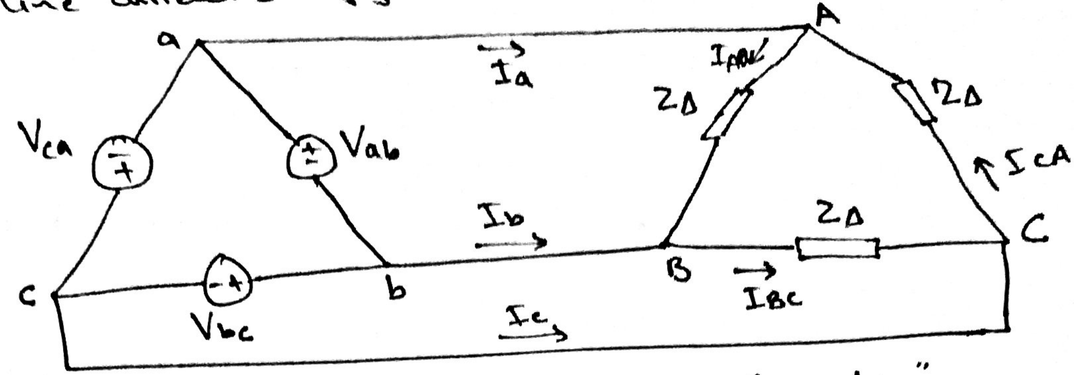
⇒ Balanced Delta-Delta (Δ-Δ) Connections:-

For Δ connections
* Line voltage = phase voltage
* line current = √3 Phase current . ∠-30°



"Delta - Delta Connections"

$V_{AB} = V_{ab}$

* First of all the voltage V_{AB}, is same as voltage V_{ab}. To find line current I_{AB} we can do it by $I_{AB} = \frac{V_{ab}}{Z_\Delta}$

* Other way is to convert both Δs to Ys and then find one of the phase and solve.

Q-1. A balanced Δ connected load having an impedance $20 - j15\,\Omega$ is connected to a Δ connected, positive sequence generator having $V_{ab} = 330\angle 0°$ V. Find phase currents of load and line currents.

Sol: The load per phase is:

$$Z_\Delta = 20 - j15 = 25\angle -36.87°\ \Omega.$$

Since $V_{AB} = V_{ab}$ the phase currents are:

$$I_{AB} = \frac{V_{AB}}{Z_\Delta} = \frac{330\angle 0°}{25\angle -36.87} = 13.2\angle 36.87°\text{ A} ✓$$

$$I_{BC} = I_{AB}\angle -120° = 13.2\angle -83.13°\text{ A} ✓$$

$$I_{CA} = I_{AB}\angle +120° = 13.2\angle 156.87°\text{ A} ✓$$

Line current: line current = √3 phase current. ∠-30°. ✓

$$I_a = I_{AB}\angle 30° . \sqrt{3} = (13.2\angle 36.87°)(\sqrt{3}\angle -30°) = 22.86\angle 6.87$$

$$= 22.86\angle -113.13°\text{ A} ✓$$

$$I_b = I_a\angle -120° = 22.86\angle 126.87°\text{ A} ✓$$

$$I_c = I_c\angle +120° =$$

Q-2. A positive sequence, balanced Δ-connected source supplies a balanced Δ-connected load. If the impedance per phase of the load is 18+j12 Ω and $I_a = 9.609 \angle 35°$ A, find I_{AB} and V_{AB}. (9)

Sol:

We use formula: Line current = $\sqrt{3}$ phase current $\cdot \angle -30°$

$$I_{AB} = \frac{I_a}{\sqrt{3} \cdot \angle -30°} = \frac{9.609 \angle 35°}{\sqrt{3} \cdot \angle -30°} = 5.57 \angle 65°$$ ✓

$$V_{AB} = I_{AB} \times Z_\Delta = 5.57 \angle 65° \times (18 + j12)$$

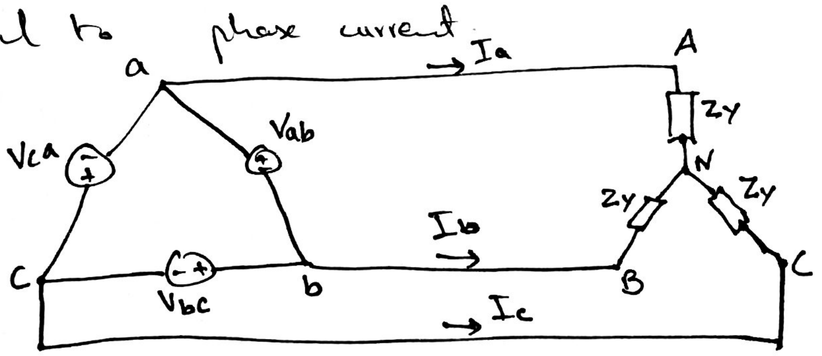
$$= 5.57 \angle 65° \times 21.6 \angle 33.69°$$

$$V_{AB} = 120.3 \angle 98.69°.$$ ✓

Δ → Y

⇒ **Balanced Delta-Wye Connection:-** A balanced Δ-Y system consists of balanced Δ connected source feeding a balanced Y connected load.

* The line voltage is equal to the phase voltage.
* For load at Y-connections is: load current is equal to phase current.

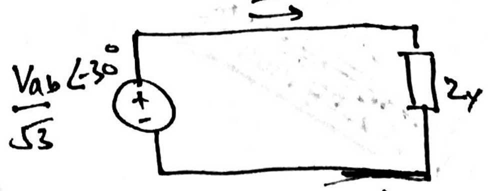


+ First convert Δ source to Y source.

$$V_L = \sqrt{3}\, V_P \angle 30°$$

$$V_P = \frac{V_L}{\sqrt{3} \angle 30°}$$

$$V_{an} = \frac{V_{ab}}{\sqrt{3}} \angle -30°$$



Equivalent Single Phase

Q.1: A balanced Y-connected load with a phase impedance of $40+j25\,\Omega$ is supplied by a balanced, positive sequence Δ-connected source with a line voltage of 210 V. Calculate the phase currents, use V_{ab} as a refference.

Sol:

$Z_Y = 40+j25 = 47.17\angle 32°\,\Omega$

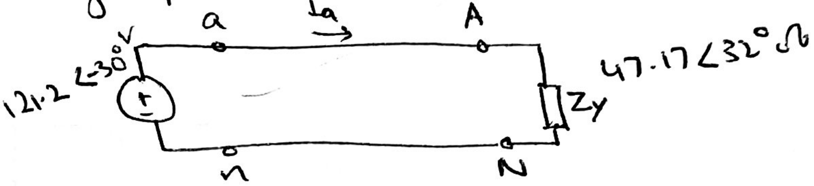
$V_{ab} = 210\angle 0°\ V$

When the Δ-connected source is transformed to a Y-conneted source:

$V_{an} = \frac{V_{ab}}{\sqrt{3}}\angle -30° = \frac{210\angle 0°}{\sqrt{3}} \cdot \angle -30°$

$V_{an} = 121.2\angle -30°\ V$

Now we can separat single phase network



The line currents are:

$I_a = \frac{V_{an}}{Z_Y} = \frac{121.2\angle -30°}{47.12\angle 32°}$

$I_a = 2.57\angle -62°\ A$ ✓

Similarly, $I_b = I_a\angle -120° = 2.57\angle -178°\ A$ ✓

$I_c = I_a\angle 120° = 2.57\angle 58°\ A$ ✓

The phase current: $I_P = I_L$

So, the phase current here will be same as line currents found above.

Q.2 In a balanced Δ-Y circuit, $V_{ab} = 240\angle 15°\ V$ and $Z_Y = (12+j15)\,\Omega$. Calculate the line currents.

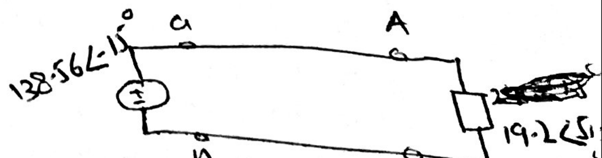
Sol: $Z_Y = (12+j15)\,\Omega = 19.20\angle 51.34°\,\Omega$

$V_{ab} = 240\angle 15°\ V$

Transform Δ source to Y source:

$V_{an} = \frac{V_{ab}}{\sqrt{3}}\angle -30° = \frac{240\angle 15°}{\sqrt{3}}\angle -30°$

$V_{an} = 138.56\angle -15°\ V$



Now we separate single phase network:

The line currents are:

$I_a = \frac{V_{an}}{Z_Y} = \frac{138.56\angle -15°}{19.20\angle 51.34°} = 7.21\angle -66.34°\ A$ ✓

$I_b = I_a\angle -120° = 7.21\angle -186.34°\ A$ ✓

$I_c = I_a\angle 120° = 7.21\angle 53.66°\ A$ ✓