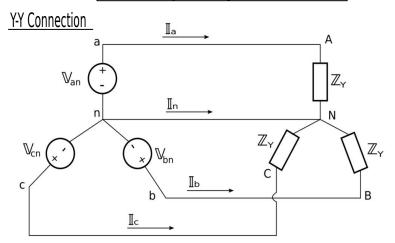
for three-phase systems

Phase and Line Voltages/Currents \mathbb{V} , \mathbb{I} , \mathbb{Z} = phasor (complex) expressions



Phase Voltages:

$$\begin{split} & V_{\text{an}} = V_p \, \angle \, \, \, 0^{\circ} \\ & V_{\text{bn}} = V_p \, \angle \, \, -120^{\circ} \\ & V_{\text{cn}} = V_p \, \angle \, \, +120^{\circ} \end{split}$$

Line Voltages:

$$V_{ab} = \sqrt{3} V_p \angle 30^{\circ}$$

$$V_{bc} = V_{ab} \angle -120^{\circ}$$

$$V_{ca} = V_{ab} \angle +120^{\circ}$$

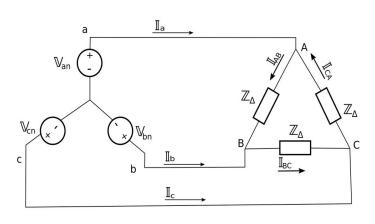
Phase Currents:

-Same as line currents

Line Currents:

$$\begin{array}{l} \overline{\mathbb{I}_{a} = \mathbb{V}_{an}/\mathbb{Z}_{Y}} \\ \mathbb{I}_{b} = \mathbb{I}_{a} \ \angle \ -120^{\circ} \\ \mathbb{I}_{c} = \mathbb{I}_{a} \ \angle \ +120^{\circ} \end{array}$$

Y-Delta Connection



Phase Voltages:

$$\begin{split} \mathbb{V}_{\text{an}} &= V_p \angle 0^{\circ} \\ \mathbb{V}_{\text{bn}} &= V_p \angle -120^{\circ} \\ \mathbb{V}_{\text{cn}} &= V_p \angle +120^{\circ} \end{split}$$

Line Voltages:

$$V_{ab} = V_{AB} = \sqrt{3} V_p \angle 30^{\circ}$$

$$V_{bc} = V_{BC} = V_{ab} \angle -120^{\circ}$$

$$V_{ca} = V_{CA} = V_{ab} \angle +120^{\circ}$$

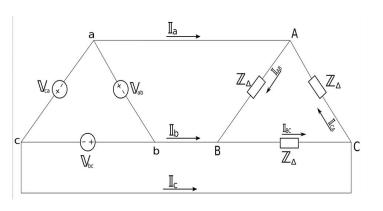
Phase Currents:

$$I_{AB} = V_{AB}/\mathbb{Z}_{\Delta}
I_{BC} = V_{BC}/\mathbb{Z}_{\Delta}
I_{CA} = V_{CA}/\mathbb{Z}_{\Delta}$$

Line Currents:

$$\begin{split} \mathbb{I}_{a} &= \mathbb{I}_{AB} \sqrt{3} \ \angle \ -30^{\circ} \\ \mathbb{I}_{b} &= \mathbb{I}_{a} \ \angle \ -120^{\circ} \\ \mathbb{I}_{c} &= \mathbb{I}_{a} \ \angle \ +120^{\circ} \end{split}$$

Delta-Delta Connection



Phase Voltages:

$$\begin{array}{c} \hline V_{ab} = V_p \angle 0^{\circ} \\ \hline V_{bc} = V_p \angle -120^{\circ} \\ \hline V_{ca} = V_p \angle +120^{\circ} \\ \end{array}$$

Line Voltages:

-same as phase voltages

Phase Currents:

$$\mathbb{I}_{AB} = \mathbb{V}_{ab} / \mathbb{Z}_{\Delta} \\
\mathbb{I}_{BC} = \mathbb{V}_{bc} / \mathbb{Z}_{\Delta} \\
\mathbb{I}_{CA} = \mathbb{V}_{ca} / \mathbb{Z}_{\Delta}$$

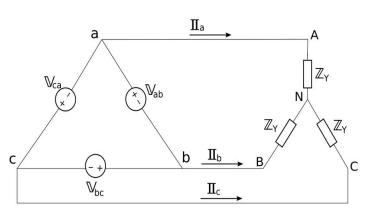
Line Currents:

$$I_a = I_{AB} \sqrt{3} \angle -30^{\circ}$$

$$I_b = I_a \angle -120^{\circ}$$

$$I_c = I_a \angle +120^{\circ}$$

Delta-Y Connection



Phase Voltages:

$$\begin{array}{c} \hline \hline V_{ab} = V_p \ \angle \ 0^\circ \\ V_{bc} = V_p \ \angle \ -120^\circ \\ V_{ca} = V_p \ \angle \ +120^\circ \\ \end{array}$$

Phase Currents:

-Same as line currents

Line Voltages:

-same as phase voltages

Line Currents:

$$\mathbb{I}_{a} = \frac{V_{p} \angle -30^{\circ}}{\sqrt{3}\mathbb{Z}_{Y}}$$

$$\mathbb{I}_{b} = \mathbb{I}_{a} \angle -120^{\circ}$$

$$\mathbb{I}_{c} = \mathbb{I}_{a} \angle -120^{\circ}$$

$$\mathbb{I}_{c} = \mathbb{I}_{a} \angle +120^{\circ}$$