25/10/24

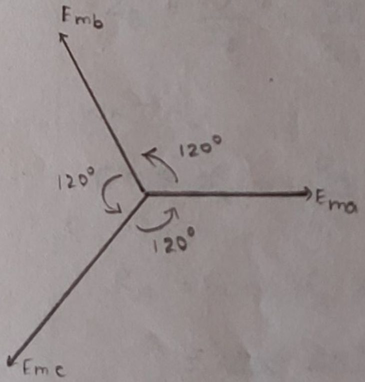
THREE - PHASE SYSTEM :

* To reduce power loss
* To increase the efficiency

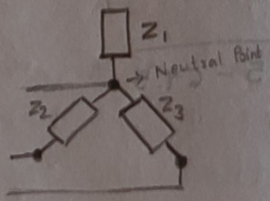
The phase difference between the phases will be generally 120

Advantages of Three-Phase system :

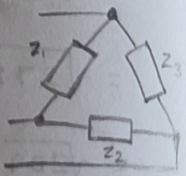
* Transmission lines require much less conductor material.
* A three-phase machine gives a higher output.
* A three-phase motor develops a uniform torque.
* The three-phase induction motors are self - starting.
* Voltage regulation is better.



(Domestic)
Star



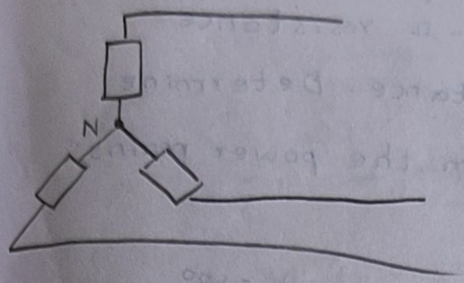
(Industry)
Delta

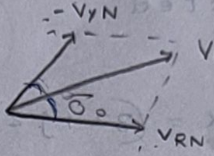


* If $Z_1 = Z_2 = Z_3$, it is known balanced system.
* If the impedances are different, it is known as unbalanced systems.

* Star connection gives high voltage, coil with less no
* Delta connection gives high current

STAR- CONNECTED SYSTEMS :





$$V_{RY} = V_{RN} - V_{YN}$$

$$V_{RY} = \sqrt{V_{RN}^2 + V_{YN}^2 + 2 V_{RN} V_{YN} \cos 60^\circ}$$

$$V_{RN} = V_{YN} = V_{BN} = V_{ph}$$

$$V_{RY} = \sqrt{3}\,(V_{RN} \cos 30^\circ)$$

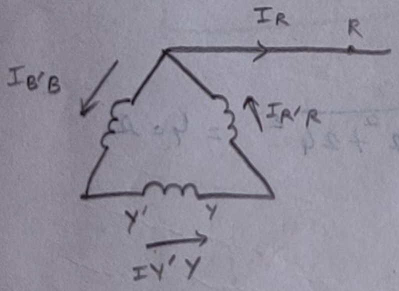
$$V_L = \sqrt{3}\, V_{ph} \left(\cancel{\tfrac{\sqrt{3}}{2}}\right)$$

$$\boxed{V_L = \sqrt{3}\, V_{ph}}$$

$$\boxed{I_L = I_{ph}}$$

DELTA- CONNECTED SYSTEMS :

$$|I_{R'R}| = |I_{Y'Y}| = |I_{B'B}| = I_{ph}$$



$$I_R + I_{B'B} = I_{R'R}$$

$$I_R = I_{R'R} - I_{B'B}$$

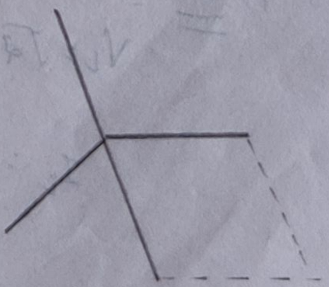
$$I_R = \sqrt{I_{R'R}^2 + I_{B'B}^2 + 2 I_{R'R} I_{BB'} \cos 60^\circ}$$

$$I_{R'R} = I_{B'B} = I_{ph}$$

$$I_L = \sqrt{3}\, 2 I_{ph} \left(\tfrac{1}{2}\right)$$

$$I_R = 2(I_{ph} \cos 30^\circ)$$

$$I_R = \sqrt{3}\, I_{ph}$$



$$\boxed{I_L = \sqrt{3}\, I_{ph}}$$

$$\boxed{V_L = V_{ph}}$$

Q) A 400-V, 3ϕ supply is connected across a balanced load of three impedances each consisting of a 32-Ω resistance and 24-Ω inductive reactance. Determine the ~~power~~ curren drawn from the power mains, if the impedances are;

a) Y-connected

b) Δ-connected

$V_L = 400$

A) $Z = R + jX = (32 + j24)\ \Omega$

$Z = \sqrt{R^2 + X_L^2} = 40\ \Omega$

a) Y

$V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}}\ V$

$I_{ph} = \frac{V_{ph}}{Z} = \frac{\frac{\cancel{400}}{\sqrt{3}}}{\cancel{40}} = \frac{10}{\sqrt{3}}$

$\therefore\ I_L = I_{ph} = \frac{10}{\sqrt{3}} = 5.78\ A$

b) Delta:

$V_{ph} = V_L = 400\ V$; $I_{ph} = \frac{V_{ph}}{Z} = \frac{\cancel{400}}{\cancel{40}} = 10$

$I_L = \sqrt{3}\ I_{ph} = \sqrt{3} \times 10 = 17.32\ A$

$Z = \sqrt{R^2 + X_L^2} = \sqrt{32^2 + 24^2} = 40\ \Omega$

$\boxed{Z = 40\Omega}$

i) SC:

$V_L = \sqrt{3}\, V_{pH}$; $V_{pH} = \frac{400}{\sqrt{3}}\ V$

$I_L = \frac{V_L}{Z} = \frac{40\cancel{0}}{4\cancel{0}}$

Q) A 20-Ω resistor is connected in series with an inductor.

$$\frac{1}{Z_1} = \frac{1}{R} + j\frac{1}{X_C}$$

$$Z = R + iX_C.$$

$$Z = X + iY$$

$$\boxed{Z = Z' + iZ''}$$

$$|Z| = \sqrt{Z_1^2 + Z_2^2}$$

$$\boxed{\tan\phi = \frac{Z_2}{Z_1}}$$

$$Y/X$$

$$\frac{1}{Z} = \frac{1}{R} - \frac{1}{\cancel{i}X_C}.$$

$$iX_C$$