Anurag Srivastava
1CR19EE009
Section - 3A (EEE).

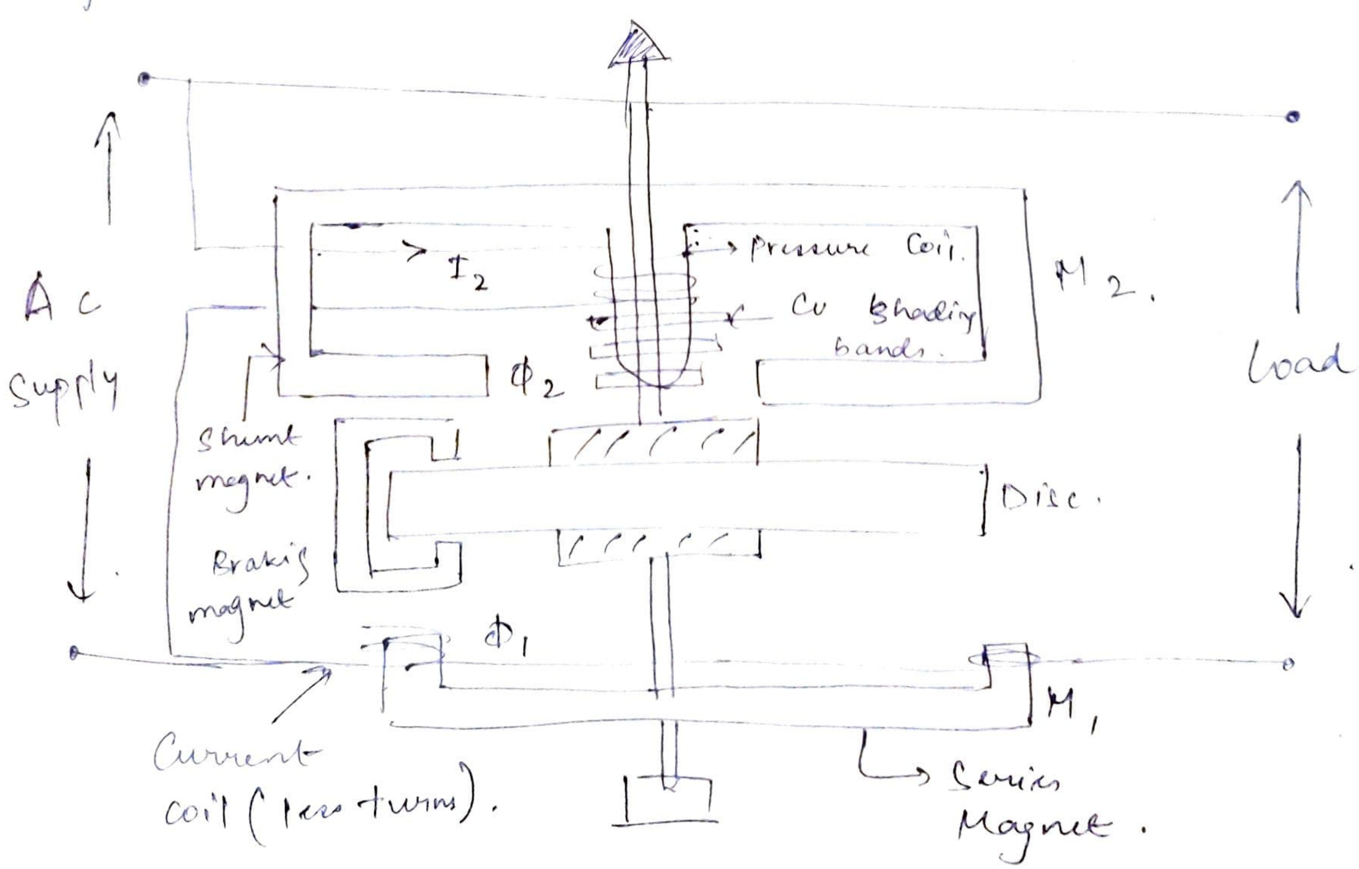
Q1. There are four main parts of operating mechanism (construction)

① Driving System:

~~It~~ It has two electromagnets whose core is made up of silicon steel laminations. The coil of one of the electromagnets called current coil is excited by load current which chooses flux further.

- The coil of another electromagnet is connected across the supply and it carries current proportional to supply voltage.

- These two magnets are called, series and shunt magnet respectively. The flux produced by shunt magnet is brought in exact quadrature with supply voltage with the help of copper shading bands whose position is adjustable.



2) Moving system:

Light aluminium disc mounted in a light alloy shaft is the main part of moving system. This disc is positioned between series and shunt magnets.

3) Braking System.

A permanent magnet is placed near the aluminium disc for braking mechanism. The position of this magnet is adjustable and hence braking torque is adjusted by shifting this magnet to different radial positions. This magnet is braking magnet.

4) Registering system:

It records continously a no. which is proportional to the revolutions made by the aluminium disc.

WORKING.

→ The pressure coil is carried by shunt magnet M_2 which is connected across the supply, it carries current proportional to the voltage.

→ series magnet M_1 carries current coil which carries load current. Both coils produce alternating flux, ϕ_1 and ϕ_2.

→ Turns are proportional to the currents in coils. Each flux of individuals are link with the disc and emf is induced in it.

→ From this emf, eddy currents are produced and induced in that disc. The eddy current of M_2 reacts with magnetic field produced by M_1 and eddy current of M_1 react with magnetic field produced by M_2.

→ The eddy current produced the torque and that experience a mech. force and disc rotates. The speed of disc is controlled by braking magnet. braking torque 'T_b' is directly proportional to the speed of disc.

Full load unity power factor Adjustment.

iii)

Adjustments.

* Prelimanary light load adjustment.

→ The disc is so positioned that the holes are not perfectly fitted with electromagnets. Rated voltage is applied to potential coil with no current in the current coil.

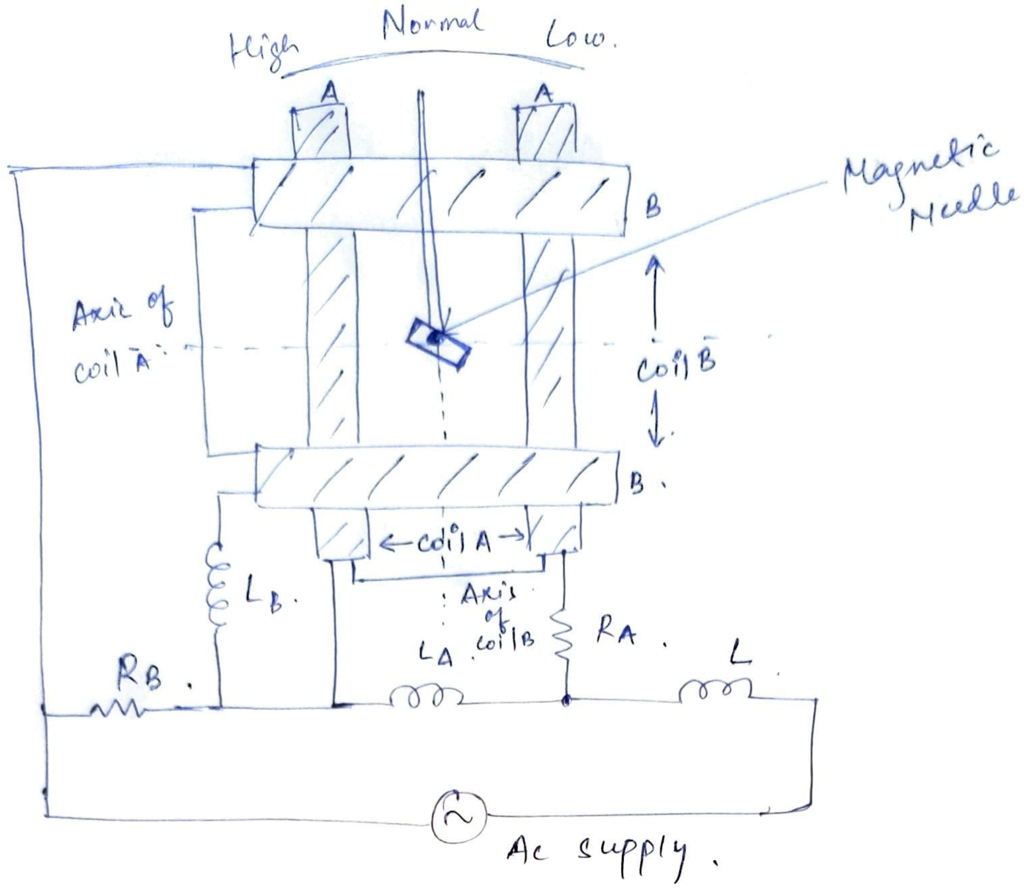
* Full load unity p.f adjustment.

→ The pressure coil is connected accross the rated supply voltage and the rated full load current at unity p.f is passed through the current coil.

* Creep Adjustment.

→ Without any current through current coil, disc rotates due to the supply voltage exciting its pressure coil. This is creeping. To eliminate this, two holes are drilled in ~~this~~ the disc 180° opposite to each other.

Q2.



Principle → When an current flows through the two coils which are perpendicular to each other, due to these currents some megnetic field will produce & thus the magnetic needle will deflect towards the stronger magnetic field showing the measurements of frequency in the meter.

→ It consists of two coils, three inductors, two resistors.

- The strength of field produced by the two coils depends on the magnitude of the current.
- At normal frequency, voltage drops across L_A and R_B and send equal current in A & B coil.
- At freq. more than normal value, Reactances of L_A and L_B increases for R_A and R_B as same

Voltage in coil A increases and current in coil B decreases.

strength of field produced by coil A is greater than the strength of field produced by coil B.

∴ deflection of pointer is to left.

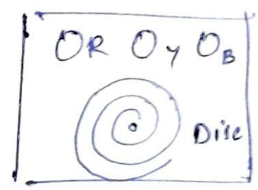
- At the freq. less than the normal freq. same way reverse pointer deflect to right.

Q5. Phase Sequence Indicator.

These instruments are used to determine the phase sequence of 3ϕ supplies. There are two types of phase sequence indicators:

(i) ~~Rot~~ Rotating Type (ii) Static Type.

Rotating Type:



The principle of working of these meters is similar to that of 3ϕ induction meters.

They consist of three coils mounted 120° apart in space. The three ends of the coils are brought out and connected to the three terminals marked RYB.

- The coils are star connected and are excited by the supply whose phase sequence is to be found.

→ The coils produce a ~~voltatig~~ rotating magnetic field and eddy emf's are induced in the disc.

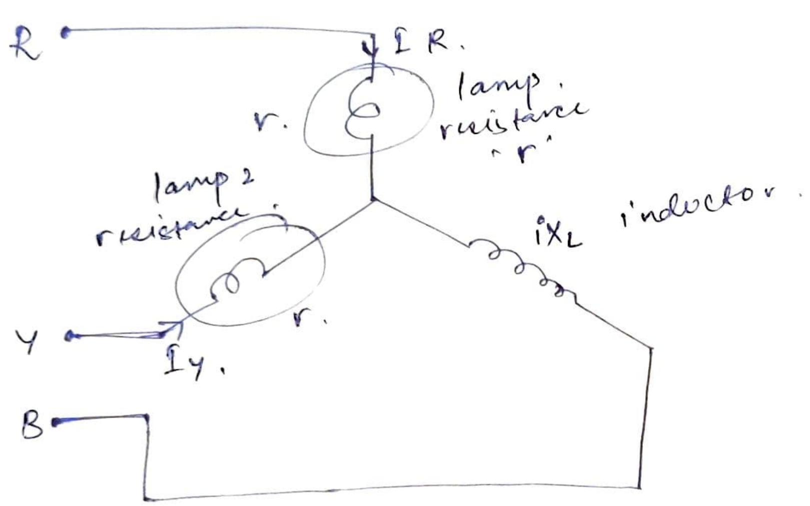
→ Torque is produced with the interaction of the eddy currents with the field.

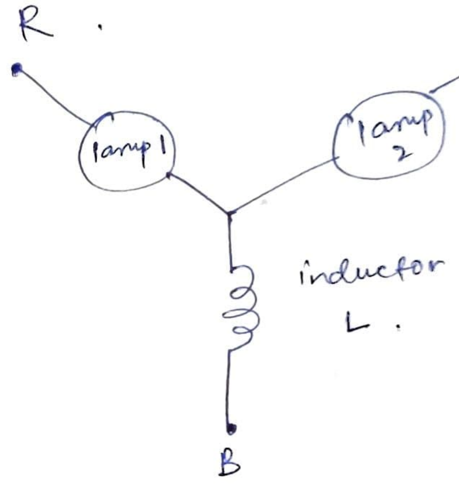
→ The disc revolves because of the torque and the direction of rotation depends upon the phase sequence of the supply.

→ An arrow indicates the direction of the rotation of the aluminium disc. If the direction of the coil is in same direction indicated by the arrow head, ~~the same as that~~ the phase sequence of the supply is the same as marked on the terminals of the instruments.

However, if the disc revolves opposite to the direction indicated by the arrowhead, the sequence of the ~~3φ~~ supply is opposite to that marked on the terminals.

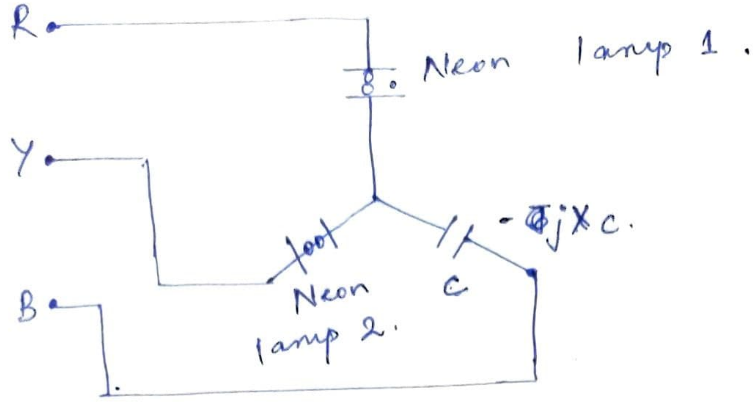
Static Type.





The static phase sequence indicator consist of two lamps and an indicator. The device whose phase sequence is to be determined is connected to the static phase sequence indicators. If the lamp 1 is dim and lamp 2 glows brightly, then the phase sequence of supply is RYB.

If the lamp 1 glows brightly and lamp 2 is dim, the device has reverse phase sequence. The brightness of the lamp depends on the voltage drop ~~occu~~ occurs across it.



— x —

Q3. V = 230V, 900 rev/kwh, current = 10 A, half load.

revolutions = 20,

Time = 69 sec.

$E_a = VI\cos\phi \times t.$

$= VI\cos\phi \times t/3600.$

$= 230 \times 10 \times \frac{1}{2} \times \frac{69}{3600} \times 10^{-3}.$

$E_a = 22.04 \times 10^{-3}$ J.

For E_k,

900 revolutions ⟶ 1 kwh.

20 revolutions. ⟶ ~~200~~ $\frac{20}{900} = 22.22 \times 10^{-3}$ J.

∴ Now,

$$\text{Error \%} = \frac{E_k - E_a}{E_a} \times 100.$$

$$= \frac{22.22 \times 10^{-3} - 22.04 \times 10^{-3}}{22.04 \times 10^{-3}} \times 100.$$

$= \boxed{0.816\ \%}$

Q4. $P = VI \cos\phi$.

a) $= 220 \times 10 \times 0.6$.

$P = 2640\ W$.

(i) Loss in CC $= I^2 R_c$.

$= 20^2 \times 0.01$

$= 400 \times 0.01 = 4\ W$.

Total measured power $= 2640 - 4$

$= 2636\ W$.

$\therefore$ % error $= \dfrac{T_v - M_v}{T_v} \times 100$.

$= \dfrac{2640 - 2636}{2640} \times 100$.

% error = 0.15 %

(ii) Loss in pressure coil:

$\dfrac{V^2}{R_P} = \dfrac{(220)^2}{1000} = 48.4\ W$.

Total power measured $= 2640 - 48.4$.

$= 2591.6\ W$.

% error $= \dfrac{2640 - 2591.6}{2640} \times 100$.

% error = 1.835 %

4.b)

$$I^2 R_c = \frac{V^2}{P_p}.$$

$$I^2 = \frac{V^2}{R_c \times P_p} = \frac{(220)^2}{0.01 \times 1000}.$$

$$\boxed{I = 69.57\ A}$$