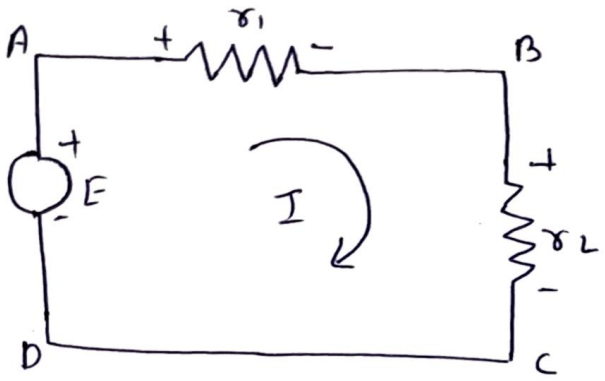
# Electrical engineering. - 2018

## Short answer type question.

1. Explain the voltage division rule?

The voltage division rule can be considering a series circuit show below. In a series circuit, voltage is divide, where the current remain the same.




let us consider a voltage source E with the resistance $r_1$ & $r_2$ connected in series across it

$I = V/R$ or $I = E/R$

the current loop ABCD will be

$$i = \frac{E}{r_1 + r_2} \quad \text{.....} (1)$$

& $r_1 = Ir_1$

By putting the value of I from equation (1) to (11) the voltage across the resistance $r_1$ & $r_2$ respectively are given the equation.

$$E_1 = \frac{Er_1}{r_1 + r_2} \quad \& \quad E_2 = \frac{Er_2}{r_1 + r_2}.$$

2(a) Drive the equation of DC. Machine.

Derivation of equation of DC Machine.

let.

In one revolution of armature, the flux cut by one conductor is given as.

Flux cut by one conductor = $P\phi$ — (1)

time taken $t = \frac{60}{N}$ — (2)

the average induced emf in one conductor.

$$e = \frac{P\phi}{t} \quad — (3)$$

Putting the value of (t) from eq. (2) in the eq (3).

$$e = \frac{P\phi}{60/N} = \frac{P\phi N}{60} \text{ volts.} \quad — (4)$$

$$E = \frac{P\phi N}{60} \times \frac{Z}{A} = \frac{PZ\phi N}{60A} \text{ V.}$$

$$E = \frac{PZ\phi n}{60} \quad — (5)$$

Speed in, revolution per second.

$$n = \frac{N}{60}$$

The number of pole and the number of conductor per parallel path (Z/A) are constant. Hence eq. (5) can be written as.

$$E = K\phi n.$$

K is a constant and given as

$$K = \frac{PZ}{A}.$$

The average induced emf eq. can also be written as.

$$E \propto \phi n$$

$$E = K_1 \phi N$$

$K_1$ is constant hence induced emf eq.

$$E \propto \phi N$$

$$E \propto \phi \omega$$

angular velocity in radian/second.

$$\omega = \frac{2\pi N}{60}$$

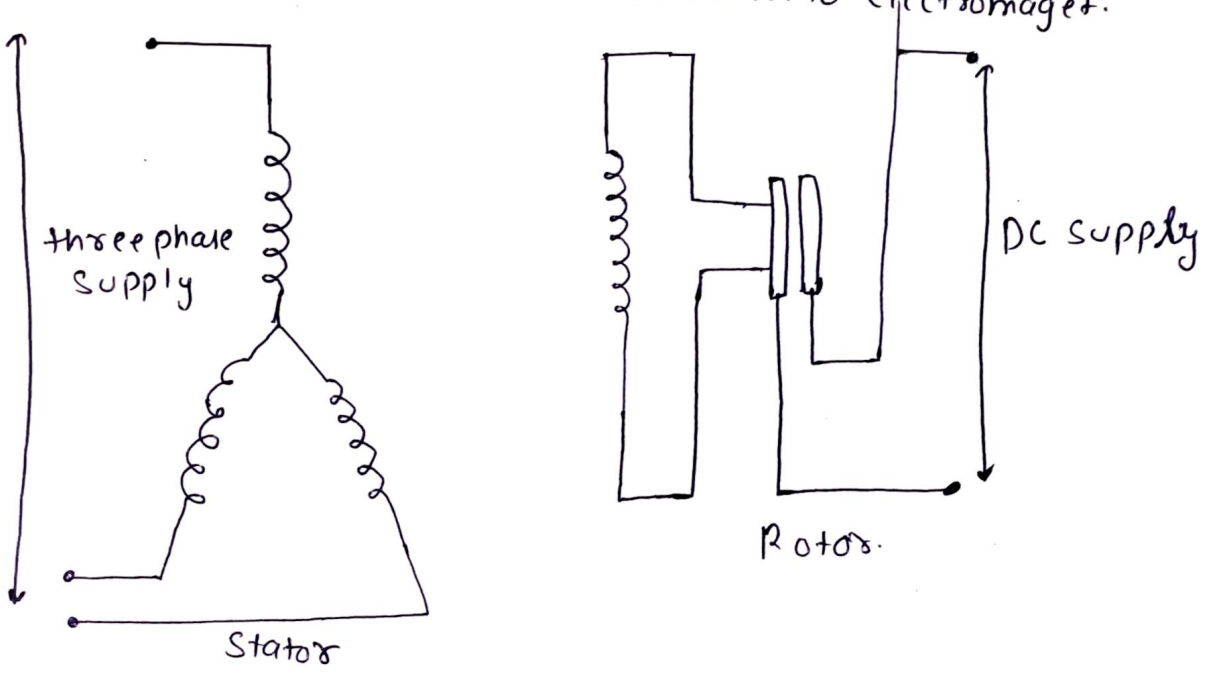
DC machine is working as a generator.

$$E_g = \frac{PZ\phi N}{60A} \text{ V.}$$

3. Explain the working principle of synchronous motor.

The Stator and rotor are two main part of the synchronous motor. The stator is the stationary part of the motor. and their rotating part. The stator is excited by the three-phase supply and the rotor is excited by the DC supply.

The term excitation means the magnetic field induces in the stator and rotar of the motor. The main aim of the excitation is to convert the stator and rotor in to electromaget.

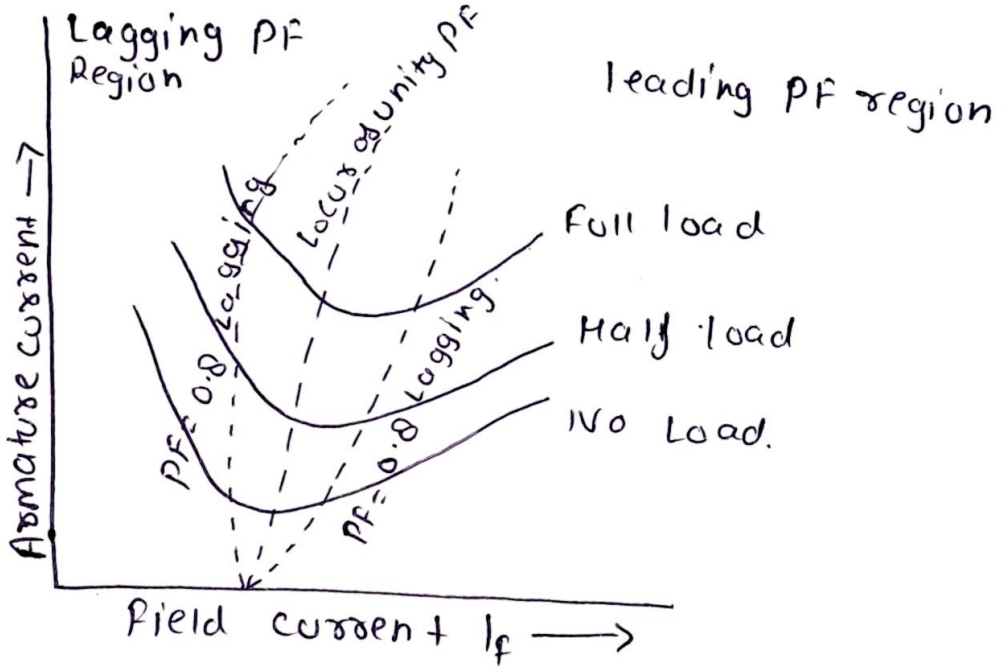



Three-phase supply induces the north and south poles on the sator the three phase supply is sinusoidal. The polarity of their wave change after very half circle and because of this reason the north & South pole also varies, Thus, we can say that the rotating magnetic field develops on the stator.

4. Explain the speed torque characteristic of synchronous motor Explain the V-curve.

The speed of the motor is decided by the number of pole & frequency. Compare to an Induction motor. it is very Sensitive to sudden changes of load. This cause a hunting of the rotor and finally leads to stability problem. it has no starting tourge and requires starting equipment to bring it to its rate speed. when i't is running at its speed the field excited. The damper winding on the field poles help in damping the hunting and providing the starting torque. The motor can be operated at different power factor. by changing the excitation.

The V curve of Synchronous motor are :—



6 (iii) Explain the following.

(iii) Eddy current loss.

When an alternating magnetic field is applied to a magnetic material, an emf is induced in the material itself according to faraday's law of electromagetic induction. Since the magnetic material is a conducting material, these EMF circulate current within the body of the material.

The circulating current are called eddy current. They will occur when the conductor experiences a changing magnetic field.

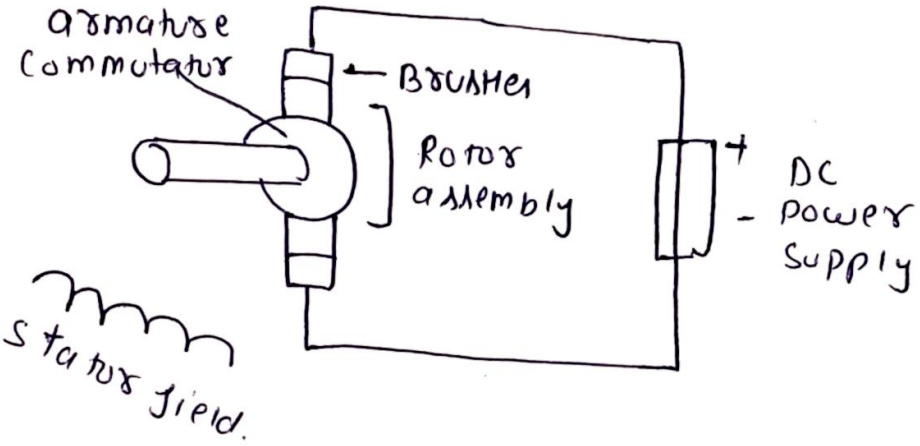
As these current are not responsible for doing any useful work, and it produced a loss ($I^2R$ loss) in the magetic material known as an eddy current loss. eddy current loss also increase the temperature of the magnetic material.

The hysteris and the eddy current loss in magnetic material are also known by the name iron loss or core loses or magnetic losses

A sectional view of the magnetic core [redacted]. when the charging flux links with the core itself it induced emf in the core which in turns sets up the circulating current edely current. and these current in return produces a loss called eddy current loss.

(IV) Series motor.

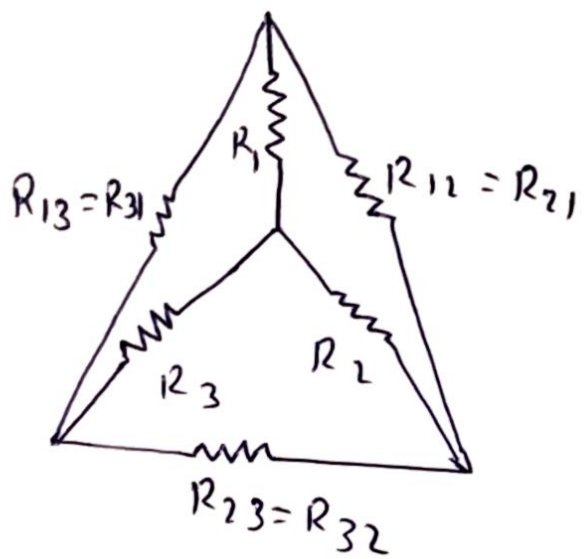
A Series motor like in the case of shunt wound motor or compound wound DC motor fall under the category of self excited DC motor and its gets it name from the fact that the field winding in the case is connected intenally in series to the amature winding. Thus the field winding and expose to the entire armature current unlike in the case of shunt motor.




A Serise motor is a direct current motor with two winding that are connected in serise, meaning the same current flow through each wing. Serise motor are used when a machine need a heavy power demand to get up to Speed such as in hoists and elevators.

6. Explain delta to star conversion.

Any resistance of the star circuit is equal to the product of to object delta resistance divided by the sum of the delta resistance.




$$R_1 = \frac{R_{12} \cdot R_{12}}{R_{13} + R_{12} + R_{23}}$$

$$R_2 = \frac{R_{12} \cdot R_{23}}{R_{13} + R_{12} + R_{23}}$$

$$R_3 = \frac{R_{12} \cdot R_{23}}{R_{13} + R_{12} + R_3}$$

the equivolent impendance of each arm of the star is given by the product of the impendance of the two delta side that meet its ends divide by the sum.

(7) What is reluctance and relative permeability.

## Relative permeability.

- Relative permeability is the ratio of premeability of the substance to absolute premeability.
- The ratio of permeability of a substance to the premeability of the ~~vacuum~~ vacuum is known as relative permeability.

$$\mu_r = \frac{\mu}{\mu_0}.$$

where $\mu_r$ is the relative peremability, $\mu$ is the permeability of the substance, and $\mu_0$ is the permeability of the vacuum.

- the relative permeability is a dimensionless quantity.

## Reluctance permeability.

- The measure of opposition in the flow of magnetic flux offered by the magnetic material is known as reluctance permeability.
- Reluctance resistance the flow of magnetic flux through the material.
- Reluctance in magnetic circuit is analogous to resistance in electric circuit.

$$R = \frac{l}{\mu A}.$$

9. Drive the R.M.S value of Sinusoidal wave?

According to Joules law of heat production the heat evolved in a conductor is proportional to the current following through it square of current is always (+ve) wheather the current is (-ve) or (+ve)

AC always produce thred effect the mean squar root of $I^2$ in complete cycle is called itis root mean squar value. It is denoted by $I_{rms}$

The Ac is given by

$$I = I_0 \sin\omega t$$

$$I_{rms} = \sqrt{\int_0^T I^2 dt}$$

$$I^2_{rms} = \frac{1}{T}\int_0^T I_0^2 \sin^2\omega t\, dt$$

$$I^2_{rms} = \frac{I_0^2}{T}\frac{1}{2}\int_0^T 2\sin^2\omega t\, dt$$

$$I^2_{rms} = \frac{I_0^2}{2T}\left[t - \frac{\sin 2\omega t}{2\omega}\right]_0^t$$

$$I^2_{rms} = \frac{I_0^2}{2\times\frac{2\pi}{\omega}}\left[\frac{2\pi}{\omega} - \frac{\sin 2\omega - 2\pi}{2\omega}\right]$$

$$I^2_{rms} = \frac{\omega I_0^2}{4\pi}\left[\frac{2\pi}{\omega} - \frac{\sin 4\pi}{2\omega}\right]$$

$$I^2_{rms} = \frac{\omega I_0^2}{4\pi} \times \frac{2\pi}{\omega}$$

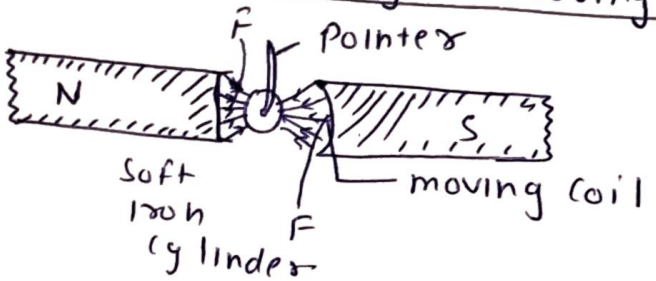
$$\boxed{I^2_{rms} = \frac{I_0^2}{2}}$$

$$\boxed{I_{rms} = \frac{I_0}{\sqrt{2}}} \qquad \boxed{I_{rms} = 0.707\, I_0}$$

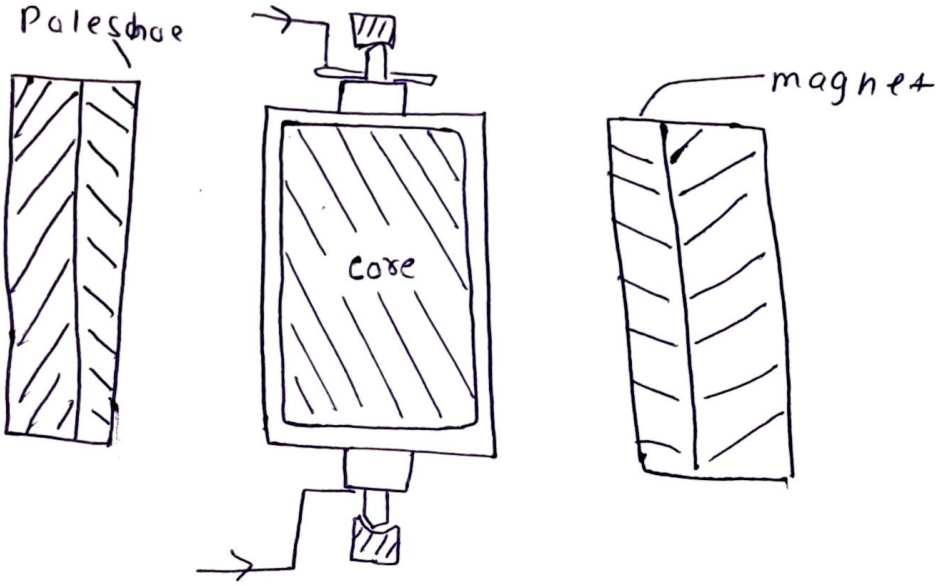
## Long Answer type question

(b) Explain the working of PMMC.

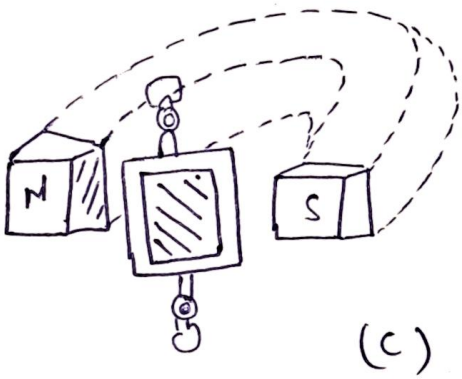
**A permanent magnet moving coil.**




(a)




(b)




(c)

A permanet magnet type moving coil instrument. It consists of permanet powerful magnet with soft iron pole pieces A cylindrical iron core is mounted between the two poles of the magnet giving very narrow air gap in which the sides of a pivoted light rectangular coil lies. The reactangle coil is wound of money turns from fine wire on light aluminium or copper former acts as moving element the purpose of using core is to make the field uniform to reduce the reluctance of the magnetic circuit. A four. reluctance help to retain permanence of the magnet for a longer period.

The current is led into out of the coil by mean of phasphor bronze hair spring provided to both ends.

Tourge. equation:-

When the current to be measured is passed through coil in direction a deflecting tourge is produced on account of the perment magnetic field with coil magnetic field.

The direction of deflecting. torque can be determined by applying fleming's left hand rule.

If 'i' is current in ampers flowing through the coil of turns 'N' length 'l' meter 'B' is flux density in teslas in air gap.

Then,

Deflection tourge $T = F \times \gamma = BilN\gamma N m$ from above expression it is obvious that if flux density B in the air gap in constant, then.

Deflecting torque, $Td \propto i$

since such instrument are spring controlled.

Controlling torque, $Tc \propto$ deflecting $\theta$ since in steady deflection of position

$$Tc = Td.$$

$$\theta \propto i$$

Since $\theta$ is directly proportional to current the scale marking of the basic dc PMMC instrument are usually linearly speed.

Ranges.

(I) DC Ammeter:-

0-5μA upto 20mA with internal shunts are 0-5,000

(II) DC Voltmeter:-

0-100mV without series resistance upto 20KV or 30KV with external serise resistance