Lecture Notes on

Basic Electrical Engineering - Th4(a)

2nd Semester Mechanical Engineering

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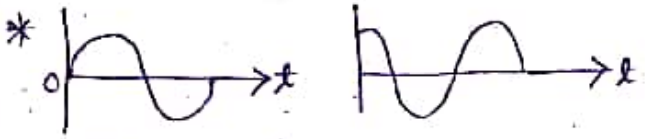
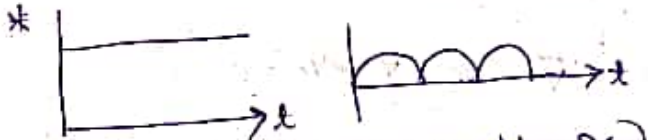
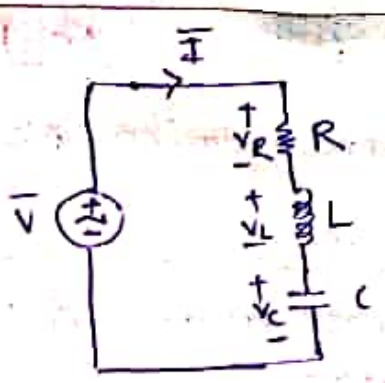
AC Fundamental

Difference between AC and DC

AC	DC
* AC means alternating current.	* DC Means Direct current.
* The electrical quantity whose magnitude changes w.r.t time and flow in alternate direction.	* The electrical quantity whose magnitude does not changes w.r.t time and flow in one direction.
*  (Sin wave) (cos wave)	*  (Pure DC) (Pulsating DC)
* Production cost is cheap	* Production cost is high
* It has frequency India F=50Hz USA, F=60Hz	* It has no frequency F=0Hz.
* It can raise by using Transformer. It can available an - 1ϕ & 3-ϕ.	* No such facility are available. VI can not be Raised.
* AC can be converted into DC by Rectifier.	* DC can be converted into AC by inverter.
* The ckt component include Resistor, inductor and capacitor.	* The ckt component include only Resistor.
* They are used in large, bulk, continuous Power supply system, where electrical energy cannot be stored.	* They are used in small, independent compact isolate Power system where electrical energy can be stored.

Series R-L-C circuit



$\bar{V}$ = supply voltage

$\bar{I}$ = supply current

R = Resistor (Ω)

L = Inductor (H)

C = capacitor (F)

V_R = Resistive voltage

V_L = Inductive voltage

V_C = capacitive voltage

Apply KVL.

$$\bar{V} - V_R - V_L - V_C = 0$$

$$\bar{V} = V_R + V_L + V_C$$

$$= IR + jX_L I - jX_C I$$

$$= I\left[R + jX_L - jX_C\right]$$

$$= I\left[R + j(X_L - X_C)\right]$$

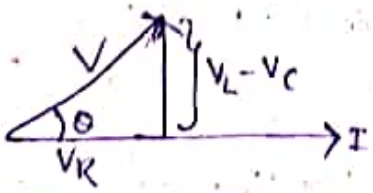
$$\boxed{\bar{V} = IZ}$$

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

$$\theta = \tan^{-1}\left[\frac{(X_L - X_C)}{R}\right]$$

Z = Impedance $= \sqrt{R^2 + (X_L - X_C)^2}$

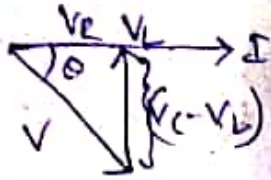
Case-1 $X_L > X_C$ or $V_L > V_C$



$$V = \sqrt{V_R^2 + (V_L - V_C)^2}, \quad Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\theta = \tan^{-1}\left[\frac{(V_L - V_C)}{V_R}\right]$$

Case-2: $X_L < X_C$ or $V_L < V_C$



$$V = \sqrt{V_R^2 + (V_C - V_L)^2}$$

$$\theta = \tan^{-1}\frac{(V_L - V_C)}{V_R}$$

$$Z = \sqrt{R^2 + (X_C - X_L)^2}$$

Power Triangle and Impedance Triangle :-

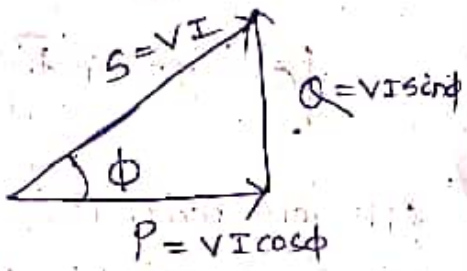
Power Triangle :-

* Power Triangle is the combination of Apparent Power, Active Power and Reactive Power.

* $\boxed{S = P + jQ}$

$$S = \sqrt{P^2 + Q^2}$$

$$\theta = \tan^{-1}\left[\frac{Q}{P}\right]$$



[Power triangle]

S = Total / apparent Power (VA)

P = Active / Real / True Power (watt)

Q = Reactive Power (VAR)

Active Power (P)

* It is the true power of a circuit. It is actually used in the ckt.
* The power consumed by R in a AC ckt is called true power.
* $P = I^2R$

  $P = V_R I$

  $\boxed{P = VI\cos\phi}$

  ϕ = angle between V & I
  = Power factor angle

* It is denoted as 'P'
* unit = watt

Reactive Power (Q)

* The power consumed by X (Reactance) in a A.C ckt is called as Reactive Power.
* It is denoted as Q. unit = VAR (Volt Ampere Reactive)
* $Q = I^2X$

$Q = VXI$

$$\boxed{Q = VI\sin\phi}$$

Apparent Power (S)

* It is the combination of Active and Reactive Power.
* It is the power that appears to the source because of the circuit impedance.
* It is denoted as 'S'. unit = VA (Volt-ampere).
* $S = VI$
* $S = \sqrt{P^2 + Q^2}$

Impedance Triangle

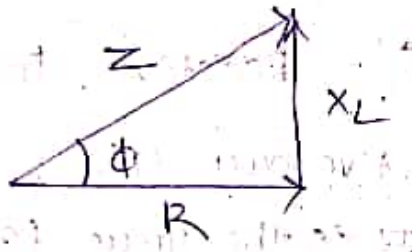
Case-1 In RL Series ckt:

$Z = \text{Impedance} = R + jX_L$

$|Z| = \sqrt{R^2 + X_L^2}$

$\phi = \tan^{-1}\left[\frac{X_L}{R}\right]$

$\cos\phi = \frac{R}{Z}$, $\sin\phi = \frac{X_L}{Z}$



(Case-1)

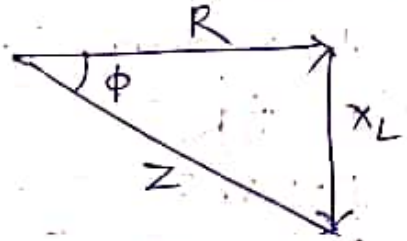
Case-2 In RC Series ckt.

$Z = \text{Impedance} = R - jX_C$

$|Z| = \sqrt{R^2 + X_C^2}$

$\phi = \tan^{-1}\left[\frac{X_C}{R}\right]$

$\cos\phi = \frac{R}{Z}$, $\sin\phi = \frac{X_C}{Z}$



(Case-2)

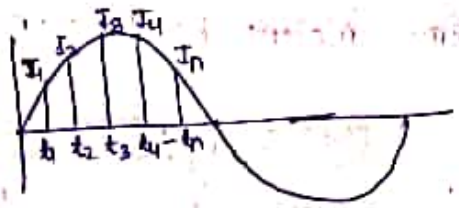
(Impedance Triangle)

Derive Average and Rms Value of an alternating quantity

Average Value derivation :-

Two method

① **Mid-ordinate method :**



$$I_{av} = \frac{I_1 + I_2 + I_3 + \cdots + I_n}{n}$$

$$V_{av} = \frac{V_1 + V_2 + V_3 + \cdots + V_n}{n}$$

② **Analytical method :-**

* This Method is more convenient for sinusoidal wave.
* Let an AC quantity generally expressed as

$$V = V_m \sin\theta$$
$$I = I_m \sin\theta$$

Now the average value over a cycle is given as

$$\boxed{V_{av} = \frac{1}{T}\int_0^T V \cdot d\theta}$$

$$\Rightarrow V_{av} = \frac{1}{2\pi}\int_0^{2\pi} V_m \sin\theta \cdot d\theta$$

$$\Rightarrow V_{av} = \frac{2}{2\pi}\int_0^{\pi} V_m \sin\theta \cdot d\theta$$

$$= \frac{V_m}{\pi}\int_0^{\pi} \sin\theta \, d\theta$$

$$= \frac{V_m}{\pi}\left[-\cos\theta\right]_0^{\pi}$$

$$= \frac{V_m}{\pi}\left[-\cos\pi - (-\cos 0)\right]$$

$$= \frac{V_m}{\pi}\left[-(-1)-(-1)\right]$$

$$V_{av} = 2V_m/\pi$$

$$\boxed{V_{av} = \frac{2V_m}{\pi} = 0.637\, V_m}$$

Similarly

$$\boxed{I_{av} = \frac{2I_m}{\pi} = 0.637\, I_m}$$

RMS Value of an AC.

* Rms means Root means square Value.

* $R.m.s = \sqrt{\frac{\text{Area of half cycle : square wave}}{\text{Base length}}}$

* Rms value over a cycle is given as

$$V_{Rms} = \sqrt{\frac{1}{T}\int_0^T v^2 \cdot d\theta}$$

$$= \sqrt{\frac{1}{2\pi}\int_0^{2\pi} V_m^2 \sin^2\theta \cdot d\theta}$$

$$= \sqrt{\frac{V_m^2}{2\pi}\int_0^{2\pi} \frac{1-\cos 2\theta}{2} \cdot d\theta}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\int_0^{2\pi} (1-\cos 2\theta)\, d\theta}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\int_0^{2\pi} (d\theta - \cos 2\theta\, d\theta)}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\left[\theta - \frac{\sin 2\theta}{2}\right]_0^{2\pi}}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\left[(2\pi - 0) - \left(\frac{\sin 4\pi}{2} - \frac{\sin 0}{2}\right)\right]}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\left(2\pi - \frac{\sin 4\pi}{2}\right)}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\left(\frac{4\pi}{2}\right)}$$

$$= \sqrt{\frac{V_m^2}{2}}$$

$$V_{Rms} = \frac{V_m}{\sqrt{2}}$$

$$\boxed{V_{Rms} = \frac{V_m}{\sqrt{2}}}$$

$$\boxed{I_{Rms} = \frac{I_m}{\sqrt{2}}}$$

Explain KCL and KVL:

KCL : Kirchhoff's current Law

* It states that the algebraic sum of all currents meeting at any node is zero.

* $$\boxed{\Sigma I|_{node} = 0}$$

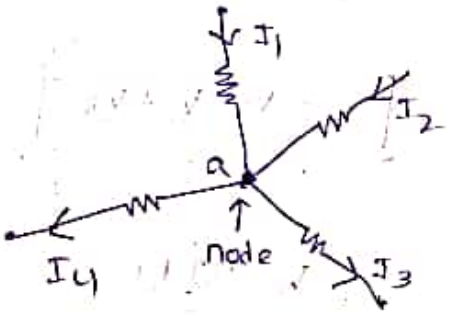
* Sum of incoming current is equal to sum of the outgoing current at same node.

* This Law follows the Law of conservation of charge.

* Example:

Apply KCL at node 'a'

Sum of incoming current is equal to sum of outgoing current



$$\boxed{I_1 + I_2 = I_3 + I_4}$$

$$\boxed{I_1 + I_2 - I_3 - I_4 = 0}$$

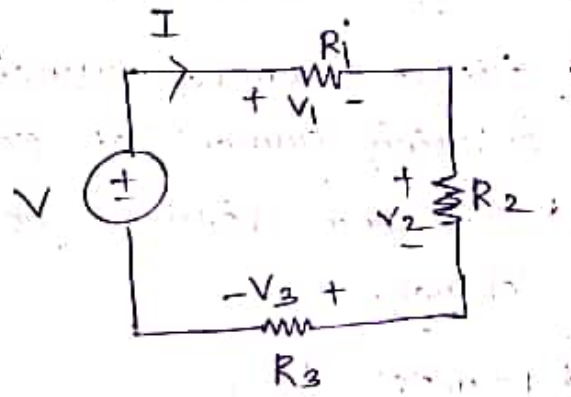
KVL: Kirchhoff's Voltage Law

* This Law states that the algebraic sum of Voltage around any closed Path is zero.

$$\boxed{\Sigma V|_{mesh} = 0} \quad (1)$$

* Mesh is a Loop that does not contain other loops.
* Loop is any closed Path or connection of branch.
* All mesh are Loop but all Loops are not mesh.
* KVL based on Law of conservation of energy.

Example :



Apply KVL

$$-V + V_1 + V_2 + V_3 = 0$$

$$-V = -V_1 - V_2 - V_3$$

$$\boxed{V = V_1 + V_2 + V_3}$$

$$V_1 = IR_1$$

$$V_2 = IR_2$$

$$V_3 = IR_3$$

$$V = IR_1 + IR_2 + IR_3$$

$$\boxed{V = I(R_1 + R_2 + R_3)}$$

Comprison of Different type of wiring :-

Feature	Cleat	Batten	Casing & capping	Lead Sheathed wiring	conduct pipe wiring
Cost	cheapest	cheap	Fairly expensive	Expensive	Expensive
Durability	shortest	Long	Fairly long	fairly Long	very Long
Appearance	Bad	Good	Faire	Good	Very Good
General Reliability	Poore	Good	Good	Faire	Very Good
Time Required for installation	Short	Short	fairly Long	fairly Long	Long
Quality of workmanship	Semiskilled	Semiskilled	Very skilled	Very skilled	Perfect skilled
Protection from					
* fire	No	fair	Worst	Good	very good
* Mechanical hazard	No	Good	Good	Good	very good
* dampness	No	Good	fair	Good	good
Nature of application	Temporary	Domestic	Domestic	service mains	Everywhere
Maintenance & Repair	Easy	Easy	difficult	difficult	Very difficult.

Derive emf equation of DC Generator :-

Let ϕ_m = Flux/Pole in weber

Z = Total number of armature conductor

A = Number of Parallel Path

= 2 (wave winding)

= P (lap winding)

N = Speed in R.P.M (Revolution Per minute)

E_g = emf generated Per Path

* Flux cut by one conductor in one revolution of armature $P\phi = d\phi$

* The number of Revolution Per second = $N/60$

time taken Per one Revolution = $\frac{1}{N/60} = 60/N$

Now emf generate Per conductor = $\frac{d\phi}{dt}$

$$\Rightarrow \frac{d\phi}{dt} = \frac{P\phi}{60/N} = \frac{P\phi N}{60}$$

* For A Parallel Path the total number of conductor is Z.

* The number of conductor Per Parallel Path = $\frac{Z}{A}$

Emf generated Per Path $E_g = \frac{\phi PN}{60} \times \frac{Z}{A}$

$$\boxed{E_g = \frac{P\phi ZN}{60A}}$$

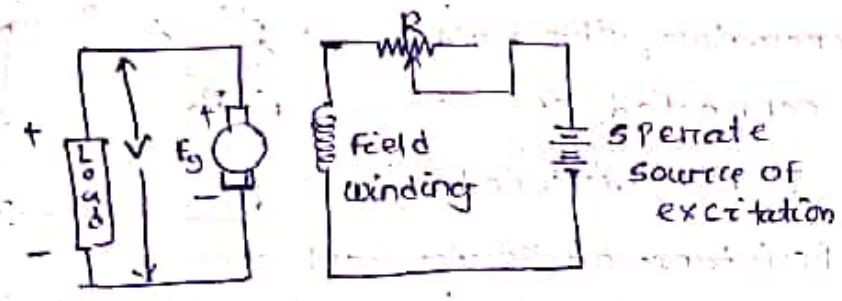
Explain types of Generators :

DC Generator has two type.

(1) Separately Excited dc Generator

(2) self excited dc Generator

Separately excited generator :- In these generator the field magnets are energized from an independent external source of direct current.

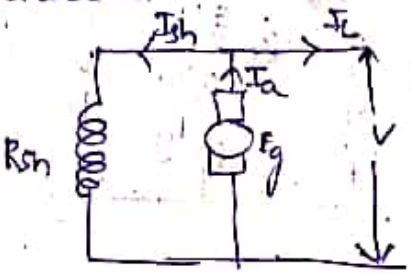


Self excited DC generator : These generators supply their own field current to their field magnets, so that no external source of dc Power is Required.

* It has 3 types
  * DC Shunt Generator
  * DC Series Generator
  * DC compound Generator

* DC shunt Generator : In this Generator the field winding is connected in Parallel with the armature winding so that the terminal voltage of the generator is applied across it.

* I_a = Armature current
  I_{sh} = Shunt field current
  I_L = Load current
  R_a = Armature Resistance



R_{sh} = Shunt field Resistance.

E_g = Generated emf

V = Load or Temcinal Voltage.

$I_a = I_L + I_{sh}$

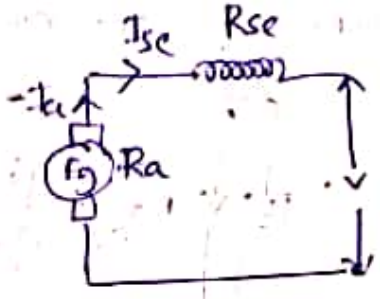
$I_{sh} = \frac{V}{R_{sh}}$

$V = E_g - I_a R_a$

input Power $P_{in} = E_g I_a$

output Power $P_o = V \cdot I_L$

DC Series Generator



* In this generator, the field winding is connected in series with armature winding.

R_{se} = Resistance of series field winding

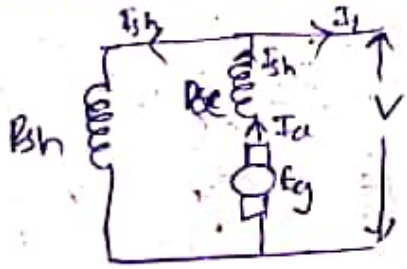
I_{se} = current in series field winding

* $I_a = I_L = I_{se}$
* $V = E_g - I_a R_a - I_{se} \cdot R_{se}$
* $P_{in} = E_g I_a$
* $P_o = V \cdot I_L$

DC compound Generator: In compound generator, there are two sets of field windings i.e both series and shunt field windings on each pole. It has two types (a) Long shunt and (b) Short shunt.

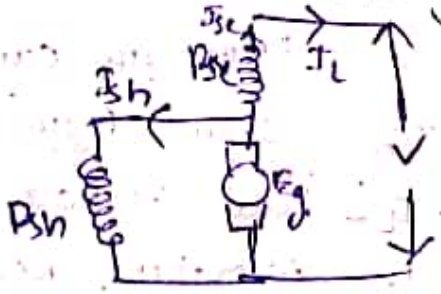
Long shunt

* In this generator shunt field winding is in parallel with both series and armature winding



Short shunt

* In this generator shunt field winding is in parallel with armature winding only



Basic Electrical Engineering

2marks questions & Answer

(1) State ohm's Law.

(ANS) * Ohm's Law states that the electric current (I) flowing in an circuit is Proportional to the voltage (V) and Inversely Proportional to the Resistance (R).

* Mathematically,

$$V \propto I$$

$$V = IR$$

$$\frac{V}{I} = R \quad \text{(where 'R' is constant)}$$

(2) Define KCL & KVL.

(ANS) KCL

* KCL Means Kirchhoff's current law.
* This Law States that the algebraic sum of currents meeting at a Point in an electric circuit is always zero.
* $\Sigma I = 0$
* This Law supports the Law of conservation of charge.

KVL

* KVL Means Kirchhoff's Voltage Law.
* This Law States that the algebraic sum of Voltage around a closed Loop Must be zero.
* $\Sigma V = 0$
* This Law supports the Law of conservation of energy.

③ Define current, Voltage and Resistance.

(ANS) **current** :

* It is defined as the Rate OF Flow OF electric charge Through any cross-section of a conductor.
* It is denoted by I. Its unit is Ampere.
* $I = \frac{\text{Total charge Flowing } (q)}{\text{Time taken } (t)}$

$$\boxed{I = \frac{q}{t}}$$

Voltage

* Voltage is the difference in electric Potential between two Point.
* The difference in electric Potential between two Points in a Static electric field is defined as The work needed Per unit of charge to move a test charge between the two Points.
* It is denoted by V. Its unit is Volt.
* $V = \frac{\text{work or energy}}{\text{charge}}$
* $\boxed{V = \frac{W}{Q}}$

Resistance

* Resistance is a measure of opposition to current flow in an electric circuit.
* It is denoted by R. It's measured in ohms (Ω).

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

(4) Define Power and energy.

(ANS) **Power** :- Electric Power is defined as Rate of doing electrical work.

* Electric Power is the Rate, Per unit time at which electrical energy is transferred by an electric circuit.
* It is denoted by P. unit of Power is watt.
* $P = \frac{W}{t}$ (Joule/sec)

$P = VI$
$P = V^2/R$
$P = I^2R$

Energy

* The energy which is caused by the movement of the electrons from one place to another such type of energy is called electrical energy.
* Electrical energy is the work done by the moving streams of the electrons or charge.
* It is denoted by E. Its unit is Joule or watt-second.
* Electric Energy (E) = Electrical Power x time

$E = VIt$
$E = I^2Rt$
$E = \frac{V^2t}{R}$

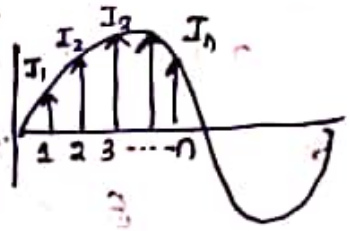
(5) Define Rms value of an AC.

(ANS) Root mean square (Rms) Value of an Alternating current is the value of direct current which Produces in the same conductor the same amount of heat in the same time.

* $I_{Rms} = \frac{I_m}{\sqrt{2}} = 0.707 I_m$ where I_m = maximum value of current
* $V_{Rms} = \frac{V_m}{\sqrt{2}} = 0.707 V_m$ V_m = maximum value of voltage

⑥ Define Average Value.

(ANS) The Average of all the instantaneous value of an alternating voltage and current over one complete cycle is called Average value.



* $$I_{av} = \frac{I_1 + I_2 + I_3 \cdots + I_n}{n}$$

$$I_{av} = \frac{\text{Area of alternation}}{\text{base}}$$

⑦ Define Power factor. ($\cos\phi$).

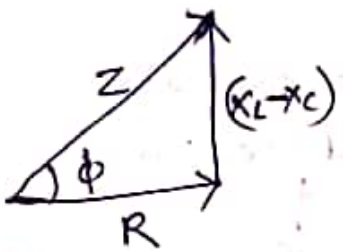
(ANS) Power factor may be defined as:

1. cosine of angle between voltage and current
2. The Ratio $\frac{\text{Resistance}}{\text{Impedance}}$
3. The Ratio $\frac{\text{Real Power}}{\text{Apparent power.}}$

⑧ Define Impedance Triangle.

(ANS) Impedance triangle is used to calculate Impedance.

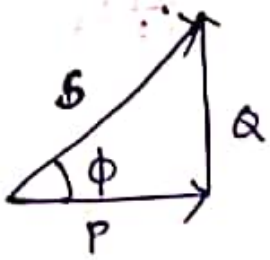
* When Resistance (R), inductance (L) and capacitance (C) are all present in the circuit, and the total Reactance (X) is the difference between the Inductive Reactance (X_L) and capacitive Reactance (X_C)



for RLC CKt, $Z = \sqrt{R^2 + (X_L - X_C)^2}$

(9) Define Power triangle.

(ANS)* Power triangle is the Representation of a right angle triangle showing the Relation between active Power, Reactive Power and apparent Power.



P = active Power (watt)

Q = Reactive Power (VAR)

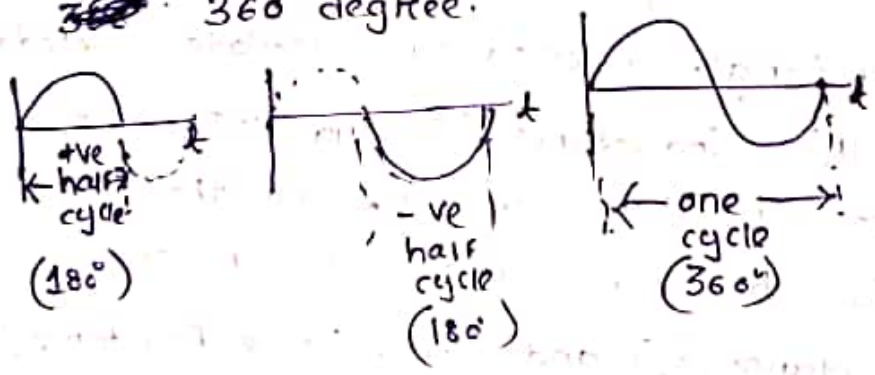
S = apparent Power (VA)

$$S = \sqrt{P^2 + Q^2}$$

(10) Define cycle and time Period.

(ANS) cycle :-

* when a waveform reaches a complete set of positive and negative value it is called one cycle.
* one cycle is corresponding to angular Measure of 360 degree.



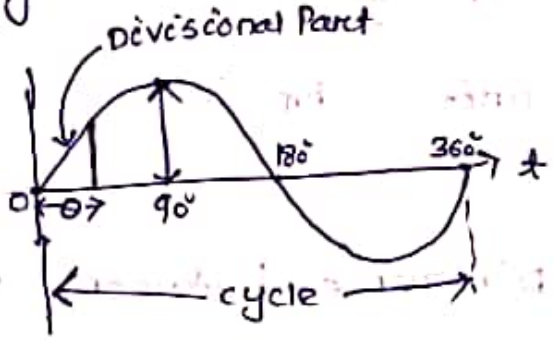
Time Period :-

* The Time Require to Produce one complete cycle is called time Period of the wave.
* It is denoted by T. unit - second.
* $\boxed{T = \frac{1}{F}}$ F = frequency.

(11) Define Phase angle and Phase difference.

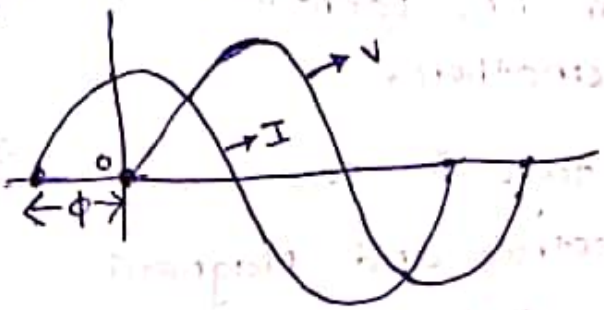
(Ans) The Phase of an alternating quantity is defined as the divisional Part of a cycle through which the quantity moves forward from a selected origin.

* When the two quantity have the same frequency and their Maximum and minimum Point achieve at the same Point, then the quantity are said to have in the same Phase.
* Phase angle denoted by θ.



Phase difference :-

* The two alternating quantity have phase difference when they have the same frequency, but they attain their zero value at the different instant.
* The angle between zero Points of two alternating quantity is called angle of Phase difference.



* Phase difference of angle ϕ.

(12) Define frequency.

(Ans) * It is defined as the number of cycle complete in one second.
* Let 1 cycle complete in T seconds
so $\frac{1}{T}$ cycle complete in 1 second

$$\boxed{F = \frac{1}{T}}$$

unit = Hz or sec^{-1}

F = 50Hz

(18)

(13) Deffarence between Resistance and Impedance.

(Ans)

Resistance	Impedance
* Resistance is the opposition of electrical current flow in DC circuit.	* Impedance is the opposition of electrical current flow in a AC circuit.
* $R = \frac{V}{I}$	* $Z = \frac{V}{I}$
* unit = ohm (Ω)	* unit = ohm (Ω)

(14) Difference between voltage and emf.

(Ans)

Voltage or Potential difference	emf
* Voltage is the energy use by one coulomb of charge to move from one point to another.	* The emf (electro motive force) is the measure of energy supply to each coulomb of charge.
* Voltage is caused by the electric and Magnetic field	* Emf is generated by the electrochemical cell, dynamo meter, Photodiode etc.
* It is denoted as V. Unit is Volt.	* It is denoted as E. Unit is Volt.

(15) Write emf equation of Generator.

(ANS) The emf equation of Generator is given by

$$E_g = \frac{P\phi ZN}{60A} \text{ volts}$$

Where E_g = generated emf

P = Number of Pole

ϕ = Flux Per Pole

Z = Total number of conductor

A = Number of Parallel Path

$A = P$ in case of Lap winding

$A = 2$ in case of wave winding

(16) Write Principle of Generator.

(ANS) * Working Principle of dc generator is based on Faraday's Law of electromagnetic induction

* when a conductor is Rotated in a magnetic field, an emf is induced in it.

* This induced emf is known as dynamically induced emf and its direction is determined by Fleming's Right hand Rule.

(17) Write Principle of Motor.

(ANS) Working Principle of Dc motor is based upon. When a current carrying conductor is Placed in a magnetic field, mechanical force acts on it.

* This force is given by $F = BIL$ Newtons

Where F = Force, B = Magnetic field, I = current, L = length of the conductor

* Direction of Rotation is determined by Fleming's left hand

(18) Define back emf.

(ANS) The Rotating conductors in a motor armature cut the Flux from the Poles, so an emf is developed in them.

* By Lenz's Law this emf opposes the applied emF, it is known as Back emF (E_b).

* $E_b = \frac{P\phi ZN}{60A}$ volts

(19) classify Generator.

(ANS) DC Generator has two types

(1) Separately excited DC generator

(2) Self excited DC Generator

* Self excited dc Generator 3 types (1) shunt Generator
(2) Series Generator
(3) compound Generator

(20) Write main Parts of DC Generator.

(ANS) DC Generator main Parts are :-

Yoke, Pole core, Pole shoe, field coils, Armature, Armature windings, commutator, Brushes, Bearing, shaft.

(21) Classify DC motor.

(ANS) DC motor has 3 types

(1) Permanent Magnet DC Motor

(2) Separately Excited dc motor

(3) Self excited dc motor → shunt motor
→ Series motor
→ compound motor.

(22) Write types of wiring.

(Ans) There are following types of wiring systems

(1) cleat wiring system

(2) T.R.S wiring system or Batten wiring system

(3) Metal sheathed wiring system

(4) casing and capping wiring system

(5) conduit wiring system.

conduit wiring system has two types

(a) Surface conduit wiring system

(b) concealed conduit wiring system

(23) Write Protective Device and its use.

(Ans) A device used to Protect equipment, machinery, components and devices, in electrical and electronics circuit, against short circuit over current and earth fault is called Protective Device.

Necessity of Protective Device

Protective devices are necessary to Protect electrical appliance or equipment against

(a) short circuit

(b) Abonormal variations in the supply voltage

(c) overdapping of equipment.

(d) To Protect operator against accidental contact with the faulty equipment.

Types of Protective device :

Different types of the Protective device that are used in electrical and electronic circuit :-

(1) fuse wire or fuse

(2) MCB - Miniature circuit breaker

(3) ELCB - Earth leakage circuit breaker

(4) ELCB & MCB

(5) Earthing or grounding.

(1) Fuse :-

* fuse generally means a fuse wire, placed in a fuse holder.
* It is a safety device, which Protects electrical and electronics circuit against over loads, short circuit and earth Faults.
* It is always connected in series with the circuit.
* when the current drawn by the circuit exceeds the Rated current of the fuse wire, the fuse wire melts and break. This disconnects the supply from the circuit and Thus Protects the circuit and the components in the circuit.

characteristics of a good fuse wire :

(a) Low melting Point

(b) Low Resistivity

(c) Low conductivity of the metal vapours formed when the fuse is blown off.

(2) MCB (Miniature circuit breaker)

* It is safety device which work magneto thermic Relase Principle.
* It is connected in the phase between the supply and load.
* when the current drawn by the load exceeds the Rated value, its acts and trips the circuit, the Protecting the apparatus, operator and appliance.

Advantage of MCB :

* They act and open the circuit in less than 5 millisecond
* Automatic switch off under overload and short circuit condition.
* No fuse to Replace or Rewire. It needs no Repairs
* Supply is Restored by resetting it again.

(3) ELCB (Earth Leakage circuit breaker)

* This is a domestic safety device, which trips the circuit when there is a small leakage to earth or body of the appliance.
* Thus it Protects the Operator from shocks and accidents.
* There are two types of ELCB
  1. Voltage Earth Leakage circuit breaker
  2. current Earth Leakage circuit breaker

(4) MCB & ELCB :

* It is the combination of both MCB and ELCB Placed in one unit.
* It acts on both the occasion of earth leakage and overload and Protects the circuit, appliance and the operator.

⑤ Earthing or Grounding :

* connecting the metal body for an electrical appliance, machinery or an electrical installation to earth, through a low Resistance wire, is called Earthing or Grounding

imp **Necessity of Earthing :-**

* Earting is necessary for all domestic, commercial and industrial installation to safeguard the operator, tall buildings and machinery against Lightning.

* Metal body of the electrical appliances, equipment and machinery, the earth points of all three-pin sockets and the body of the energy meter are connected to earth through a thick G.I wire.

* Whenever a Live wire comes in contacts with the body of the appliance, it is directly connected to earth the grounding wire and hence the body voltage comes to zero. Therefore the operator does not get any shock, when he comes in contact with body of the appliance.

* The high voltage included during Lightning is discharges to earth through groundingwire and Thereby building and Machinery are Protected

(24) Define Lumen.

(ANS) It is the unit of Luminous Flux.

* Lumen is defined as the luminous flux emitted per unit solid angle from a point source of one candle power.

* Lumens = candle power x solid angle.

(25) Write Different types of lamps.

(ANS) The different types of Lamps include:

* Incandescent lamps
* Fluorescent lamps
* Mercury Vapour lamps.
* High Pressure sodium Vapour lamps.
* Low Pressure sodium Vapour lamps.
* Tungsten Halogen Lamps.
* LED Lamps.

(26) Write uses of P.M.M.C.

(ANS) * PMMC stands for Permanent Magnet Moving coil instruments.

* They are useful for measuring DC voltage and current.
* If coupled with Rectifier circuits, they can be used for measuring AC voltage and current.
* They possess high sensitivity as they have high operating torque.

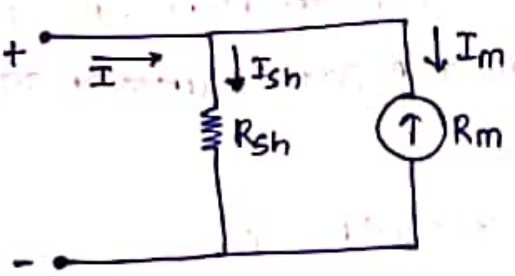
(27) Write uses of M.I.

(ANS) M.I stands for moving iron instruments.

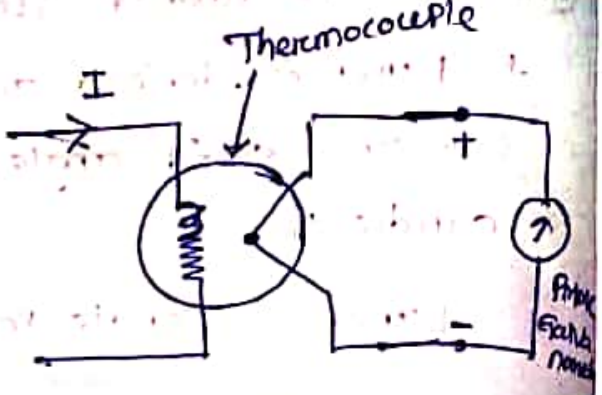
* M.I instruments are generally used to measure alternating voltages and currents

(28) Draw connection diagram of AC/DC Ammeter and Voltmeter.

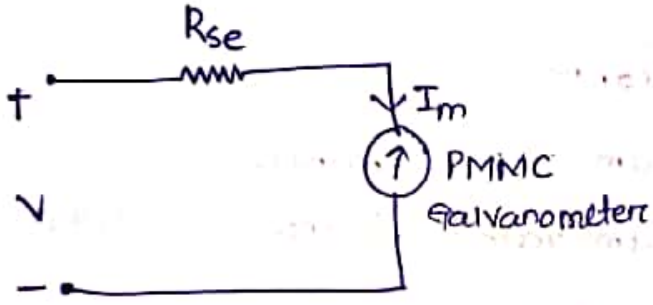
(Ans)



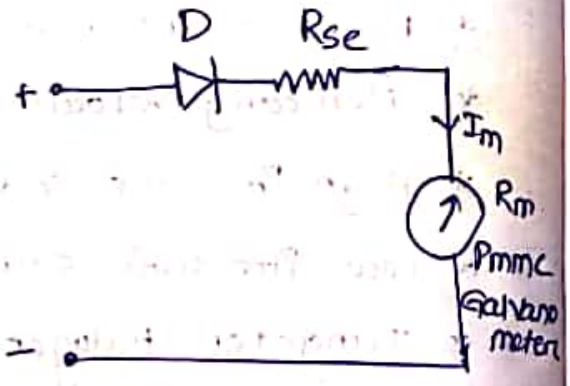
[Basic DC Ammeter]



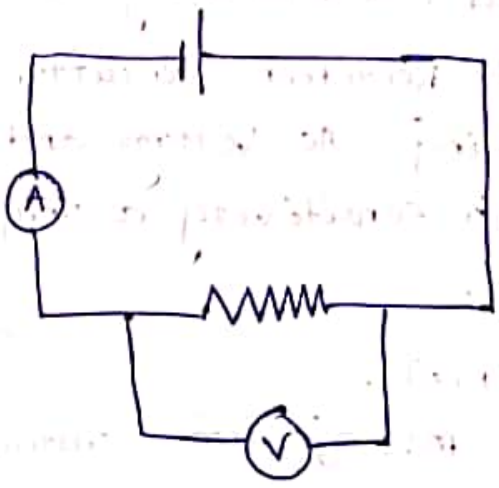
[Ac Ammeter]



[DC Voltmeter]



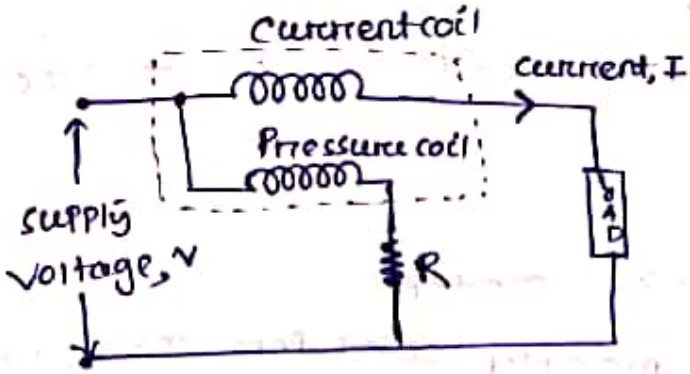
[Ac voltmeter]



[Ammeter & Voltmeter connection]

(29) Draw connection diagram of wattmeter and energy meter.

(ANS)



[Wattmeter connection]

(30) Write uses of shunt motor.

(ANS) DC shunt motor are constant speed motors, hence used in applications Requiring constant speed.

* It used in

Lathe machine, Drilling machine, Grinders, Blowers, compressors, Fan, Centrifugal Pumps.

(31) Write uses of shunt Generator.

(ANS) * DC shunt Generator are used for general lighting

* They are used to charge battery because they can be made to give constant output voltage.

* They are also used for small Power supply.

(32) Write uses of series Generator.

(ANS) DC series Generator are used for supplying field excitation current in DC Locomotives for Regenerative braking.

* DC Series generator are used as boosters to compensate the voltage drop, Railway service.
* DC series generator are used in series are Lightening.

(33) Write uses of series motor.

(ANS) DC series motor mostly used for Industrial applications Like hoists, cranes, trolley cars, conveyors, elevators, air compressors, Vacuum cleaners, sewing machine etc.

(34) Write uses of compound Generator.

(ANS) * cumulative compound wound generator are generally used for Lighting, Power supply.
* cumulative compound wound generator are also used for driving a motor.
* for small distance operation, such as Power supply for hotels, office, homes and Lodges, the Flat compounded generators are generally used.

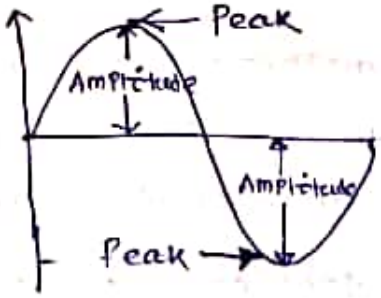
(35) Write uses of compound Motor.

(ANS) cumulative compound motors are used for Elevators, Rolling mills, Punches, Sheares, Planers.

(36) Define Amplitude of alternating cycle.

(ANS) * Amplitude is the maximum value of current or voltage of an ac.

*



* It is also known as Peak value or maximum value and can be either positive or negative.

(37) Define Peak Factor.

(ANS) Peak factor is defined as the Ratio of maximum value to the R.m.s value of an alternating quantity

$$\text{Peak factor} = \frac{\text{Maximum value}}{\text{R.m.s value}} = \frac{I_m}{I_{RMS}} = \frac{V_m}{V_{rms}}$$

$$\text{Peak factor} = \frac{I_m}{I_m/\sqrt{2}} = \sqrt{2} = 1.4142 \quad \text{(ANS)}$$

(38) Define form factor.

(ANS) Form factor is defined as the Ratio of R.m.s value to the average value of an alternating quantity.

$$\text{Form factor} = \frac{\text{Rms value}}{\text{Average value}} = \frac{I_{Rms}}{I_{av}} \text{ or } \frac{V_{Rms}}{V_{av}}$$

$$= \frac{I_m/\sqrt{2}}{2I_m/\pi} = \frac{\pi I_m}{2\sqrt{2} I_m} = 1.11 \quad \text{(ANS)}$$

(39) What is earthing? why it is used?

(Ans) * Earthing is used to Protect you From an electric shock.

* The Primary Purpose of earthing is to Reduce the risk of serious electric shock from current leaking into uninsulated metal Parts of an appliance, Power tool or other electrical devices.

(40) State Fleming's Right hand Rule?

(Ans) * Fleming's Right hand Rule states to hold the forefinger, middle finger and Thumb of Right hand Mutually Perpendicular to each other so that the fore finger points in the direction of Magnetic field, and Thumb Points in the direction of motion of the conductor and Middle finger is pointed gives the direction of induced current in the conductor.

* Generator Principle depends on Fleming's Right hand Rule.

(41) state fleming's Left hand Rule?

(Ans) * fleming's Left hand Rule states that if we stretch the thumb, the forefinger and the middle finger of our left hand such that they are mutually Perpendicular to each other.

If the forefinger gives the direction of current and middle finger points in the direction of magnetic field then thumb points towards the direction of the force or motion of the conductor.

* Motor Principle depends on Fleming Left hand Rule.

(42) What is the function of boiler in thermal Power plant ?

(ANS) Boilers are used in Plants in order to Produce high Pressure steam, so that Plant can generate electricity.

* The Boiler takes in energy from some Form of fuel such as coal to heat water into steam.

(43) What is Function of brush in a DC Generator.

(ANS) carbon brushes are normally used in dc generator to collect the generated Power from Rotating armature.

* The brushes will make contact with commutator and transfer it to external load.

(44) What is the function of commutator in a DC Generator?

(ANS) Commutator converts alternating current Produced in armature conductors to a unidirectional current in the external load circuit.

* It acts as Mechanical Rectifier.

(45) Define 'star Rating concept.

(Ans) * Star Rating is Provided for customer awareness by BEE (Bureau of Energy efficiency).

* Star Ratings are developed to help buyers to compare energy efficiency of different models that Perform a similar task.

* For most Products, the standard Star Rating system is minimum 1 star and Maximum 5.

* It is the Rating that accutally help you in Saving your bills.

* The higher the number of stars, the more efficient it is.

ex: A 5 star air conditioner 5 will cool your Room in the most efficient manner. To elucidate, the Rating means that a 5-star AC will cool a Particular Room faster, while using lesser electricity than a 3-star AC.

(46) Define energy efficiency.

(Ans) Energy efficiency simply means using less energy to Perform the same task - that is, eliminating energy waste.

* energy efficiency brings a variety of benefits: Reducing greenhouse gas emissions, Reducing demand for energy import, Lowering our costs and economy wide le

(47) Define Transformer and its application

(ANS) A Transformer is a static device which transfers electrical energy from one circuit to another throug the Process of electromagnetic induction.

* It is most commonly used to increase or decrease voltage levels between circuits.
* Transformers used for isolate two circuits electrically.
* The Transformer used in Voltmeter, ammeters, Protective Relay etc.

(48) Write the uses of 1-ϕ induction motor.

(ANS) 1-ϕ induction motor uses in Pumps, compressors, small fans, mixer, toys, Electric shavers, High speed Vacuum cleaner, Drilling machines.

(49) Write the uses of 3-ϕ induction motor.

(ANS) 3-ϕ induction motor uses in Electric Train engine, cooling fans used to cool Large machine like alternators etc, chimneys at Power Plant, Printing machines, Rolling mills.

(50) Write two difference between AC & DC.

AC	DC
* Direction Vary.	* Direction Remain same.
* Frequency 50Hz.	* Frequency 0
* Efficiency High.	* Efficiency low.
* Easy to measure.	* Easily amplify

Basic Electrical Engineering (Th 4(a))

2 marks question

(1) State ohm's Law.
(2) Define KCL & KVL.
(3) Define current, Voltage and Resistance.
(4) Define Power and Energy.
(5) Define Rms Value.
(6) Define Average Value.
(7) Define Power factor.
(8) Define Impedance Triangle.
(9) Define Power Triangle.
(10) Define cycle and Time Period.
(11) Define Phase angle & Phase difference.
(12) Define Frequency.
(13) Define Impedance and Resistance.
(14) Define Voltage and emf.
(15) Write emf equation of generator.
(16) Write Principle of Generator.
(17) Write Principle of Motor.
(18) Define Back emf.
(19) Classify Generator.
(20) Write Main Parts of Dc machine.
(21) classify Dc Motor.
(22) Write types of Wiring.
(23) Write Protective Device and its use.
(24) Define Lumen.
(25) Write Different type of Lamps.
(26) Write uses of PMMC.
(27) Write uses of M.I
(28) Draw connection diagram of AC/DC Ammeter & Voltmeter.

(29) Draw connection diagram of wattmeter and energy meter.

(30) Write uses of shunt motor.

(31) Write uses of shunt Generator.

(32) Write uses of series Generator

(33) Write uses of series Motor.

(34) Write uses of compound Generator.

(35) Write uses of compound Motor.

(36) Define Amplitude of alternating cycle.

(37) Define Peak factor.

(38) Define form factor.

(39) What is earthing ? why it is used ?

(40) State Fleming's Right hand Rule.

(41) State Fleming's left hand Rule.

(42) What is the function of boiler in Thermal Power Plant ?

(43) What is the function of brush in a DC Generator

(44) What is the function of Commutator in a DC Generator

(45) Define star Rating concept.

(46) Define Energy efficiency.

(47) Define Transformer and its application

(48) Write uses of 1-ϕ induction motor.

(49) Write used of 3-ϕ induction motor.

(50) Write two difference between AC & DC.

— * —

Long question

5 Marks / 10 Marks

(1) Explain Generation of an Alternating Emf.
(2) Explain Power triangle and Impedance Triangle.
(3) Derive expression for voltage and current of a RLC series circuit.
(4) Derive RMS value and Average value.
(5) Explain types of wiring.
(6) Explain KCL & KVL.
(7) Explain working Principle of PMMC type of instrument.
(8) Explain working Principle of MI type of Instrument.
(9) Explain Principle of DC Generator.
(10) Explain Main Parts of DC Machine.
(11) Explain Difference between AC & DC.
(12) Classify types of DC Generator.
(13) Derive emf equation of DC Generator.
(14) Explain Different torque act in an instrument.
(15) Explain working Principle of Thermal Power Plant.
(16) Explain working Principle of Hydro Power Plant.
(17) Explain working Principle of Nuclear Power Plant.
(18) Derive Expression for voltage and current of RL, RC series CKt with Phasor diagram
(19) Write construction and Principle of Fluorescent lamp and Filament Lamp.
(20) Write construction and Principle of Sodium Vapour Lamp and Led bulb.