

< UNIT-3 >

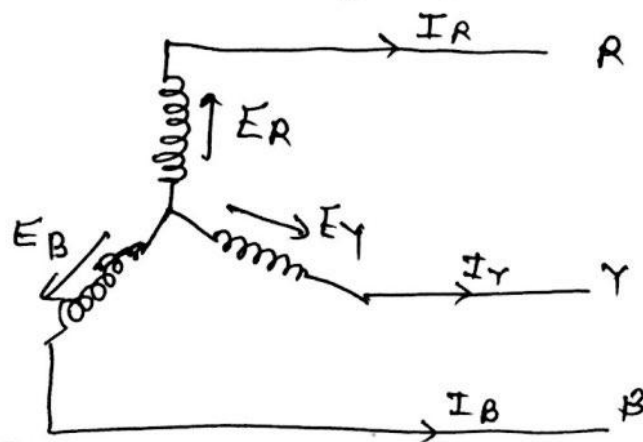
< Three phase A.C. Circuit >

Ans. 1 > Write down Merits & Demerits of poly phase system over single phase system.

- Ans. 1 > (i) In a single phase system power delivered is pulsating even when current and voltage are in phase. The power is zero twice in a cycle. In case of heavy motor this causes vibration. This problem is resolved in three phase system.
- (ii) The rating of given machine increases with the increase in no. of phases.
- (iii) Single phase motor (Induction) has no starting torque but three phase induction motor has starting torque.
- (iv) Power factor of single phase motor is lower than that of poly phase motor of same rating.
- (v) Three phase system requires $\frac{3}{4}$ th weight of copper of that required in single phase system to transmit the same amount of power at given voltage over same distance.
- (vi) Rotating magnetic field can be set up by poly phase system only.

Ans. 2 > Prove that for a star connected system the line voltage = $\sqrt{3}$ Phase Voltage. ($V_L = \sqrt{3} V_p$).

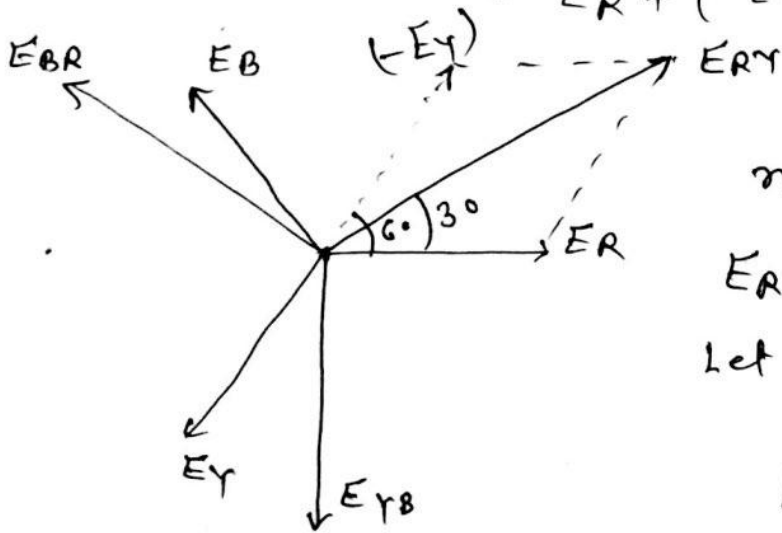
Ans. >



* Voltage b/w any two line is known as line voltage.

⇒ here the Phase Sequence is R, Y, B
Line Voltages are E_{RY}, E_{YB}, E_{BR}

now $E_{RY} = E_R - E_Y$
 $= E_R + (-E_Y)$



now from phasor Diagram

$$E_{RY} = \sqrt{E_R^2 + E_Y^2 + 2E_R E_Y \cos 60}$$

Let $E_R = E_Y = E_B = \text{Phase Voltage } (E_p)$

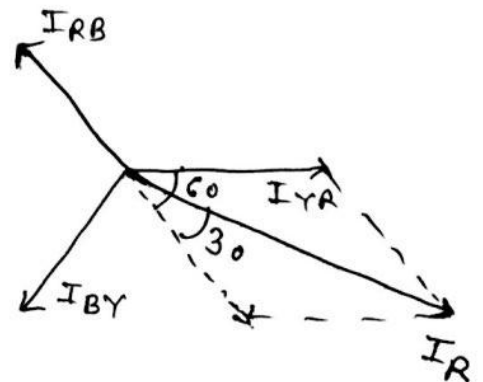
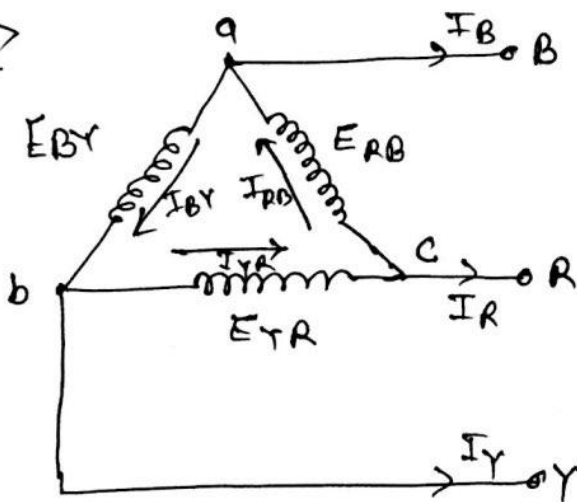
$E_{RY} = E_L$ (Line Voltage)

$$E_{RY} = \sqrt{E_p^2 + E_p^2 + 2E_p^2 \cos 60}$$

$$\boxed{E_L = \sqrt{3} E_p}$$

Ques. 3 > For Delta Connected System Prove that $I_L = \sqrt{3} I_p$.

Ans. >



from the figure we can say

line Voltage = Phase voltage

$$\boxed{E_L = E_p}$$

Now apply KCL at Node C →

$$I_R = I_{YR} - I_{RB}$$

$$I_R = I_{YR} + (-I_{RB})$$

the angle b/w I_{YR} & $-I_{RB}$ is 60°

So
$$I_R = \sqrt{I_{YR}^2 + I_{RB}^2 + 2 I_{YR} I_{RB} \cos 60}$$

now $I_{YR} = I_{RB} = I_{BY} = I_p$ (Phase Voltage)

$$I_R = \sqrt{I_p^2 + I_p^2 + 2 I_p^2 \cos 60}$$

$$I_R = \sqrt{3} I_p$$

$$I_L = \sqrt{3} I_p$$

Ques. 4 > A balanced Delta Connected load of $(12 + j9) \Omega$ / phase is connected to 3 phase 400V supply line
 (i) line current (ii) Power factor (iii) Power consumed (iv) Reactive Power

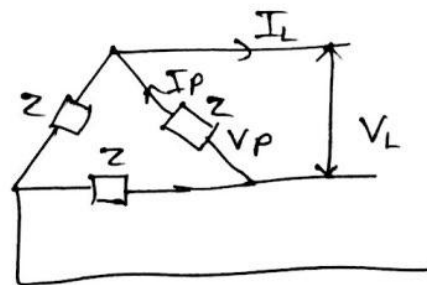
Ans. > $R = 12 \Omega$ $X_L = 9 \Omega$

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

$$= 15 \Omega$$

$$\cos \phi = R/Z = 12/15$$

$$\phi = 36.87^\circ$$



$$I_L = \sqrt{3} I_p$$

$$V_p = V_L$$

(i) Phase current $I_p = \frac{V_p}{Z} = \frac{400}{15} = 26.67 \text{ A}$

$$I_L = \sqrt{3} I_p \quad I_L = 46.2 \text{ A}$$

(ii) $\cos \phi = 12/15 = 0.8$ (lagging)

(iii) $P = 3 V_p I_p \cos \phi = 25600 \text{ W}$

(iv) $P_R = 3 V_p I_p \sin \phi = 3 \times 400 \times 26.67 \times 0.6 = 19200 \text{ W}$