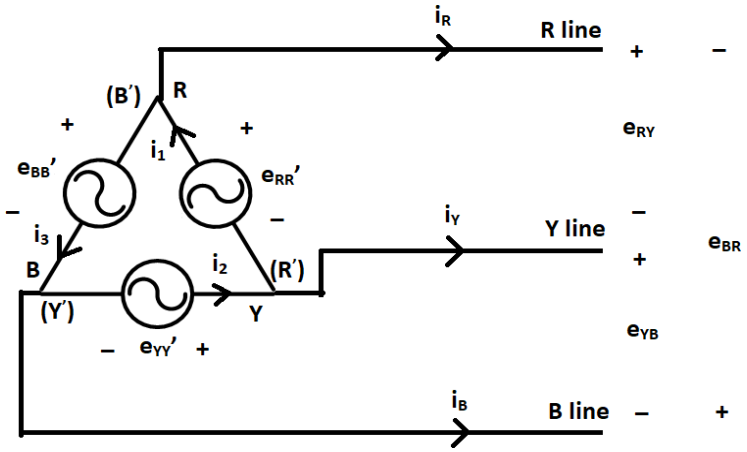
NOTES -Class 42

Balanced Delta (or) Mesh Connected Three Phase System

To make a delta connected three phase system, the three coils R, Y & B are connected back to back (or) end to end. And lines are run from the junction points R, Y and B.



Phase Voltage:

The voltage across the terminals of a phase is called the Phase Voltage. Here, $e_{RR'}$, $e_{YY'}$ & $e_{BB'}$ represent phase voltages.

Line Voltage:

The voltage across any two lines is called the Line Voltage. Here, e_{RY} , e_{YB} & e_{BR} represent Line (or) Line to line voltages.

Phase Current:

The current flowing through a phase is called the Phase Current. Here, i_1 , i_2 & i_3 represent phase currents.

Line Current:

The current flowing through a line is called the Line Current. Here, i_R , i_Y & i_B represent line currents.

Relation between Line & Phase Voltages – Balanced Delta System:

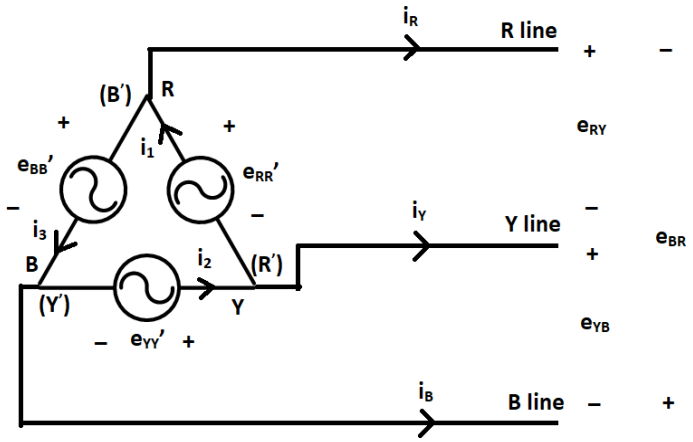
In a balanced delta connected three phase system, it can observed that Line Voltage = Phase Voltage

i.e., $e_{RY} = e_{RR'}$

$e_{YB} = e_{YY'}$

$e_{BR} = e_{BB'}$

Relation between Line & Phase Currents – Balanced Delta System:



By KCL at R, $i_1 = i_R + i_3$

Hence, $i_R = i_1 - i_3$

$$\overline{I_R} = \overline{I_1} - \overline{I_3}$$

$$\overline{I_1} = \frac{I_m}{\sqrt{2}}\angle 0^\circ = I_{ph}\angle 0^\circ$$

where, I_{ph} is the RMS value of phase current.

$$\overline{I_2} = \frac{I_m}{\sqrt{2}}\angle -120^\circ = I_{ph}\angle -120^\circ$$

$$\overline{I_3} = \frac{I_m}{\sqrt{2}} \angle -240^\circ = I_{ph} \angle -240^\circ$$

$$\overline{I_R} = I_{ph} \angle 0^\circ - I_{ph} \angle -240^\circ$$

$$= I_{ph}(1-(\cos 240^\circ - j\sin 240^\circ))$$

$$= I_{ph}(\frac{3}{2} - j\frac{\sqrt{3}}{2})$$

$$= \sqrt{3} I_{ph}(\cos 30° - j\sin 30°)$$

$$= \sqrt{3} I_{ph} \angle -30°$$

$$\overline{I_Y} = \overline{I_2} - \overline{I_1} = \sqrt{3} I_{ph} \angle -150^\circ$$

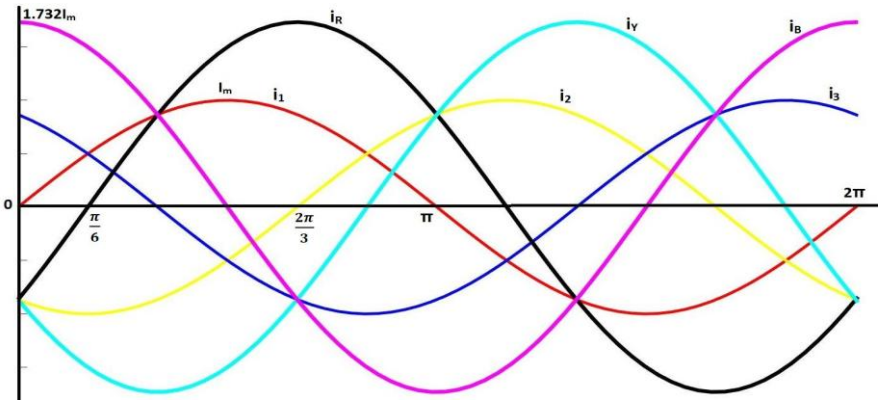
$$\overline{I_B} = \overline{I_3} - \overline{I_2} = \sqrt{3} I_{ph} \angle -270^\circ$$

Thus, in a balanced delta connected three phase system,

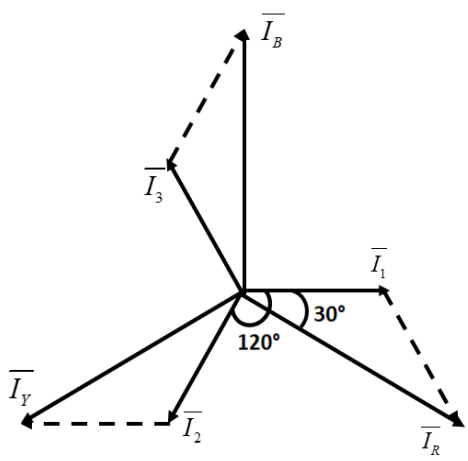
(i) Magnitude (RMS value) of Line current = √3*(Magnitude of Phase current)

(ii) Each line current lags the corresponding phase current by 30°

Balanced Delta System – Line and Phase current Waveforms:



Balanced Delta System – Phasor diagram:



$$\overline{I_R} = \overline{I_1} - \overline{I_3}$$