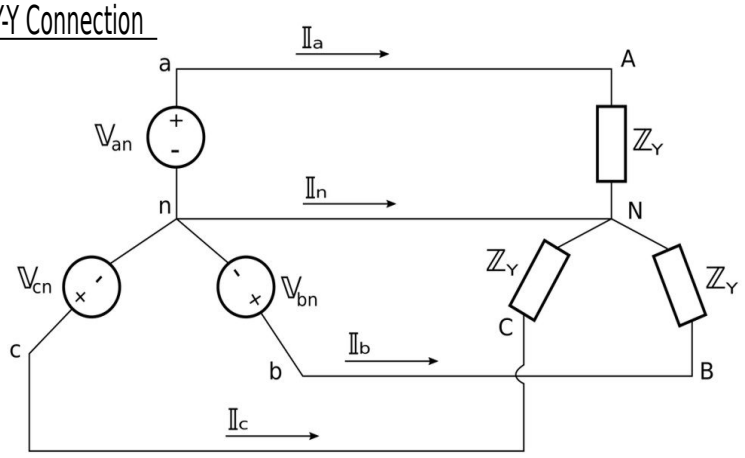
Phase and Line Voltages/Currents for three-phase systems

$\mathbb{V}, \mathbb{I}, \mathbb{Z}$ = phasor (complex) expressions

Y-Y Connection



Phase Voltages:

$\mathbb{V}_{an} = V_p \angle\ 0°$

$\mathbb{V}_{bn} = V_p \angle\ -120°$

$\mathbb{V}_{cn} = V_p \angle\ +120°$

Line Voltages:

$\mathbb{V}_{ab} = \sqrt{3}\ V_p \angle\ 30°$

$\mathbb{V}_{bc} = \mathbb{V}_{ab} \angle\ -120°$

$\mathbb{V}_{ca} = \mathbb{V}_{ab} \angle\ +120°$

Phase Currents:

-Same as line currents

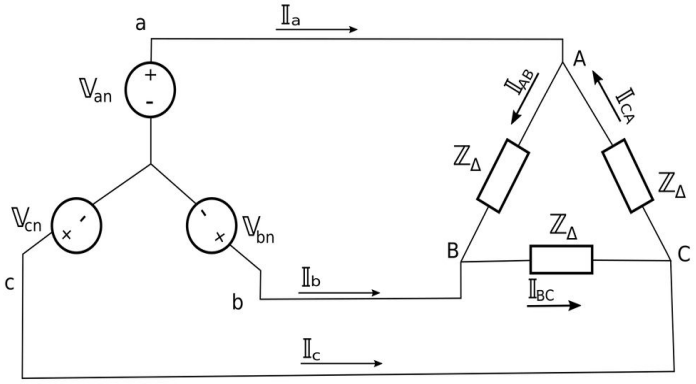
Line Currents:

$\mathbb{I}_a = \mathbb{V}_{an} / \mathbb{Z}_Y$

$\mathbb{I}_b = \mathbb{I}_a \angle\ -120°$

$\mathbb{I}_c = \mathbb{I}_a \angle\ +120°$

Y-Delta Connection



Phase Voltages:

$\mathbb{V}_{an} = V_p \angle\ 0°$

$\mathbb{V}_{bn} = V_p \angle\ -120°$

$\mathbb{V}_{cn} = V_p \angle\ +120°$

Line Voltages:

$\mathbb{V}_{ab} = \mathbb{V}_{AB} = \sqrt{3}\ V_p \angle\ 30°$

$\mathbb{V}_{bc} = \mathbb{V}_{BC} = \mathbb{V}_{ab} \angle\ -120°$

$\mathbb{V}_{ca} = \mathbb{V}_{CA} = \mathbb{V}_{ab} \angle\ +120°$

Phase Currents:

$\mathbb{I}_{AB} = \mathbb{V}_{AB} / \mathbb{Z}_\Delta$

$\mathbb{I}_{BC} = \mathbb{V}_{BC} / \mathbb{Z}_\Delta$

$\mathbb{I}_{CA} = \mathbb{V}_{CA} / \mathbb{Z}_\Delta$

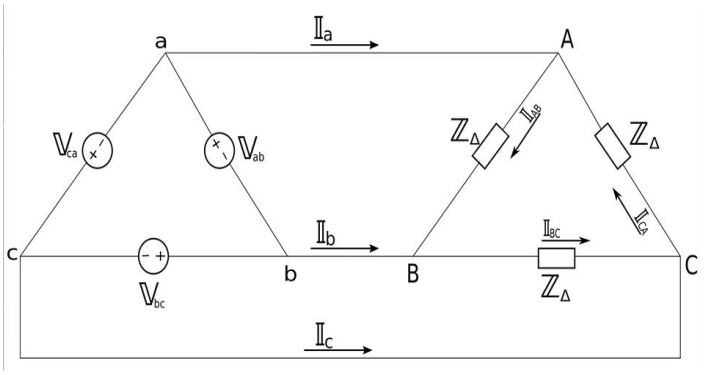
Line Currents:

$\mathbb{I}_a = \mathbb{I}_{AB}\ \sqrt{3} \angle\ -30°$

$\mathbb{I}_b = \mathbb{I}_a \angle\ -120°$

$\mathbb{I}_c = \mathbb{I}_a \angle\ +120°$

Delta-Delta Connection



Phase Voltages:

$\mathbb{V}_{ab} = V_p \angle\ 0°$

$\mathbb{V}_{bc} = V_p \angle\ -120°$

$\mathbb{V}_{ca} = V_p \angle\ +120°$

Line Voltages:

-same as phase voltages

Phase Currents:

$\mathbb{I}_{AB} = \mathbb{V}_{ab} / \mathbb{Z}_\Delta$

$\mathbb{I}_{BC} = \mathbb{V}_{bc} / \mathbb{Z}_\Delta$

$\mathbb{I}_{CA} = \mathbb{V}_{ca} / \mathbb{Z}_\Delta$

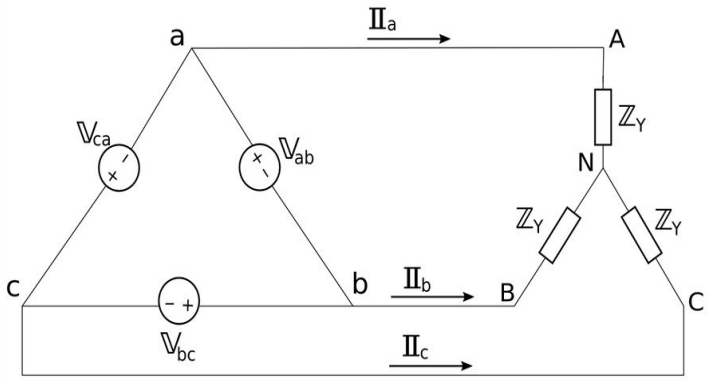
Line Currents:

$\mathbb{I}_a = \mathbb{I}_{AB}\ \sqrt{3} \angle\ -30°$

$\mathbb{I}_b = \mathbb{I}_a \angle\ -120°$

$\mathbb{I}_c = \mathbb{I}_a \angle\ +120°$

Delta-Y Connection



Phase Voltages:

$\mathbb{V}_{ab} = V_p \angle\ 0°$

$\mathbb{V}_{bc} = V_p \angle\ -120°$

$\mathbb{V}_{ca} = V_p \angle\ +120°$

Line Voltages:

-same as phase voltages

Phase Currents:

-Same as line currents

Line Currents:

$$\mathbb{I}_a = \frac{V_p \angle\ -30°}{\sqrt{3}\mathbb{Z}_Y}$$

$\mathbb{I}_b = \mathbb{I}_a \angle\ -120°$

$\mathbb{I}_c = \mathbb{I}_a \angle\ +120°$