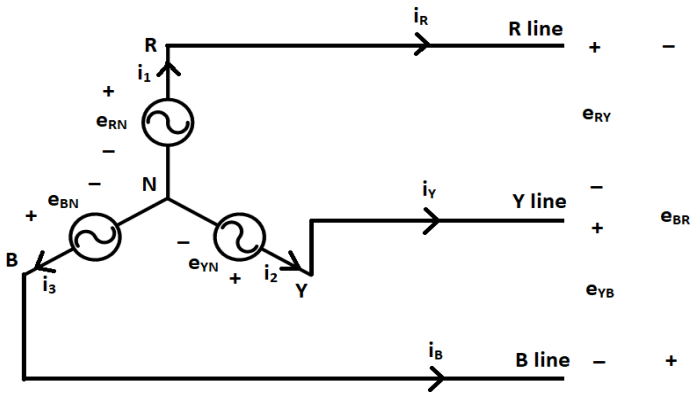
NOTES-Class 41

Balanced Star (or) WYE Connected Three Phase System

To make a star connected three phase system, similar terminals such as R' , Y' and B' are connected together to make 'Neutral' point (N) of the three phase system. And lines are run from the other three terminals i.e., R, Y and B.



Phase Voltage:

The voltage across the terminals of a phase is called the Phase Voltage. Here, e_{RN} , e_{YN} & e_{BN} 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 currents – Balanced Star System:

In a balanced star connected three phase system, it can observed that

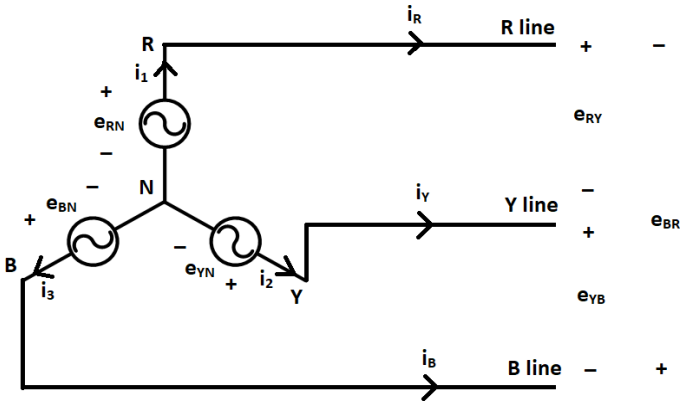
Line current = Phase current

i.e., $i_1 = i_R$

$i_2 = i_Y$

$i_3 = i_B$

Relation between Line & Phase voltages – Balanced Star System:



By KVL in the path RYNR, $- e_{RY} - e_{YN} + e_{RN} = 0$

Hence, $e_{RY} = e_{RN} - e_{YN}$

$$\overline{E_{RY}} = \overline{E_{RN}} - \overline{E_{YN}}$$

$$\overline{E_{RN}} = \frac{E_m}{\sqrt{2}}\angle 0^\circ = E_{ph}\angle 0^\circ$$

where, E_{ph} is the RMS value of phase voltage.

$$\overline{E_{YN}} = \frac{E_m}{\sqrt{2}}\angle -120^\circ = E_{ph}\angle -120^\circ$$

$$\overline{E_{BN}} = \frac{E_m}{\sqrt{2}} \angle -240^\circ = E_{ph} \angle -240^\circ$$

$$\overline{E_{RY}} = E_{ph} \angle 0^\circ - E_{ph} \angle -120^\circ$$

$$= E_{ph}(1-(\cos 120^\circ - j\sin 120^\circ))$$

$$= E_{ph}(\frac{3}{2} + j\frac{\sqrt{3}}{2})$$

$$= \sqrt{3}E_{ph}(\cos 30^\circ + j\sin 30^\circ)$$

$$= \sqrt{3}E_{ph} \angle 30^\circ$$

$$\overline{E_{YB}} = \overline{E_{YN}} - \overline{E_{BN}} = \sqrt{3}E_{ph} \angle -90^\circ$$

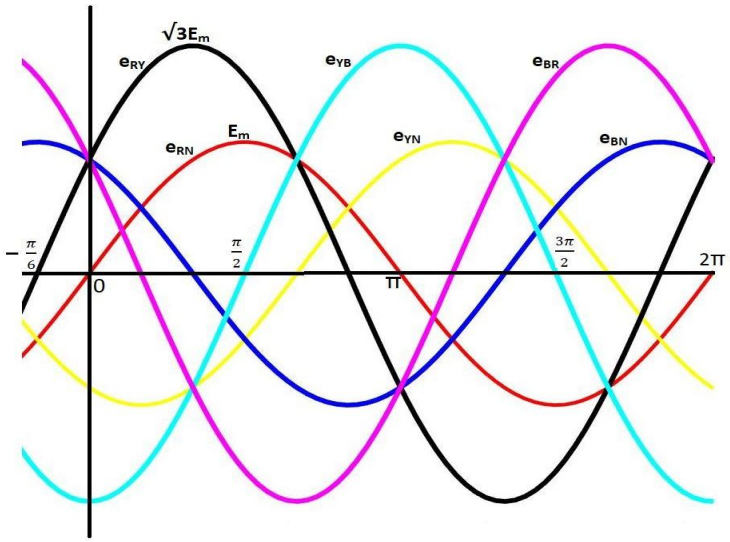
$$\overline{E_{BR}} = \overline{E_{BN}} - \overline{E_{RN}} = \sqrt{3}E_{ph} \angle -210^\circ$$

Thus, in a balanced star connected three phase system,

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

(ii) Each line voltage leads the corresponding phase voltage by 30°

Balanced Star System – Line and Phase Voltage Waveforms:



Balanced Star System – Phasor diagram:

$$\overline{E_{RY}} = \overline{E_{RN}} - \overline{E_{YN}}$$