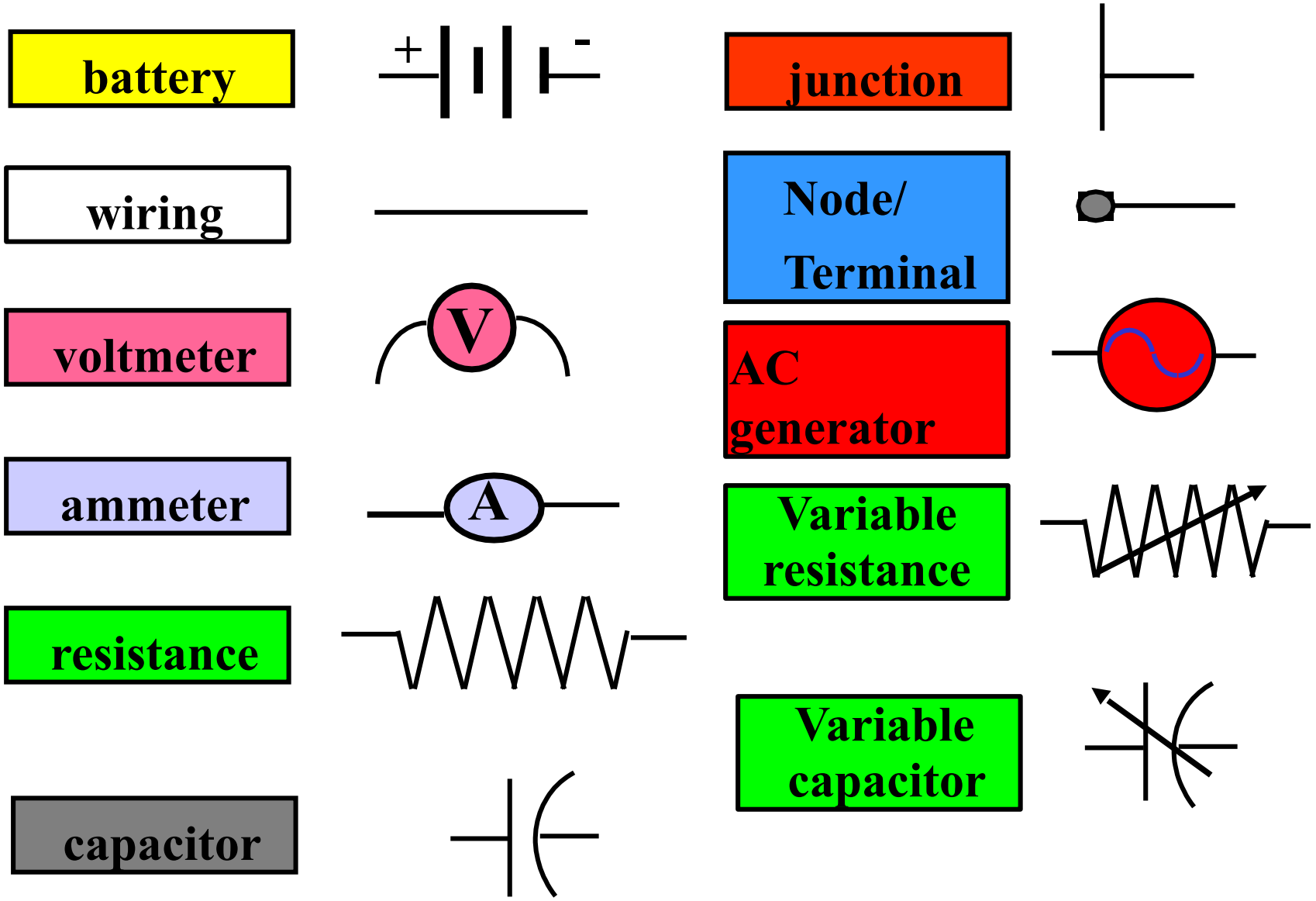


MODERN TECHNOLOGIES

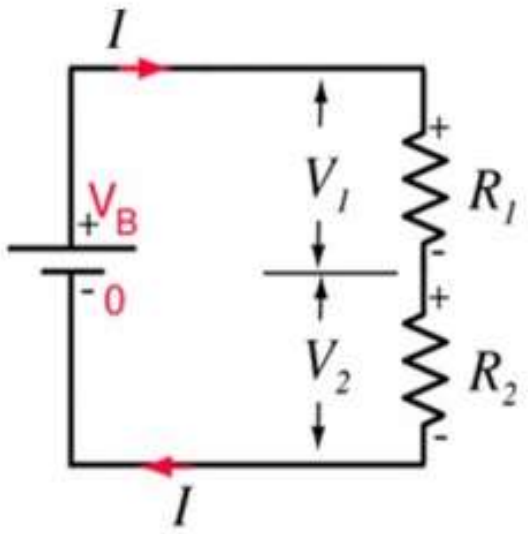


Before this era?

ELECTRICAL SYMBOLS

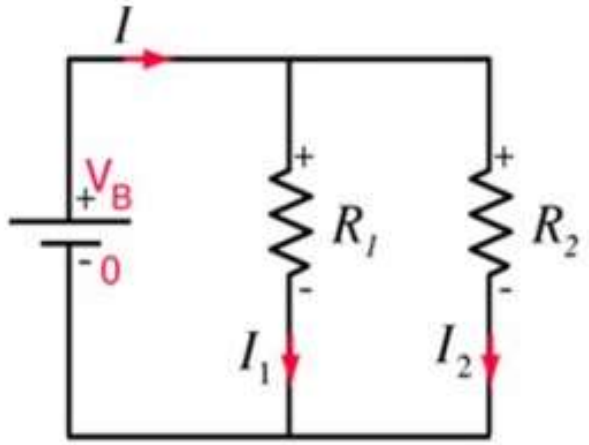


SAMPLE CIRCUIT



Series resistors

$$R_{equivalent} = R_1 + R_2$$

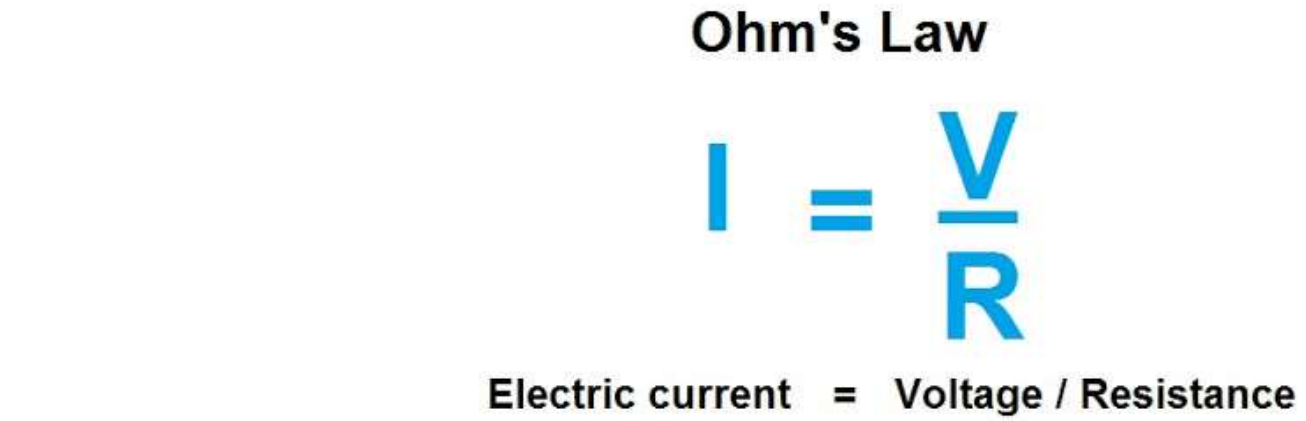


Parallel resistors

$$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2}$$

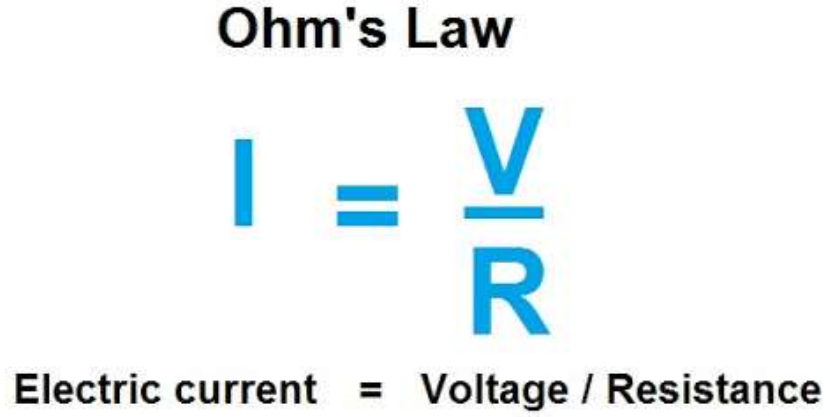
OHM'S LAW

Ohm's law states that The current that flows through most conductors is directly proportional to the voltage applied to it provided all physical conditions and temperature remain constant. Also, inversely proportional to the resistance in the conductor



ASSESSMENT

My battery is 300 Voltage, and have the resistance of 300 ohms. Determine the current flowing through the line.



Current??

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1. Bhattacharya. S.K, “Basic Electrical and Electronics Engineering”, Pearson Education , (2017)
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Unit 1 – Electrical Circuits and Measurements

Ohms' Law

DEFINITION

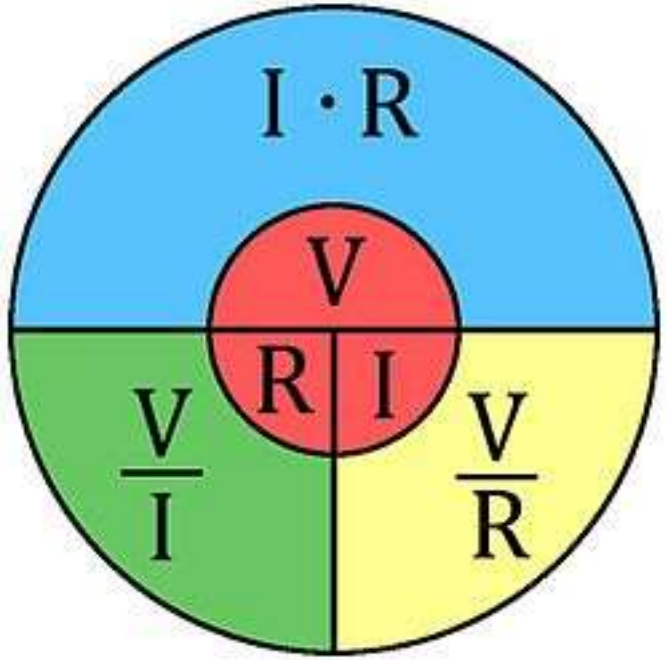
- The potential difference (voltage) across an ideal conductor is proportional to the current through it. The constant of proportionality is called the "resistance", R.

- $I = V/R$
- $V = IR$
- $R = V/I$

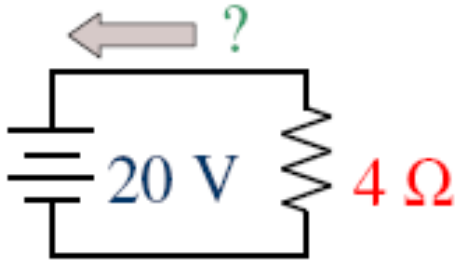
I = Current

V = Voltage

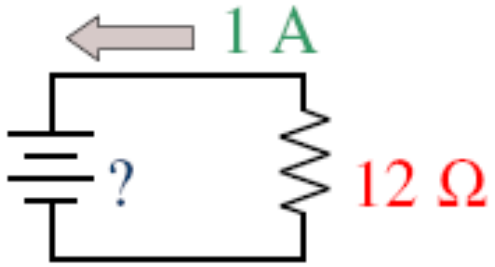
R = Resistance



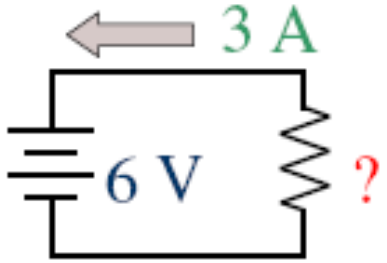
Simple Circuits with Ohm's Law



$I = (20/4) = 5\ A$



$V = 1 \times 12 = 12\ V$

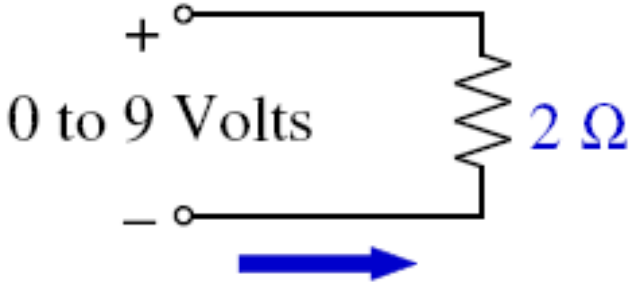


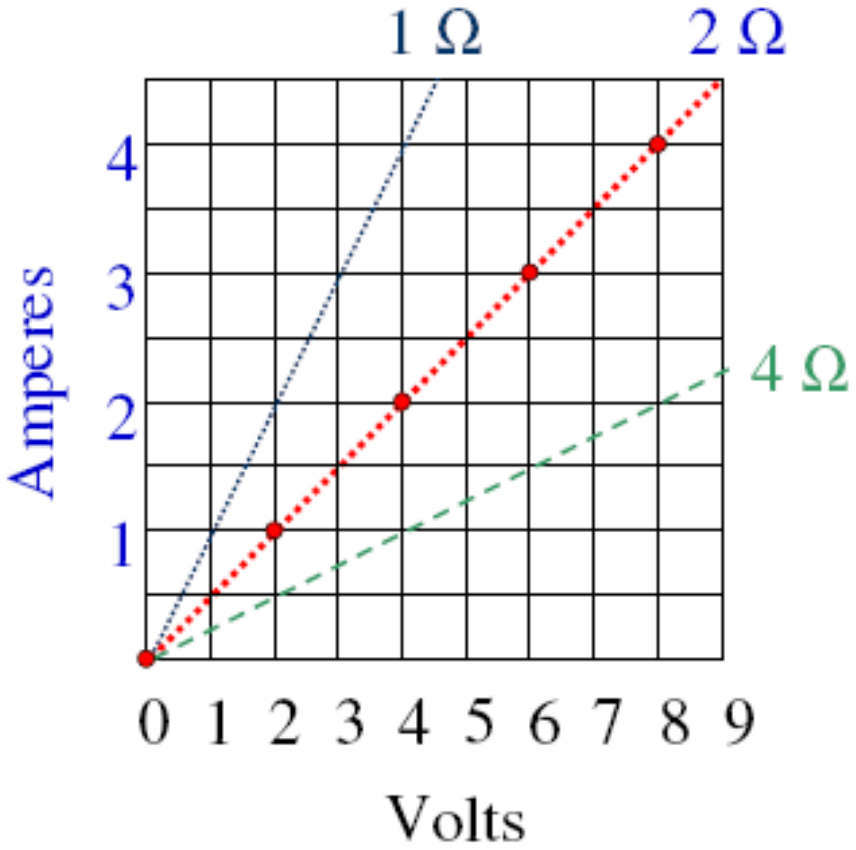
$R = (6/3) = 2\ \text{ohms}$

Can you solve?

1. V = 14 V, I = 2 A, R = ?
2. V = 25 V, I = 5 A, R = ?
3. V = 6 V, I = 1.5 A, R = ?
4. V = 24 V, I = 4 A, R = ?

LINEAR PROPORTION BETWEEN V & I





Power Dissipation in Resistance

- The amount of power dissipated in a resistance may be calculated using any one of three formulas, depending on which factors are known
- $P = I2 \times R$
- $P = V2 / R$
- $P = V \times I$

Assessment 2

1.Solve for the power, P, dissipated by the resistance, R

a. I = 1 A, R = 100Ω , P = ?

b. I = 20 mA, R = 1Ω , P = ?

c. V = 5 V, R = 150Ω , P = ?

d. V = 22.36 V, R = 1Ω , P = ?

2. How much power is dissipated by an 8Ω load if the current in the load is 200 mA?

Limitations of Ohm's Law

1) This law cannot be applied to unilateral networks.
2) Ohm's law is also not applicable for non – linear elements.

REFERENCES

1. Bhattacharya. S.K, “Basic Electrical and Electronics Engineering”, Pearson Education , (2017)
2. Muthu subramanian R, SalivahananS,“ Basic Electrical and Electronics Engineering”, Tata McGraw Hill Publishers, (2009)
3. V.Mittle“ Basic Electrical Engineering”, Tata McGraw Hill Publishers, (2017)
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5. Black & Decker , “The complete guide to Electrical Wiring” , S.Chand & Company Ltd,(2012)

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19EE101-BASIC ELECTRICAL & ELECTRONICS ENGINEERING

I YEAR /I SEMESTER CSD

Unit 1: Electrical Circuits & Measurements

Topic 4: Kirchhoff's Law

KIRCHHOFF'S LAW

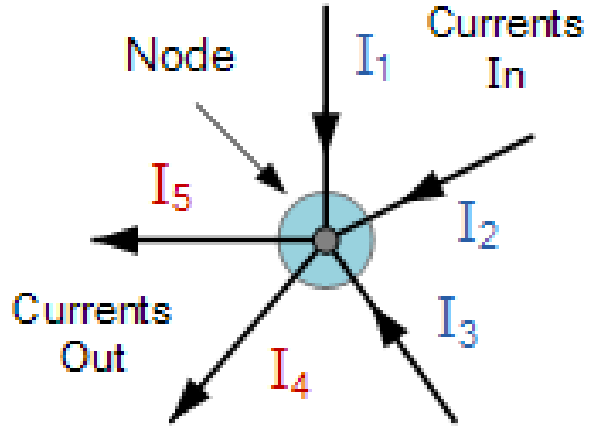
In 1845, a German physicist, **Gustav Kirchhoff** developed a pair or set of rules or laws which deal with the conservation of current and energy within electrical circuits.

These two rules are commonly known as: Kirchhoffs Circuit Laws with one of Kirchhoffs laws dealing with the current flowing around a closed circuit, **Kirchhoffs Current Law, (KCL)** while the other law deals with the voltage sources present in a closed circuit, **Kirchhoffs Voltage Law, (KVL)**.

KIRCHHOFF'S CURRENT LAW

The algebraic sum of ALL the currents entering and leaving a node must be equal to zero, $I_{(exiting)} + I_{(entering)} = 0$.

Currents Entering the Node
Equals
Currents Leaving the Node

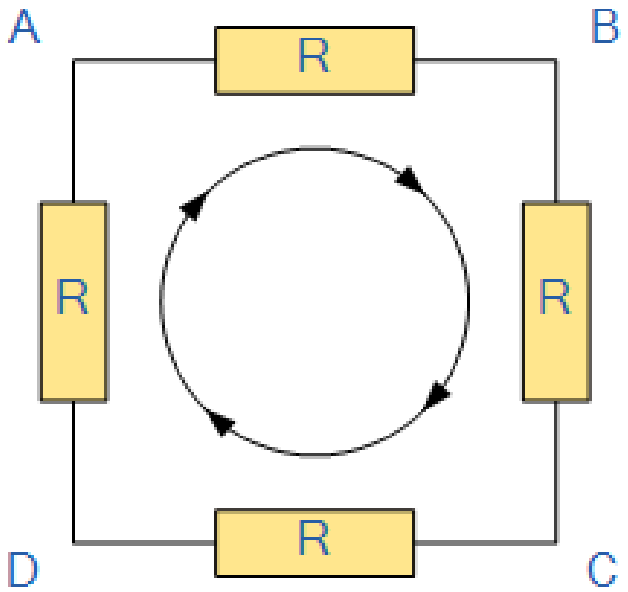


$$I_1 + I_2 + I_3 + (-I_4 + -I_5) = 0$$

KIRCHHOFF'S VOLTAGE LAW

"In any closed loop network, the total voltage around the loop is equal to the sum of all the voltage drops within the same loop"

The sum of all the Voltage Drops around the loop is equal to Zero

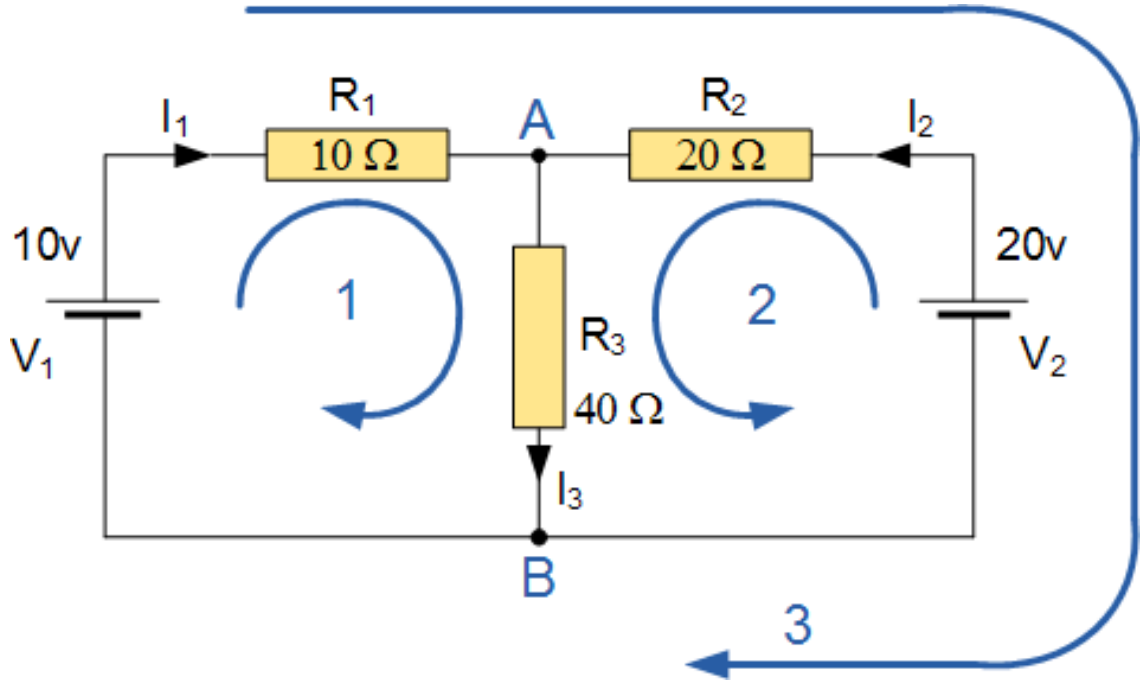


$$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$$

CHALLENGE

Find the current flowing in the 40Ω Resistor, R_3

Mesh Loop Method

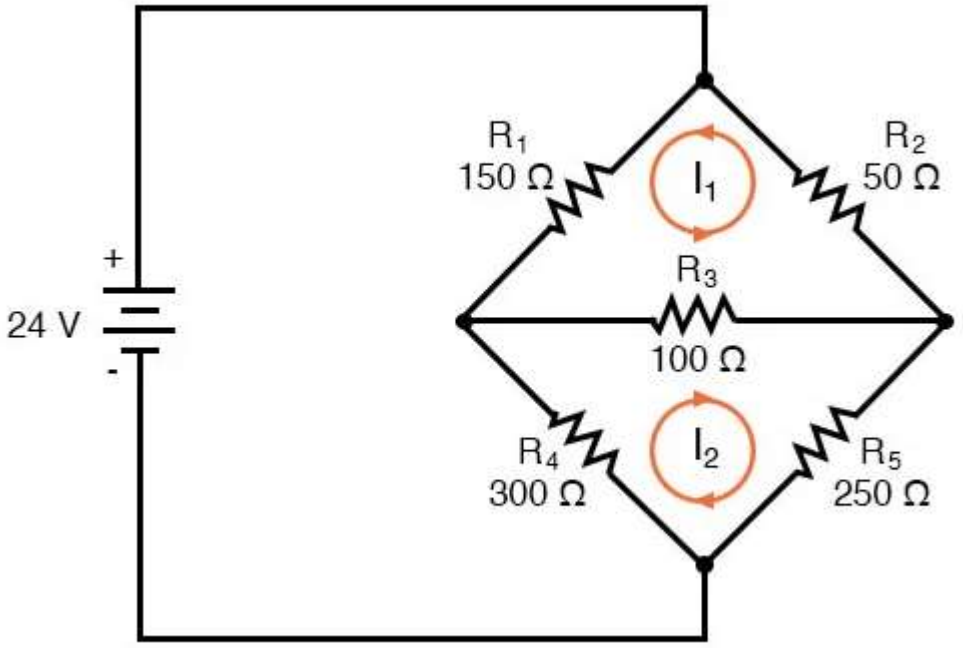


The current flowing in resistor R_3 is given as : -0.143 + 0.429 = 0.286 Amps

voltage across the resistor R_3 is given as : 0.286 x 40 = 11.44 volts

YOUR CHALLENGE

Find the current flowing through 150 ohm Resistor R1



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1. Muthusubramanian R, Salivahanan S, “Basic Electrical and Electronics Engineering”, Tata McGraw Hill Publishers, (2009) - UNIT I – V
2. Bhattacharya. S.K, “Basic Electrical and Electronics Engineering”, Pearson Education , (2017) – UNIT I – IV
3. Mehta V K, Mehta Rohit, “Principles of Electrical Engineering and Electronics”, S.Chand & Company Ltd, (2010)- UNIT I and II
4. Mehta V K, Mehta Rohit, “Principles of Electronics”, S.Chand & Company Ltd, (2005)- UNIT IV and V

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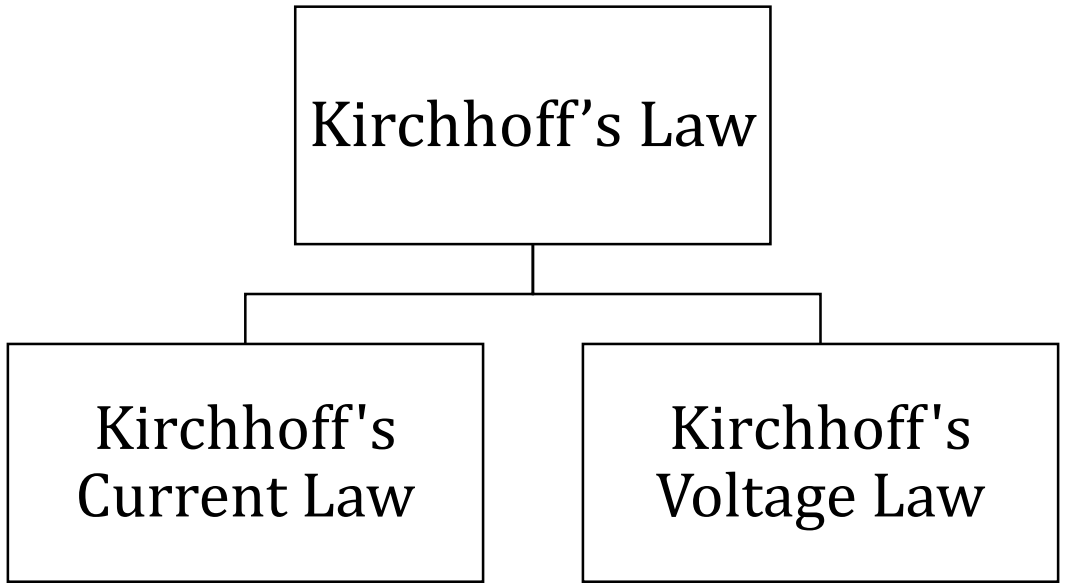
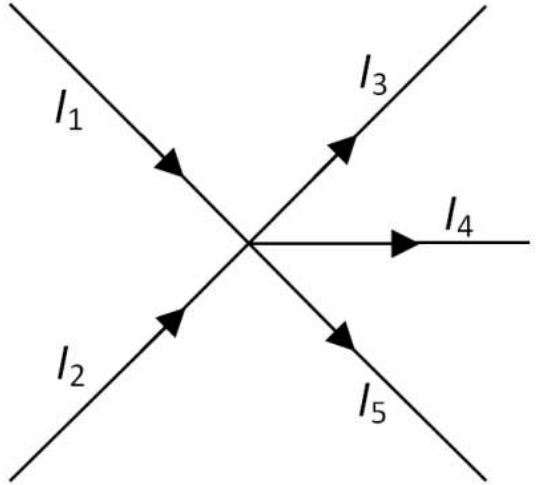
KIRCHOFF'S LAW



Gustav Robert Kirchhoff
(1824-1887)

KIRCHHOFF'S CURRENT LAW

In an electrical circuit, the current flows rationally as electrical quantity. As the flow of current is considered as flow of quantity, at any point in the circuit the total current enters, is exactly equal to the total current leaves the point. The point may be considered anywhere in the circuit.

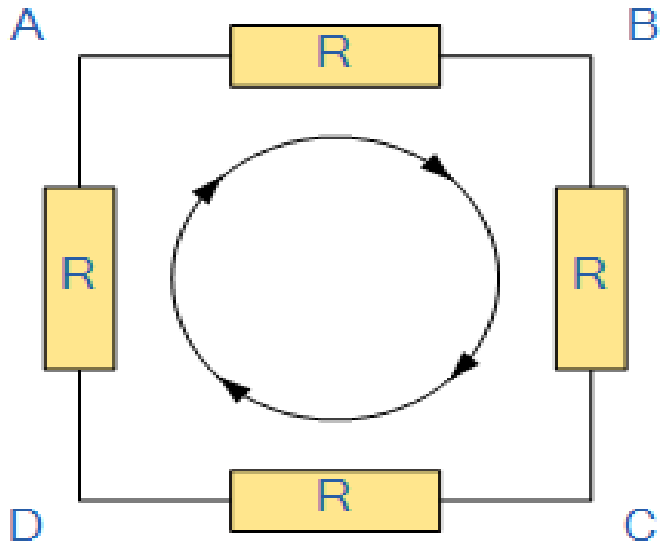


$$I_1 + I_2 = I_3 + I_4 + I_5$$

KIRCHHOFF'S VOLTAGE LAW

- Kirchoffs Voltage Law or KVL, states that “in any closed loop network, the total voltage around the loop is equal to the sum of all the voltage drops within the same loop” which is also equal to zero. In other words the algebraic sum of all voltages within the loop must be equal to zero.

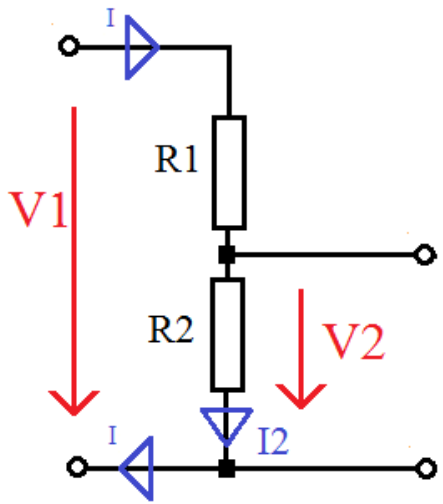
The sum of all the Voltage Drops around the loop is equal to Zero



$$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$$

VOLTAGE DIVISION RULE

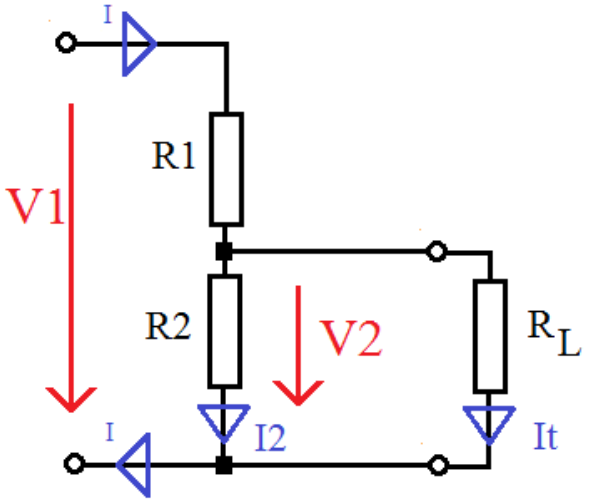
Without Load



$$I = \frac{V1}{R1 + R2} = \frac{V2}{R2}$$

$$\frac{V1}{V2} = \frac{R1 + R2}{R2}$$

With Load

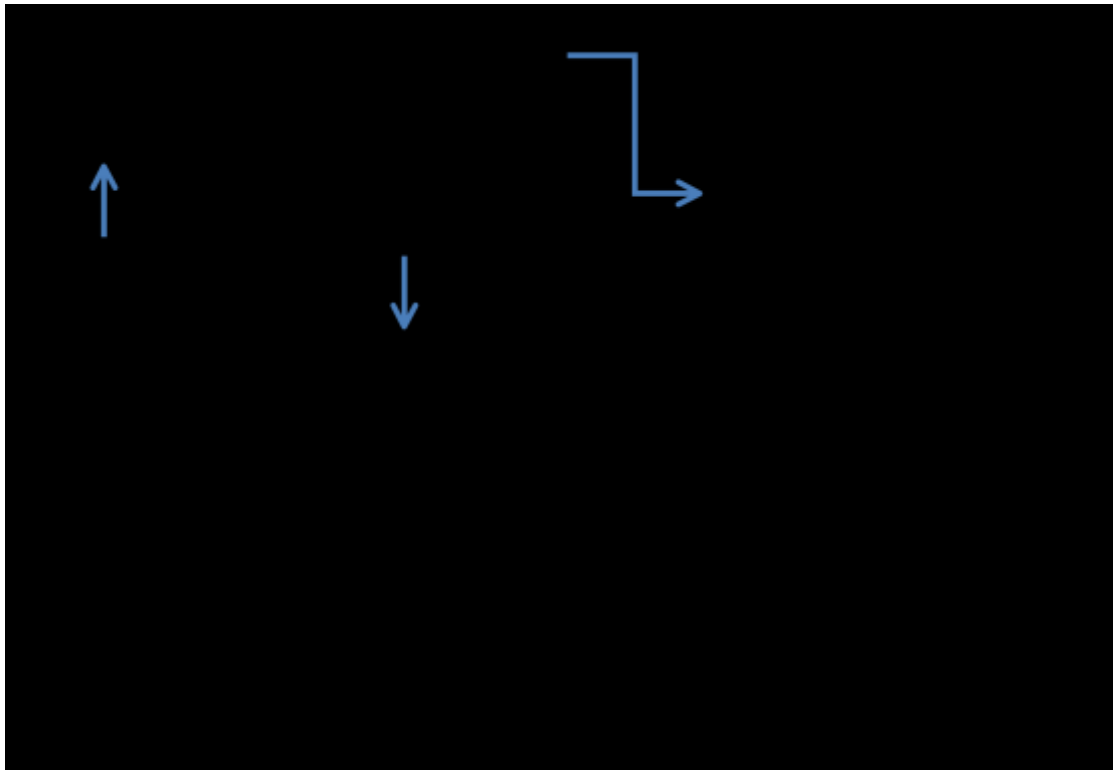


$$I = \frac{V1}{R1 + (\ R2 \times R_L\ )} = \frac{V2}{(\ R2 \times R_L\ )}$$

$$I = I_2 + It$$
$$I_2 = V2 / R2$$
$$It = V2 / R_L$$

$$\frac{V1}{V2} = \frac{R1 + (\ R2 \times R_L\ )}{(\ R2 \times R_L\ )}$$

CURRENT DIVISION RULE



PROCEDURE FOR APPLYING RULES

1.Assume all voltage sources and resistances are given. (If not label them V1, V2 ..., R1, R2 etc)

2. Label each branch with a branch current. (I1, I2, I3 etc)

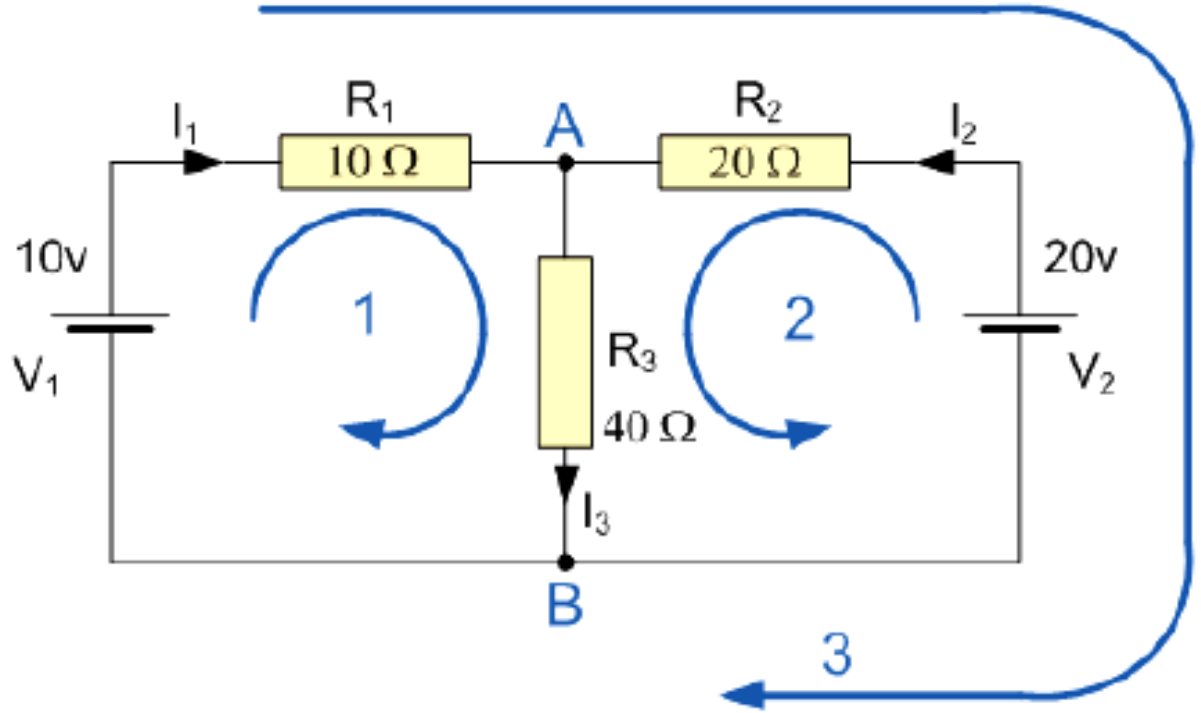
3. Apply junction rule at each node.

4. Applying the loop rule for each of the independent loops of the circuit.

5. Solve the equations by substitutions/linear manipulation.

ASSESSMENT 1

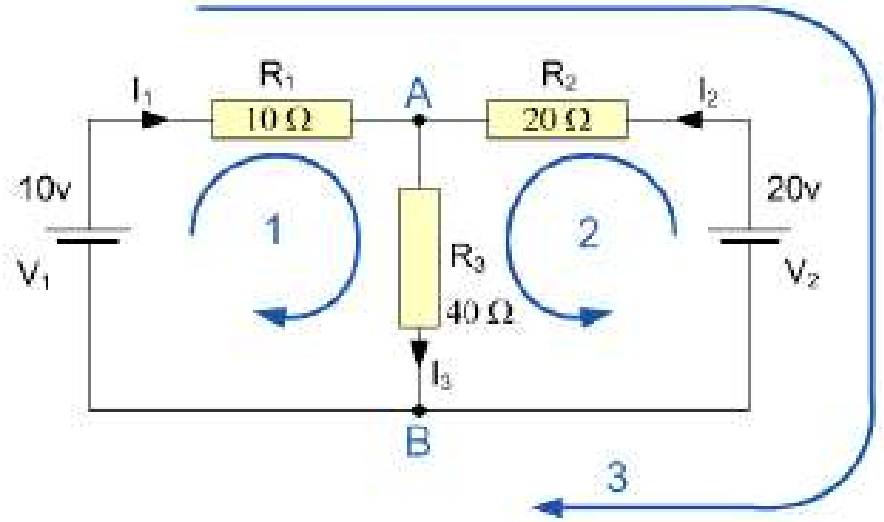
Determine the values of the current flowing through each of the resistors.



SOLUTION

The circuit has two nodes (at A and B). We have the choice of choosing only two of the three loops shown (blue). This is because only two of the loops are independent.

- Node A
- Node B
- Loop 1
- Loop 2 $I1+I2=I3$ $I3=I1+I2$
- $10-I1R1-I3R3=0$
- $20-I2R2-I3R3=0$



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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

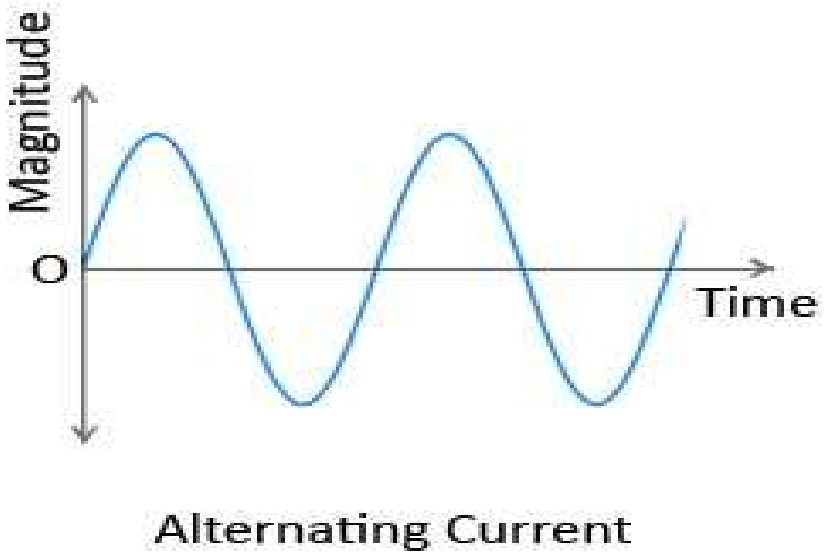
COURSE NAME : 19EE01 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I YEAR /I SEMESTER MECHANICAL ENGINEERING

Unit 1 – Electrical Circuits and Measurements

AC & DC Circuits

AC CIRCUITS



Alternating Current

AC is a sinusoidal in nature which have frequency in its signal

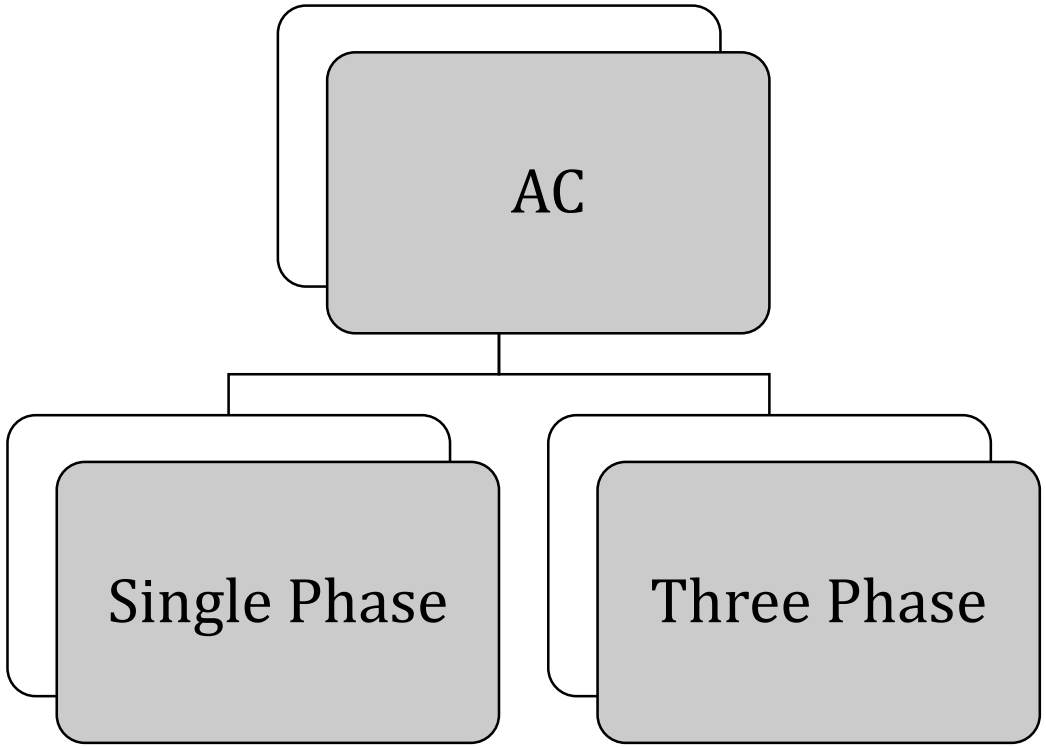
Frequency F= (1/T)

V- Voltage

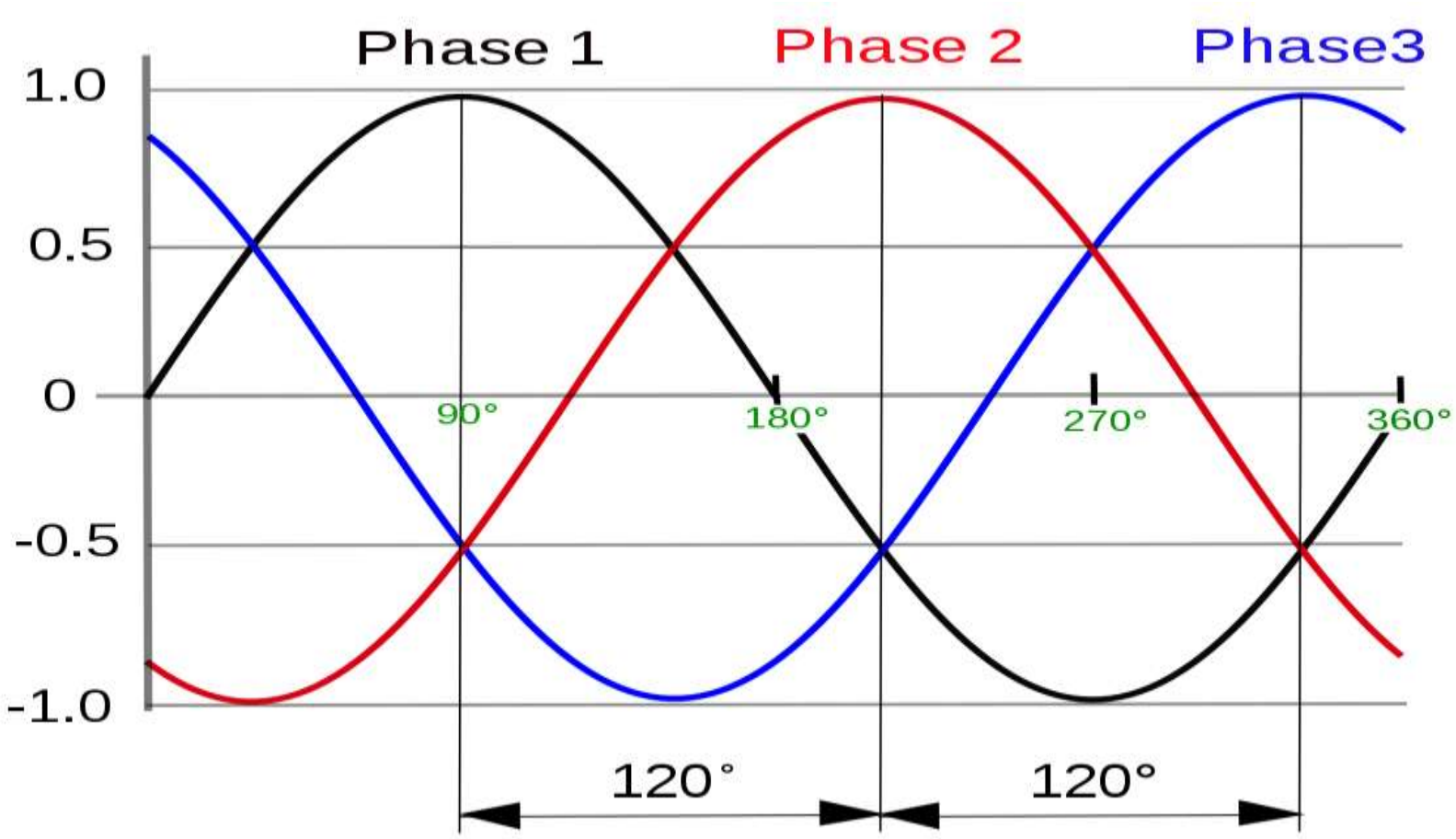
I- Current

Z- Impedence

TYPES OF AC



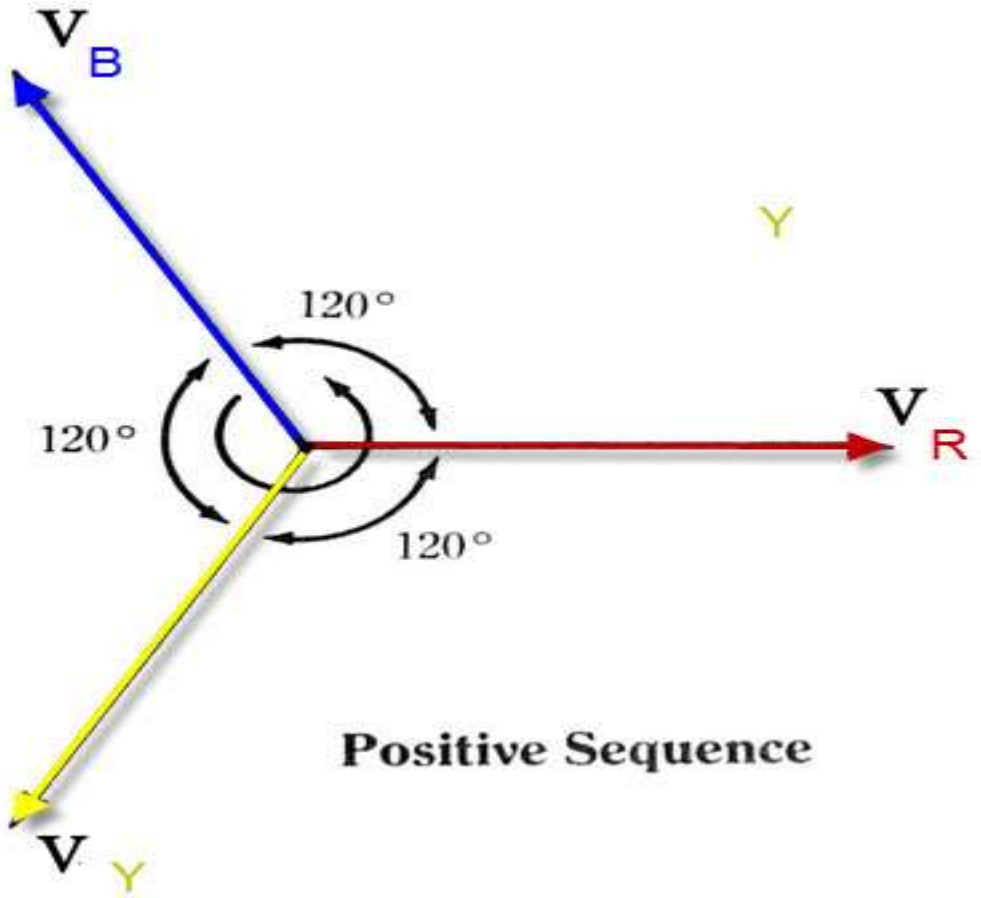
THREE PHASE SUPPLY

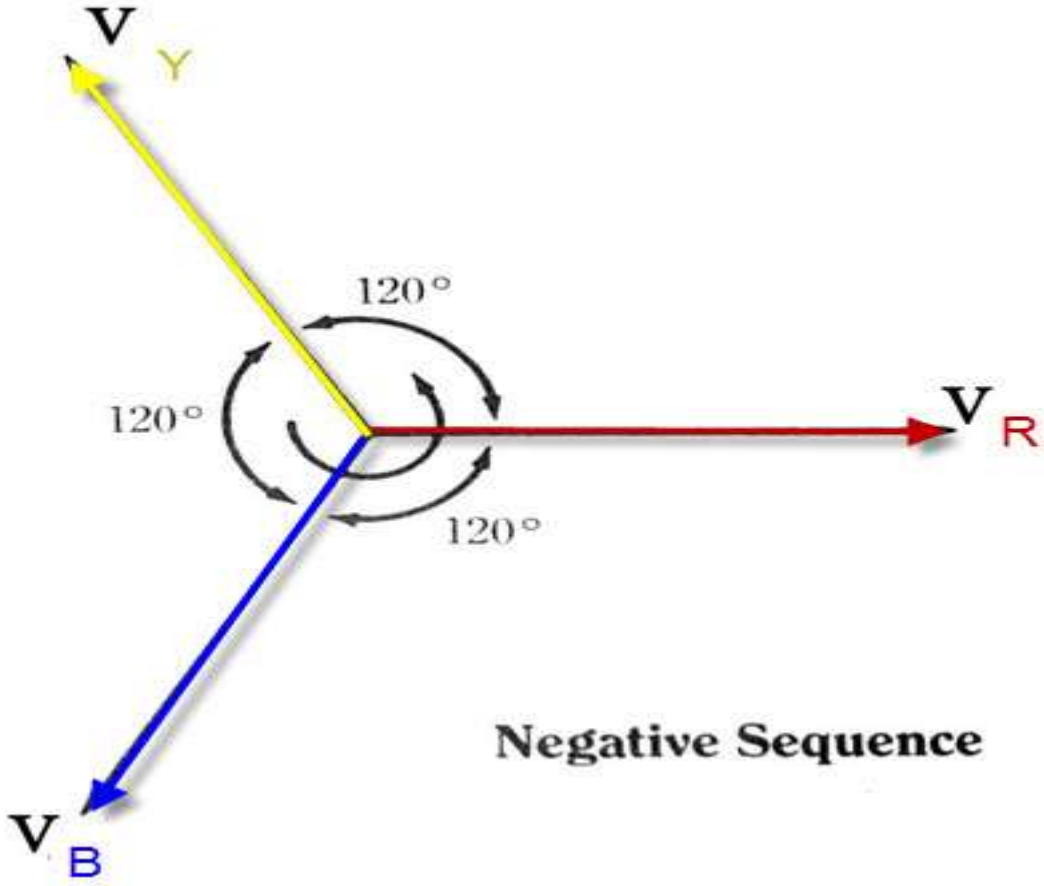


ADVANTAGES OF THREE PHASE SUPPLY

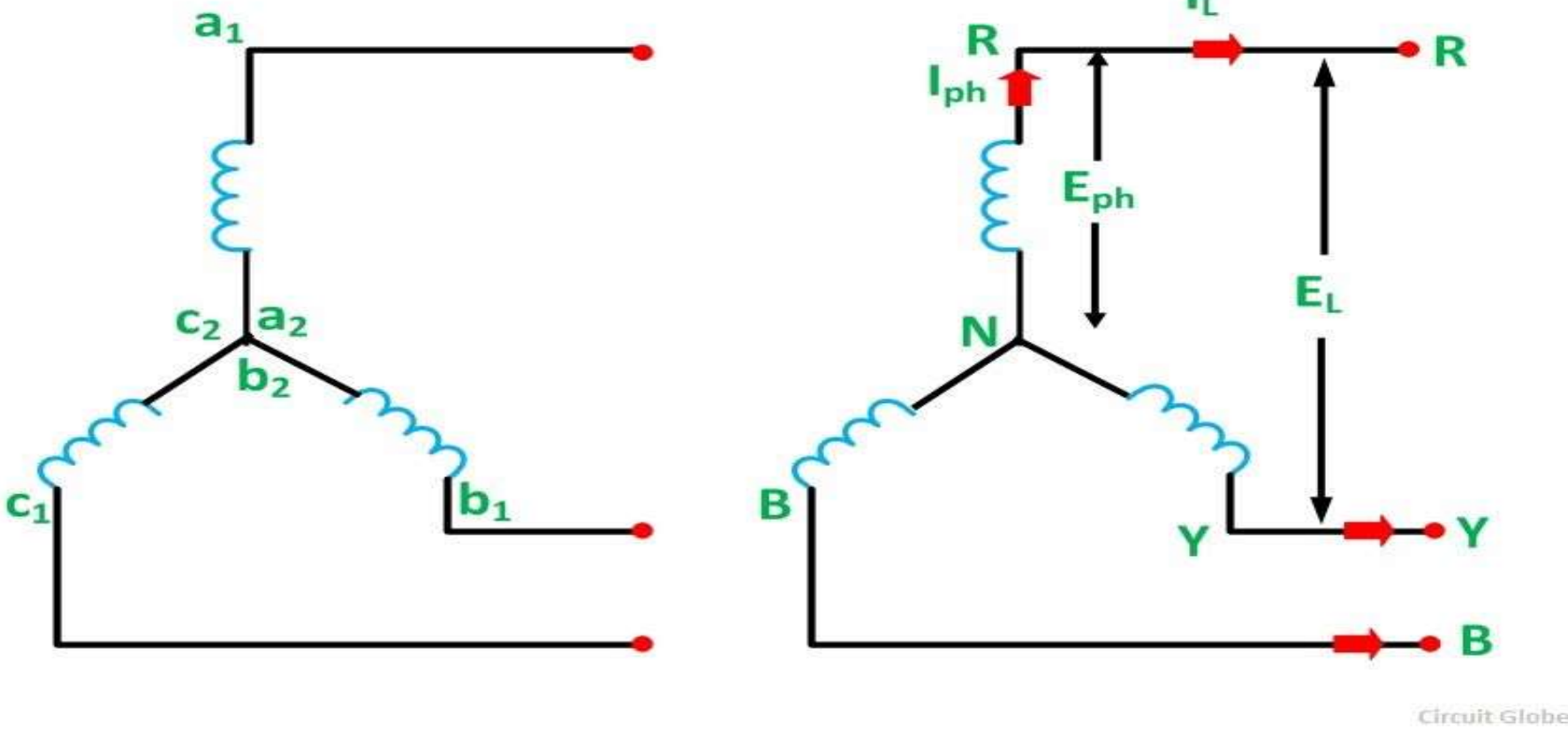
- More power
- Smaller in size with higher capacity
- Self starting
- P.f and efficiency
- More economical

AC & DC

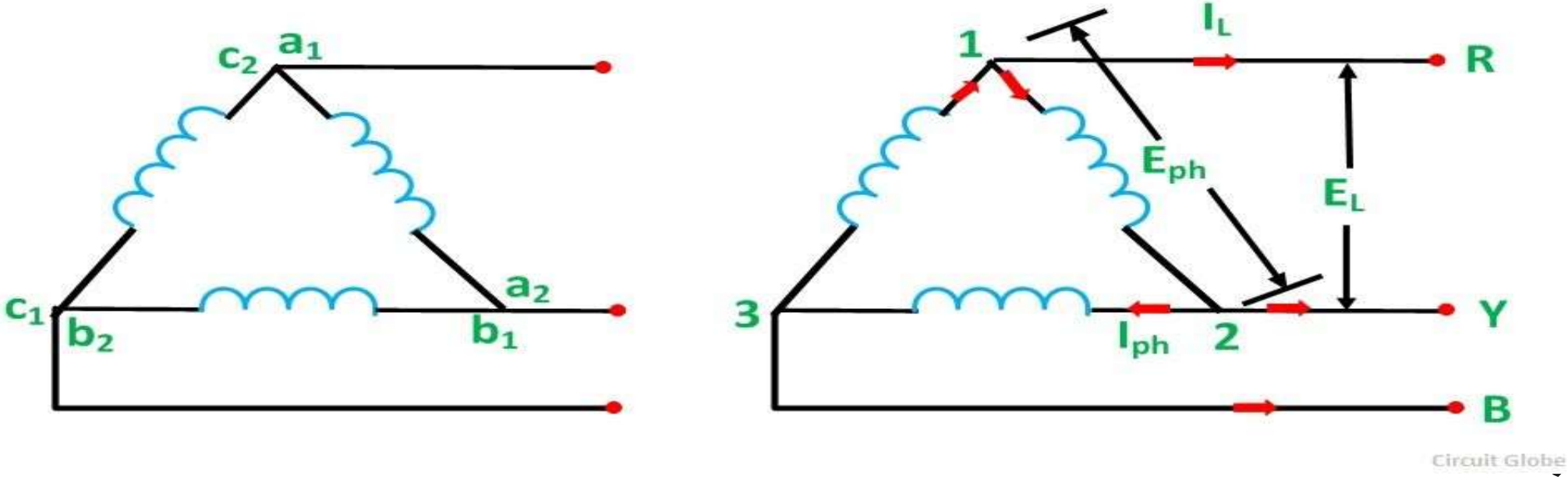

V B
Y
120°
120°
120°
V R
V Y
Positive Sequence


V Y
120°
120°
120°
V R
V B
Negative Sequence

Star connection



Delta connection



DC

DC source is Direct current where the frequency is zero

I-Current
V-Voltage
R-Resistance

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I YEAR /I SEMESTER MECHANICAL ENGINEERING

Unit 1 – Electrical Circuits and Measurements

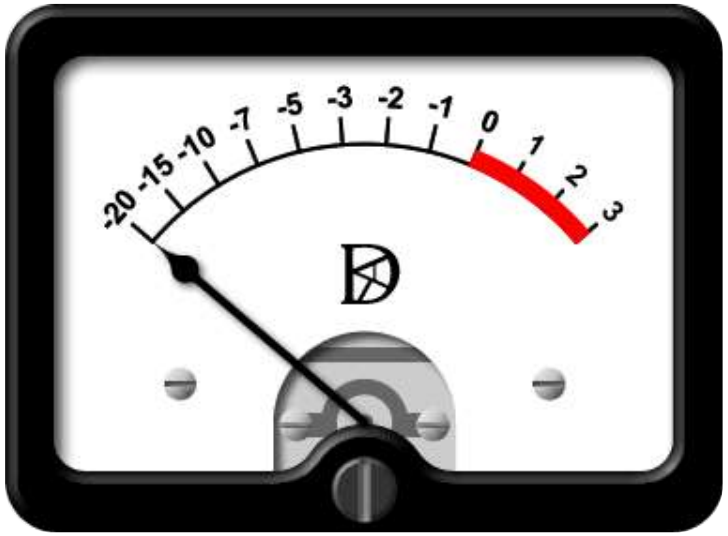
Introduction to Measuring Instruments

MEASURING INSTRUMENTS

Why do we need measuring instruments in Electrical and Electronics Engineering?

The instruments used for all electrical measurements are called measuring instruments. They include ammeters, voltmeters, wattmeters, energy meters etc.

BASIC PRINCIPLE



OMG!! How it works?

How is the pointer moving?

How do instruments operating to measure electrical and electronic quantities ?

DEFLECTING TORQUE

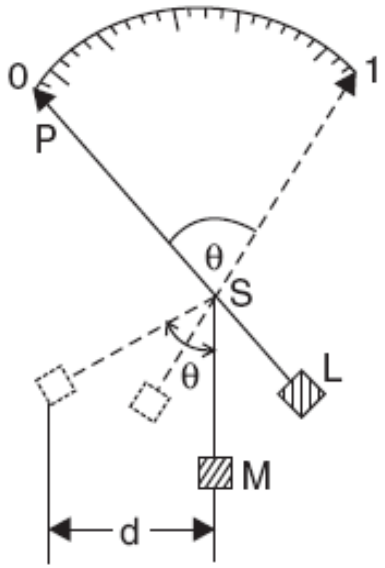
- Have you ever played with a magnet ?

- Electrostatic effect is used mainly for the deflecting torque makes the pointer moves from zero position to the final position.

CONTROLLING TORQUE

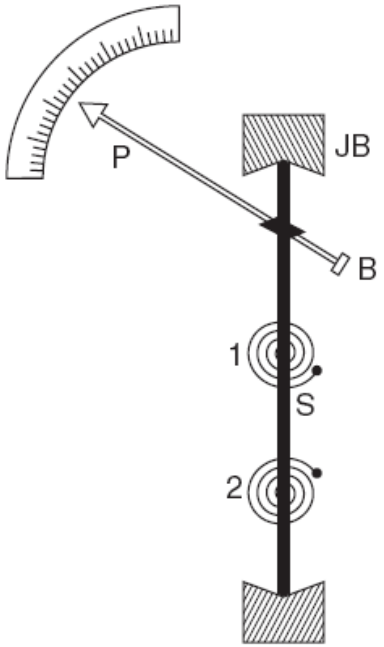
Controlling torque are used to keep the pointer of the instrument in one position and return back if its OFF

Gravity Control



P = Pointer
S = Spindle
L = Balance weight
M = Control weight
e = Angle of deflection

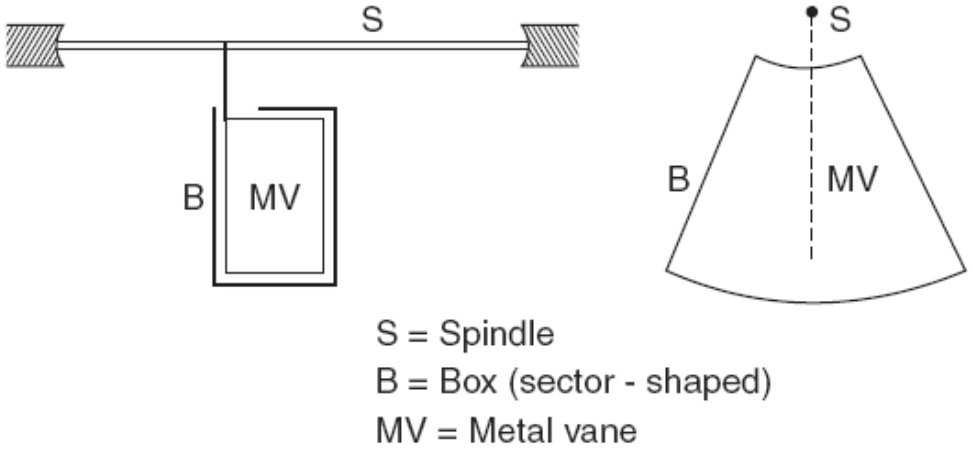
Spring control



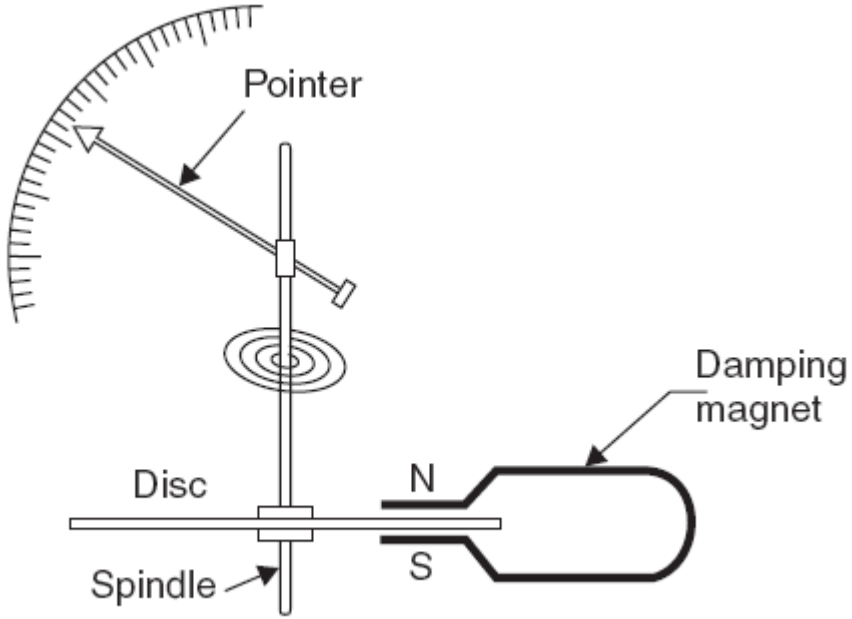
P = Pointer
B = Balance weight
S = Spindle
JB = Jewelled bearing
1,2 = Springs

DAMPING TORQUE

It is used to reduced the oscillations of pointer and also to reach the rest position of the pointer



Air Damping



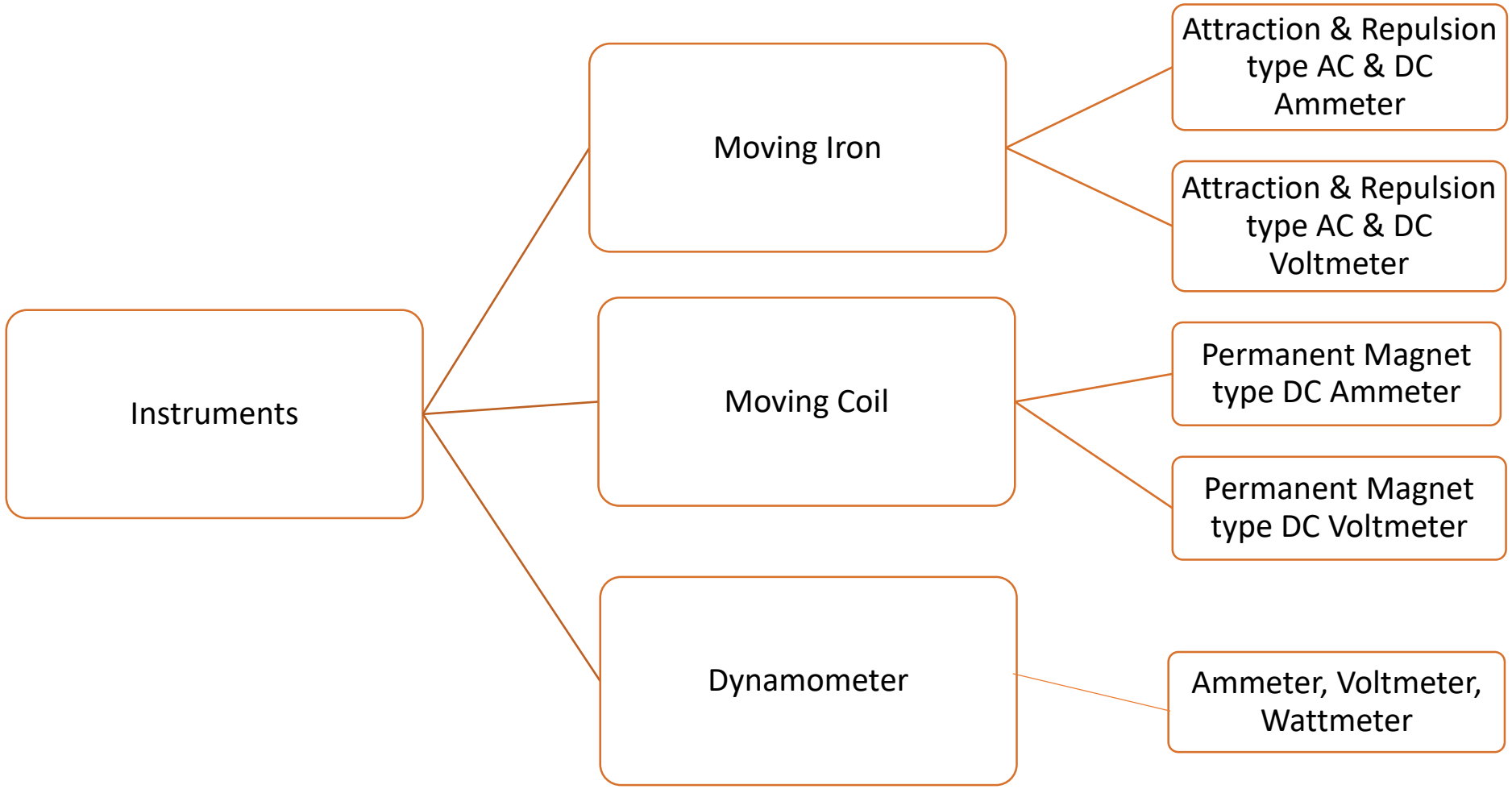
Eddy current damping

ASSESSMENT 1

1._____is used mainly for the deflecting torque makes the pointer moves from zero position to the final position.

2. Damping is used to reduce the _____of pointer and also to reach the rest position of the pointer

TYPES OF INSTRUMENT



IQ

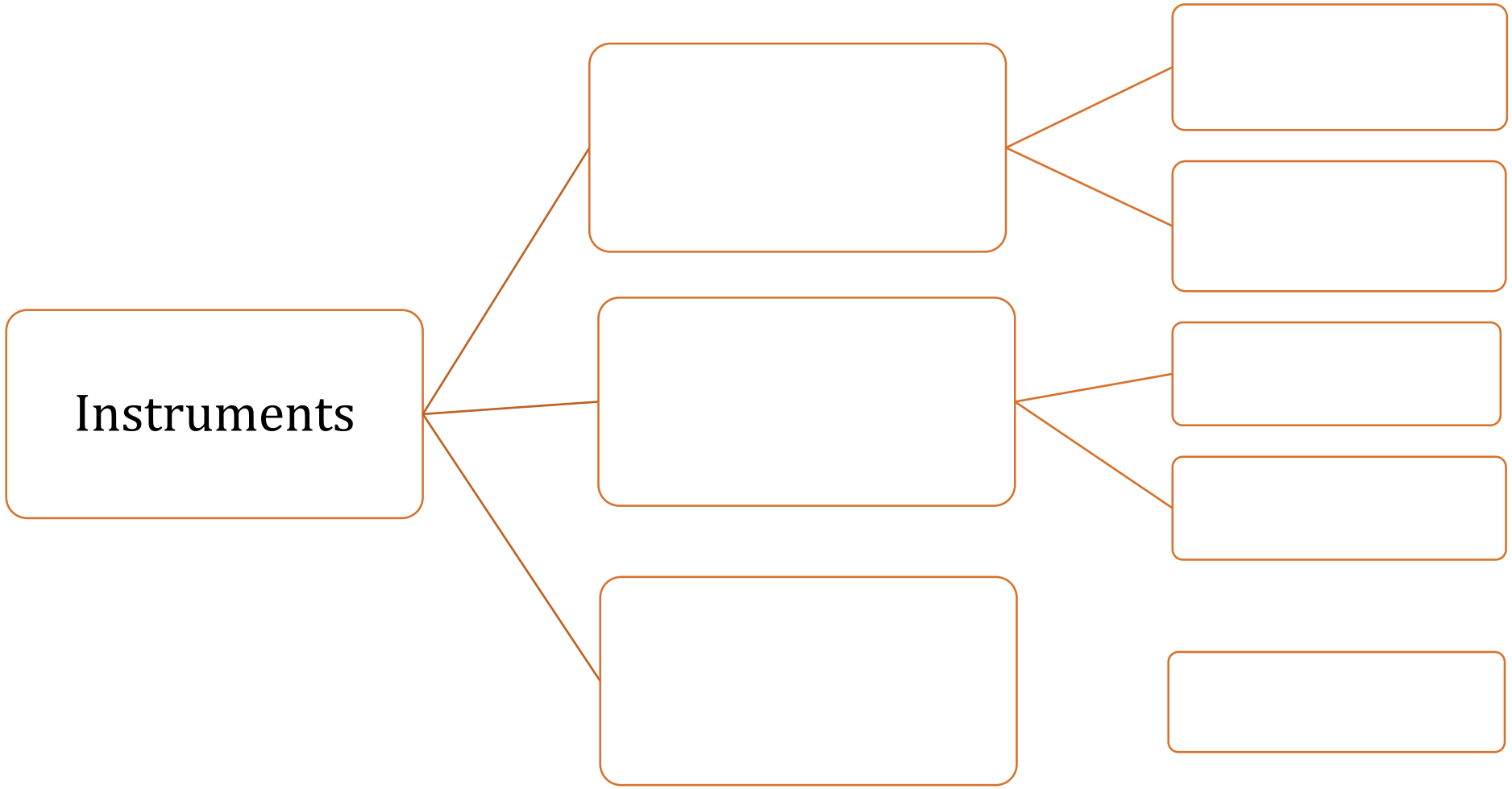
Guess the Instrument name !!

APPLICATIONS

- Electric Motor Industries
- Electric Lift Industries
- Electric Fan Industries
- Television Industries
- Educational Institutions
- TNEB

Assessment 2

- Fill the blocks



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I YEAR /I SEMESTER MECHANICAL ENGINEERING

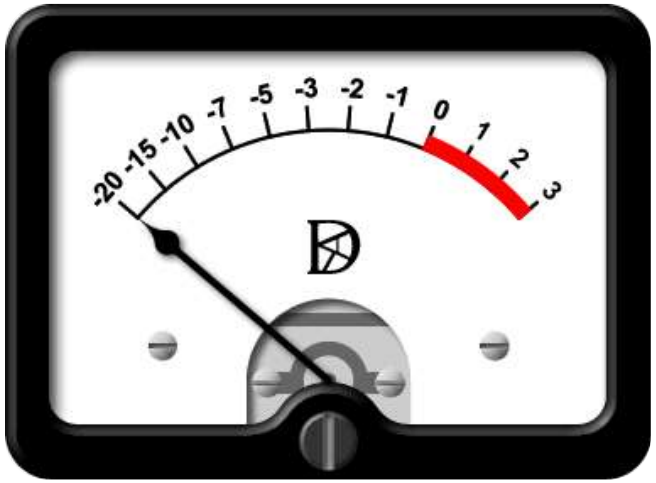
Unit 1 – Electrical Circuits and Measurements

Principle of Moving coil instruments

MEASURING INSTRUMENTS

I have two electrical supply as Alternating current and Direct current. Can I use same instrument for measuring the two supply?

TYPES OF MOVING COIL INSTRUMENTS



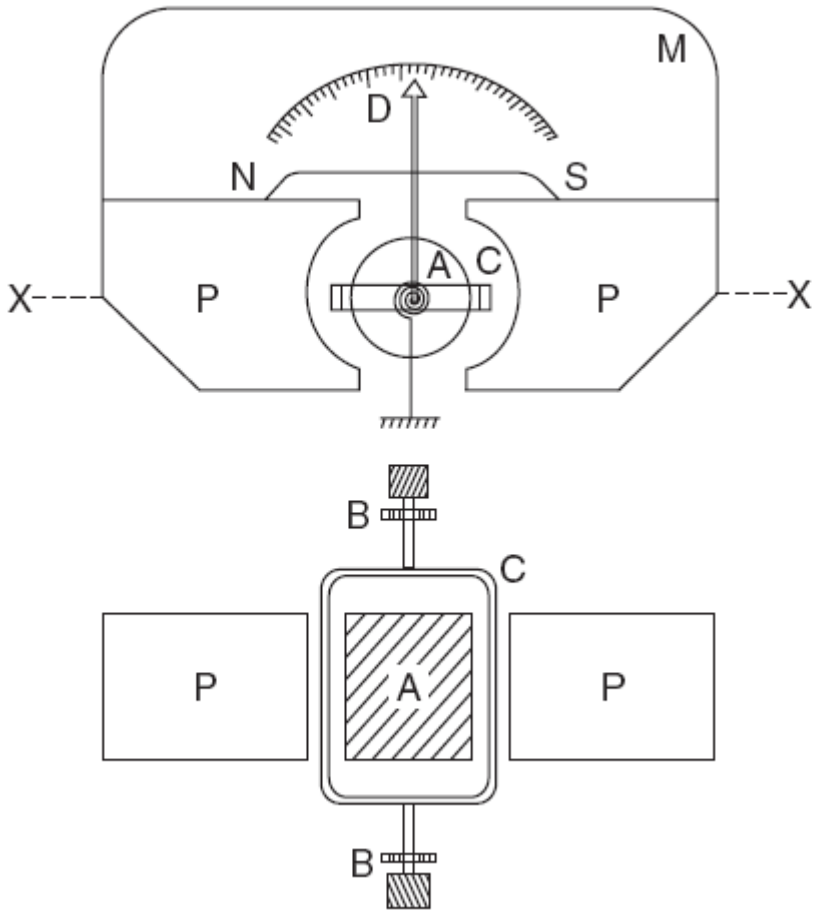
Moving coil instruments

- Permanent magnet type
  - DC only
- Electrodynamometer type
  - AC & DC

PMMC Instruments

Principle

"when a current-carrying conductor is placed in a magnetic field, it is acted upon by a force which tends to move it to one side and out of the field".

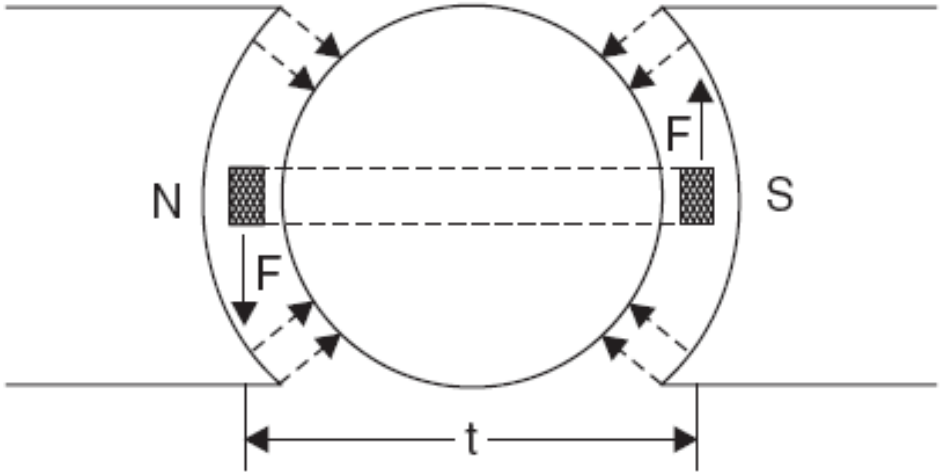


M = Permanent magnet
PP = Soft iron pole pieces
A = Soft iron cylinder (central core)
C = Rectangular coil
B = Spiral springs
D = pointer

Deflecting torque.

F = BIl newton

- B = flux density in WB/m2, and
- l = length or depth of coil in metres.



Deflecting torque (Td)

= force × perpendicular distance

= NBIl × b = NBI (l × b) = NBIA Nm

Controlling torque (Tc) = deflecting torque (Td)

Hence cθ = kI

COMPARISION

ADVANTAGES

(i) Low power consumption.

(ii) Their scales are uniform.

(iii) No hysteresis loss.

DISADVANTAGES

(i) Somewhat costlier as compared to moving-iron instruments.

(ii) Cannot be used for A.C. measurements.

(iii) Friction and temperature might introduce errors as in case of other instruments.

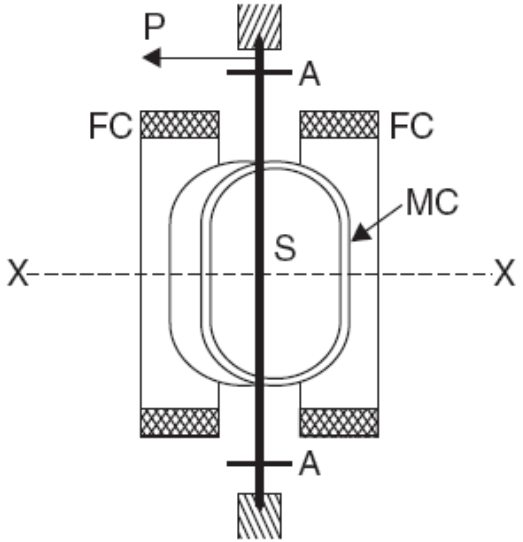
ASSESSMENT 1

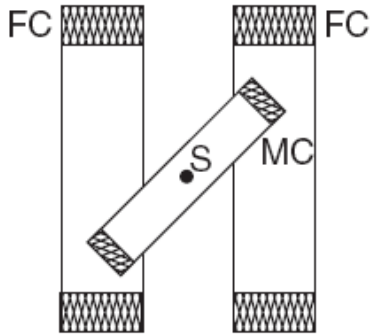
1. when a current-carrying conductor is placed in a _____, it is acted upon by a force which tends to move it to one side and out of the field".

2. Mention the advantages and disadvantages of PMMC coil instrument

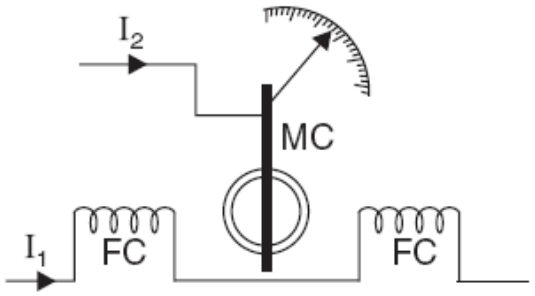
S.No	Advantages	Dis-advantages

Dynamometer Instruments





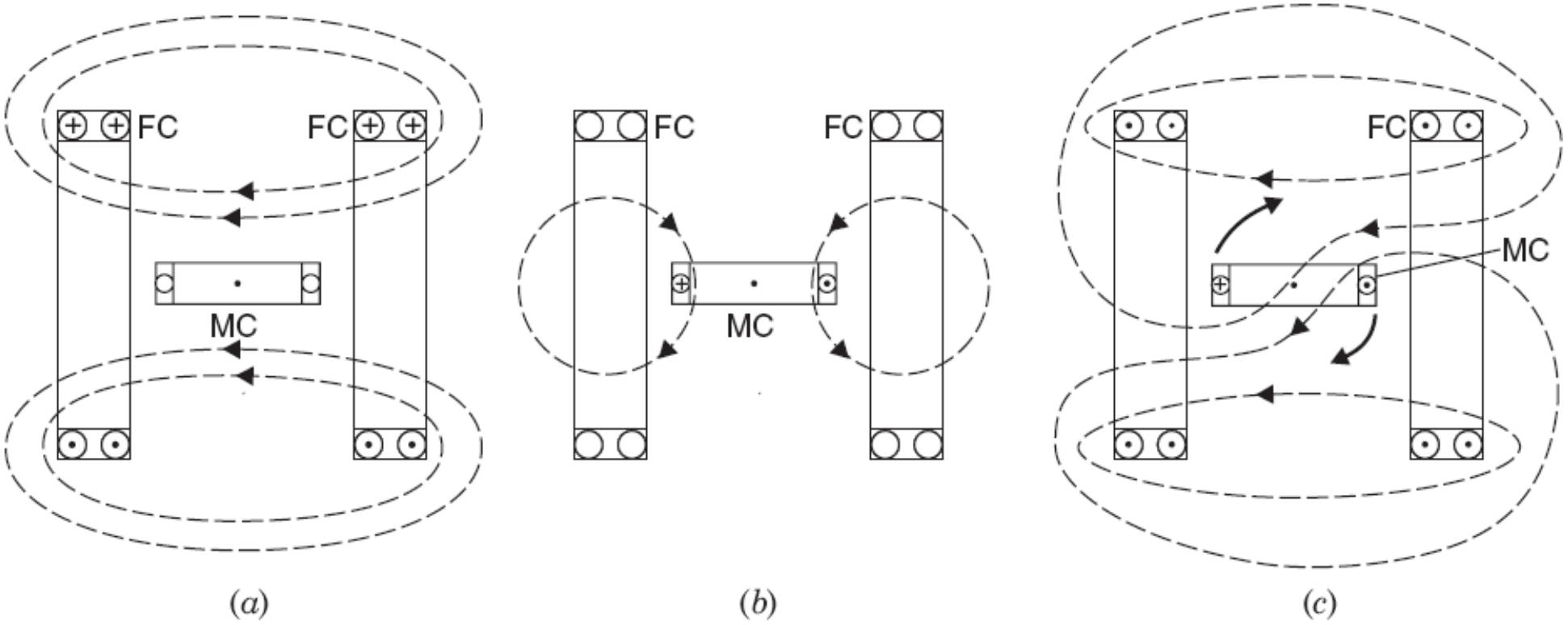
FC = Field coils (divided into two halves)
MC = Moving coils
S = Spindle
A = Spiral hair springs



I_1 = Current in FC
I_2 = Current in MC
(*b*)

In an electro-dynamic instrument the operating field is produced by another fixed coil and not by permanent magnet.

MAGNETIC FIELDS



COMPARISION OF DYNAMOMETER TYPE

Advantages :

- Can be used on both D.C. as well as A.C. systems.
- They are free from hysteresis and eddy current errors.

Disadvantages :

- Since torque/weight ratio is small, such instruments have low sensitivity.
- The scale is not uniform because $\theta \propto I$.
- Cost of these instruments is higher in comparison to those of moving iron instruments.

Assessment 2

1. List down the parts of Dynamometer type moving coil instrument.
   - _____
   - _____
   - _____

2. List the Advantages and Dis-advantages of Dynamometer type moving coil instrument.

S.No	Advantages	Dis-advantages

REFERENCES

1. Bhattacharya. S.K, “Basic Electrical and Electronics Engineering”, Pearson Education , (2017)
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I YEAR /I SEMESTER MECHANICAL ENGINEERING

Unit 1 – Electrical Circuits and Measurements

Electrodynamometer type wattmeter

PURPOSE OF INSTRUMENTS

Ammeter is used to measure _____

Voltmeter is used to measure _____

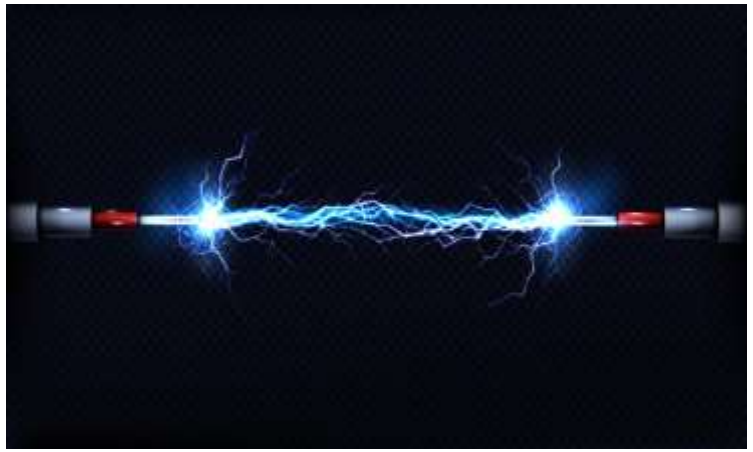
Wattmeter is used to measure _____

POWER

1.In general the Power is defined as an ability or capacity to do something or act in a particular way.

2.In terms of electrical engineering Power = V*I

3.Wattmeter is used to measure the electrical power



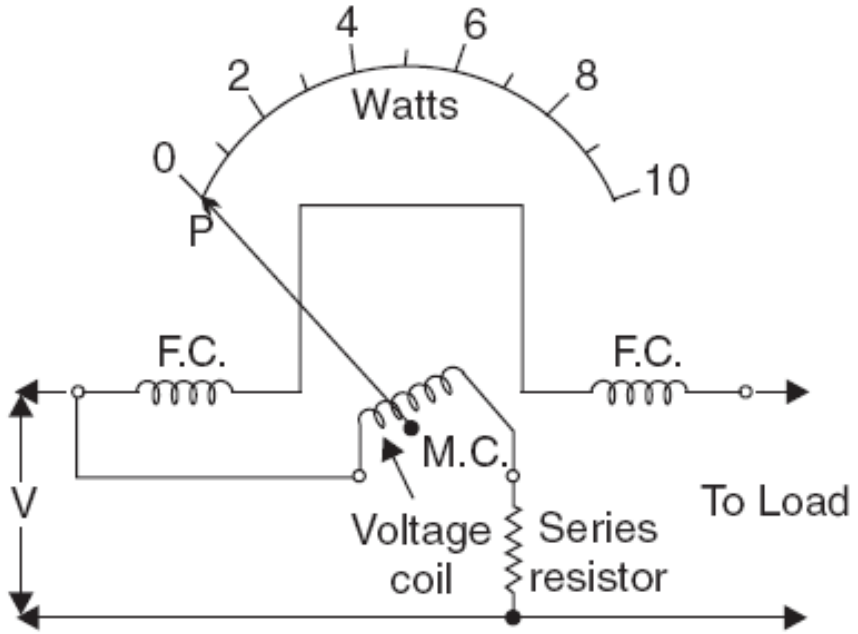
WATTMETERS

A wattmeter is a combination of an ammeter and a voltmeter and, therefore consists of two coils known as current coil and pressure coil. The operating torque is produced due to interaction of fluxes on account of currents in current and pressure coils.

Types of wattmeters

1. Dynamometer wattmeter
2. Induction wattmeter
3. Electrostatic wattmeter

DYNAMOMETER WATTMETER



F.C. = Fixed coils (current coils)

M.C. = Moving coil (voltage coil)

P = Pointer

If the coils are connected so that a value of current proportional to the load voltage flows in one, and a value of current proportional to the load current flows

ASSESSMENT 1

1. Power is _____
   a) rate of doing work
   b) rate of producing voltage
   c) rate of generating current
   d) rate of overcoming friction

2. In D.C. circuits, power is measured using _____
   a) ohmmeter and galvanometer
   b) ohmmeter and voltmeter
   c) ammeter and voltmeter
   d) ammeter and galvanometer

CALIBRATION

Let v = supply voltage,

i = load current, and

R = resistance of the moving coil circuit.

Current through fixed coils, if = i.

Current through the moving coil, im =V/R

Deflecting torque, Td ∝ if × im ∝ iV/R

.

ERRORS

1. The error may creep in due to the inductance of the moving or voltage coil. However, the high non-inductive resistance connected in series with coil swamps, to a great extent, the phasing effect of the voltage coil inductance.

2. There may be error in the indicated power due to the following :

(i) Some voltage drop in the current circuit.

(ii) The current taken by the voltage coil.

PROS AND CONS

Advantages

(i) The scale of the instrument is uniform

(ii) High degree of accuracy can be obtained by careful design, hence these are used for calibration purposes.

Disadvantages

(i) The error due to the inductance of pressure coil at low power factor is very serious

(ii) Stray field may effect the reading of the instru

Assessment 2

1. A wattmeter consists of a current coil and a potential coil.
   a) True
   b) False
2. In a Dynamometer type wattmeter, the fixed coil is split into _____
   a) 4
   b) 3
   c) 2
   d) 1
3. List the advantages of Dynamometer type wattmeter.

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Unit 1 – Electrical Circuits and Measurements

Energy Meter

ENERGY

Physics says “ Energy is the ability of work done with respect to time”

In Electrical terms Energy is power consumed with respect to time

How do I measure energy ?

What instrument/machine should use?

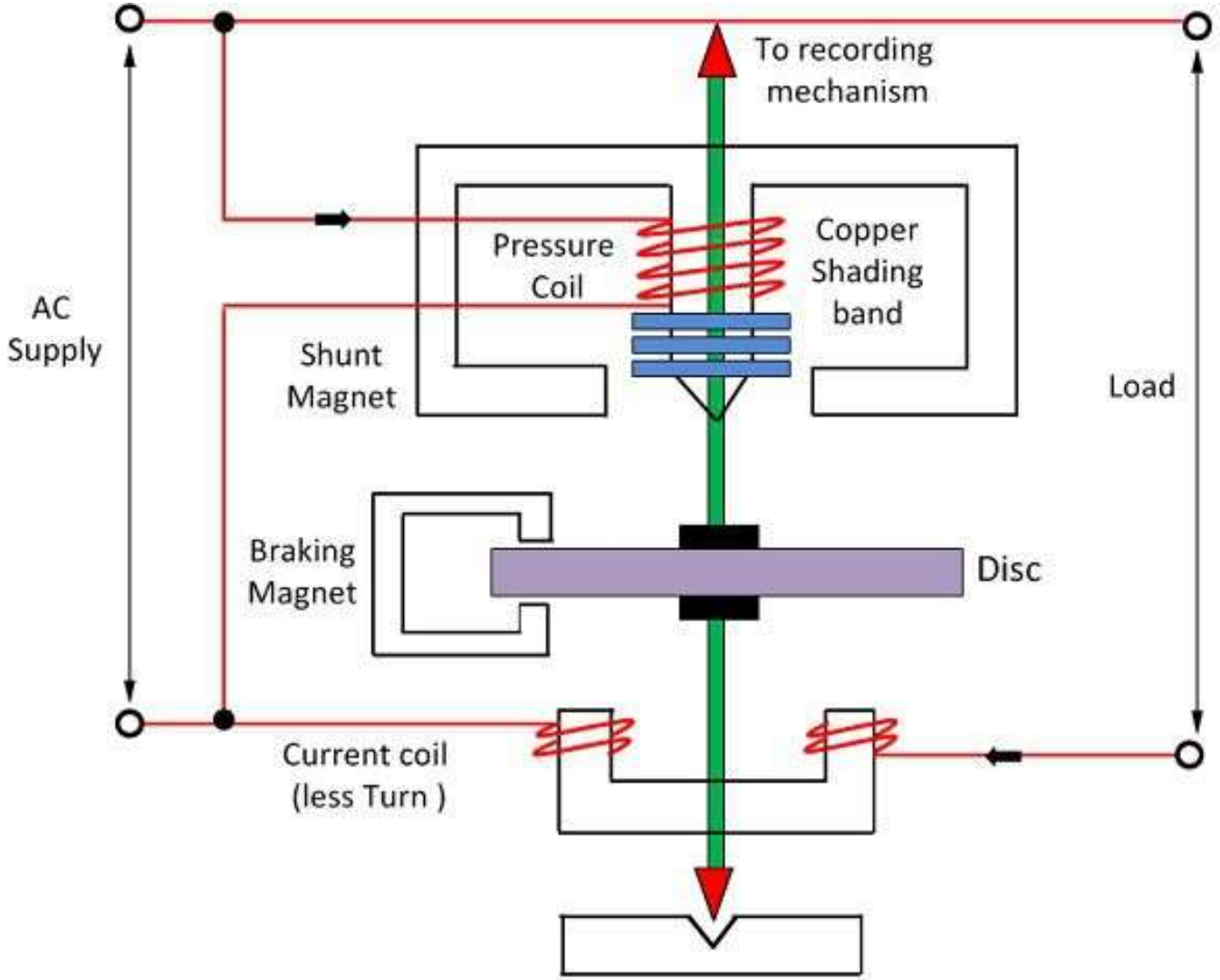
CASE

- What is he doing?
- How do he calculating?
- Why should he measure?
- Share your experiences!

ENERGY METER

- The meter which is used for measuring the energy utilizes by the electrical load is known as the energy meter.
- The energy is the total power consumed and utilized by the load at a particular interval of time.
- It is used in domestic and industrial AC circuit for measuring the power consumption.

CONSTRUCTION OF ENERGY METER



ASSESSMENT 1

1.The household energy meter is
   A. An indicating instrument
   B. A recording instrument
   C. An integrating instrument
   D. None of the above

2. The meter constant of single phase energy meter is expressed in terms of
   A. Revolutions/kWh
   B. kW/kWh
   C. Amps/kW
   D. Volts/kWh

MECHANISM IN ENERGYMETER

The energy meter has four mechanism

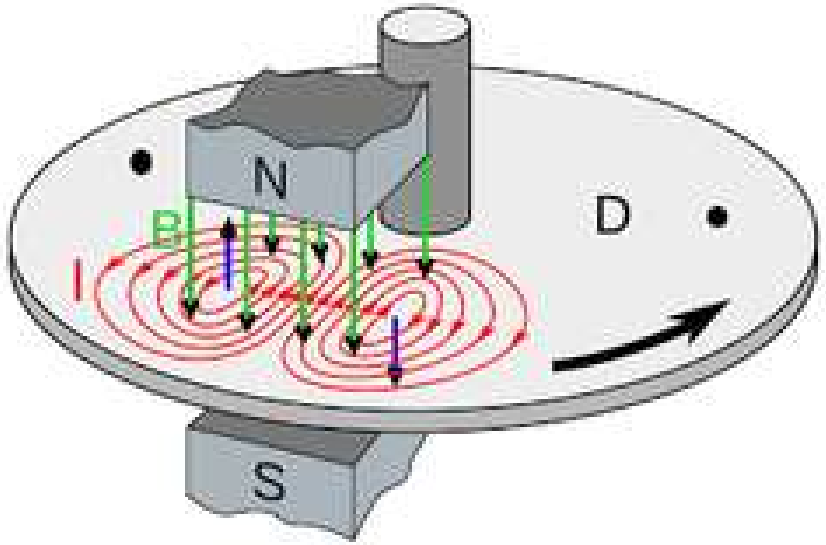
- Driving System
- Moving System
- Braking System
- Registering System

DRIVING MECHANISM

- The electromagnet is the main component of the driving system.
- The upper one is called the shunt electromagnet, and the lower one is called series electromagnet.
- The series electromagnet is excited by the load current flow through the current coil.
- The coil of the shunt electromagnet is directly connected with the supply and hence carry the current proportional to the shunt voltage and called as pressure coil.

MOVING SYSTEM

- The moving system is the aluminium disc mounted on the shaft of the alloy.
- The disc is placed in the air gap of the two electromagnets. The eddy current is induced in the disc because of the change of the magnetic field.
- This eddy current is cut by the magnetic flux. The interaction of the flux and the disc induces the deflecting torque.

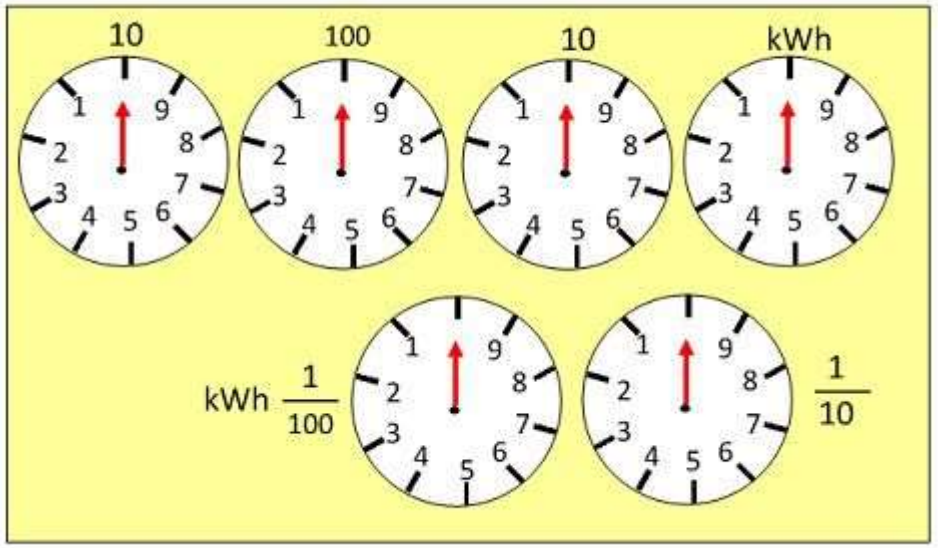


BRAKING SYSTEM

1. The permanent magnet is used for reducing the rotation of the aluminium disc.
2. The aluminium disc induces the eddy current because of their rotation.
3. The eddy current cut the magnetic flux of the permanent magnet and hence produces the braking torque.

REGISTRATION (COUNTING MECHANISM)

1. The main function of the registration or counting mechanism is to record the number of rotations of the aluminium disc.
2. The rotation is directly proportional to the energy consumed by the loads in the kilowatt hour.



Assessment 2

1.If voltage supply to the energy meter is more than the rated value, energy meter will run

A.Slow

B.Fast

C.Either of the above

D.None of the above

2.Aluminium is selected as the material for rotating disc of energy meter because

A.It is good conductor

B.It is light

C.It is indigenously available

D.All of the above reasons

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