

$$V_{AB} = V_A - V_B$$

$$= V_A + (-V_B)$$

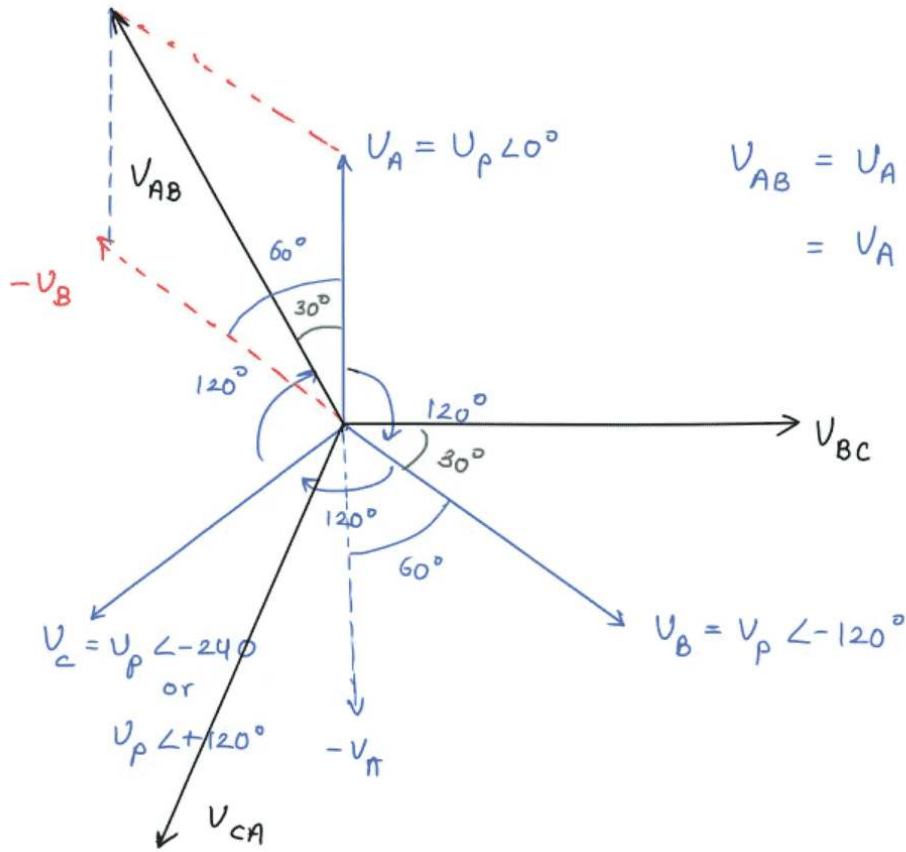
$$V_C = V_p \angle -240$$

or

$$V_p \angle +120^\circ$$

$$V_B = V_p \angle -120^\circ$$

$$V_A = V_p \angle 0^\circ$$



$$V_{AB} = V_A - V_B$$

$$= V_A + (-V_B)$$

$$V_C = U_p \angle -240^\circ$$

or

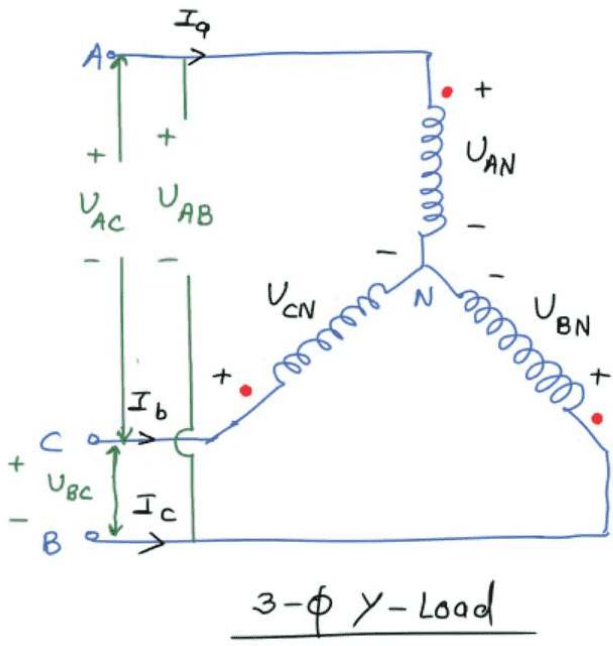
$$U_p \angle +120^\circ$$

$$V_B = U_p \angle -120^\circ$$

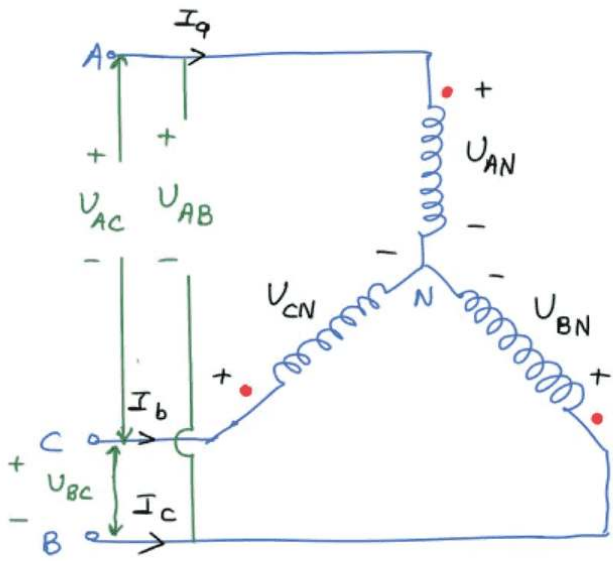
$$V_A = U_p \angle 0^\circ$$

$$V_{CA}$$

# 1. Star Connection -



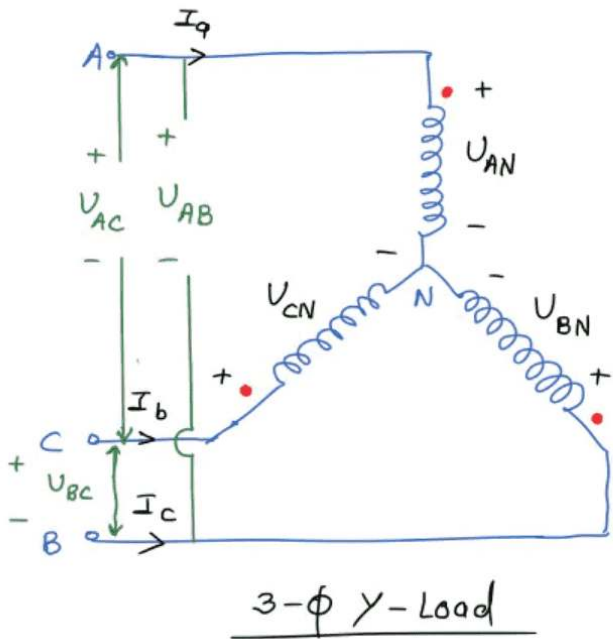
# 1. Star Connection -



3- $\phi$   $\gamma$ -Load

\* 
$$\left\{ \begin{array}{l} \underline{I_A} = \underline{I_p} \angle 0^\circ \\ \underline{I_B} = \underline{I_p} \angle -120^\circ \\ \underline{I_C} = \underline{I_p} \angle -240^\circ \text{ or } \underline{I_p} \angle +120^\circ \end{array} \right\}$$

## 1. Star Connection -

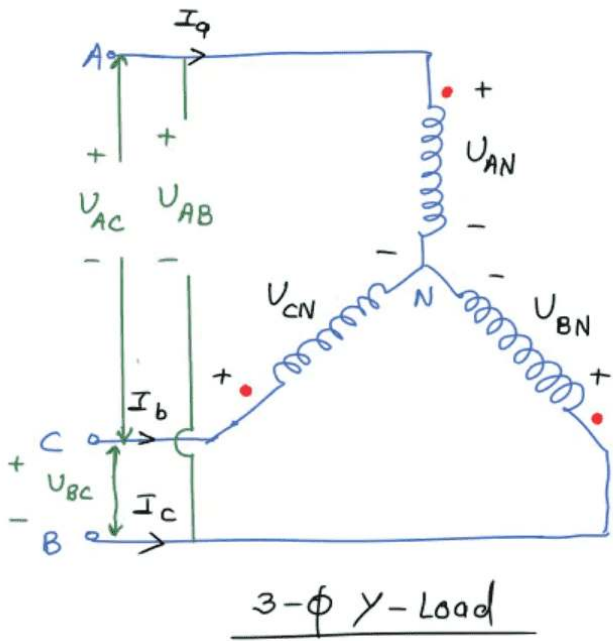


$$* \left\{ \begin{array}{l} I_A = I_p \angle 0^\circ \\ I_B = I_p \angle -120^\circ \\ I_C = I_p \angle -240^\circ \text{ or } I_p \angle +120^\circ \end{array} \right\}$$

Here phase current = line current hence

$$\left[ \frac{I_{\text{Line}}}{\text{line}} = \frac{I_L}{\text{phase}} = \frac{I_p}{\text{phase}} \right]$$

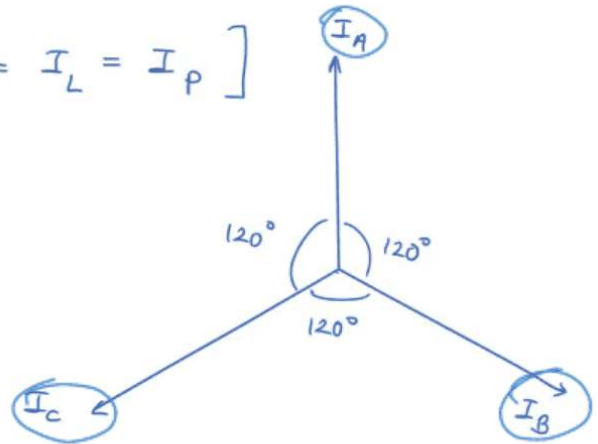
# 1. Star Connection -



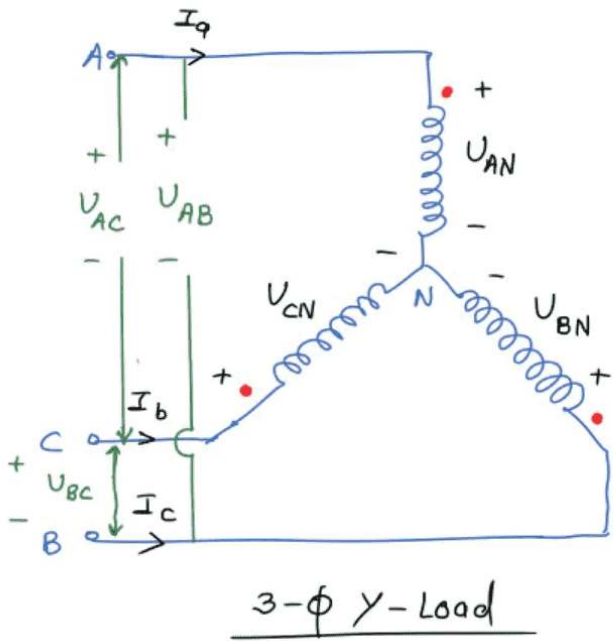
$$* \left\{ \begin{array}{l} I_A = I_p \angle 0^\circ \\ I_B = I_p \angle -120^\circ \\ I_C = I_p \angle -240^\circ \text{ or } I_p \angle +120^\circ \end{array} \right\}$$

Here phase current = line current hence

$$[ I_{Line} = I_L = I_p ]$$



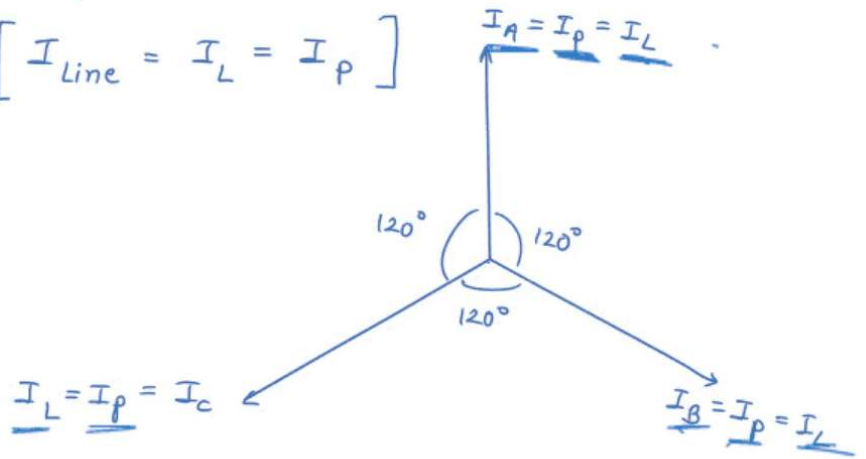
# 1. Star Connection -



$$* \left\{ \begin{array}{l} I_A = I_p \angle 0^\circ \\ I_B = I_p \angle -120^\circ \\ I_C = I_p \angle -240^\circ \text{ or } I_p \angle +120^\circ \end{array} \right\}$$

Here phase current = line current hence

$$[ I_{Line} = I_L = I_p ]$$



\* For a balanced system -



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$$\bar{U}_{AN} + \bar{U}_{BN} + \bar{U}_{CN} = 0$$

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$$\left[ \underline{U_p \angle 0^\circ} + \underline{U_p \angle -120^\circ} + \underline{U_p \angle -240^\circ} = \underline{0} \right]$$

\* For a balanced system -

$$\bar{V}_{AN} + \bar{V}_{BN} + \bar{V}_{CN} = 0$$

$$[ V_p \angle 0^\circ + V_p \angle -120^\circ + V_p \angle -240^\circ = 0 ]$$

$$\underline{\bar{V}_{AB}} + \underline{\bar{V}_{BC}} + \underline{\bar{V}_{CA}} = \underline{0}$$

\* For a balanced system -

$$\bar{U}_{AN} + \bar{U}_{BN} + \bar{U}_{CN} = 0$$

$$\left[ \underline{U}_P \angle 0^\circ + \underline{U}_P \angle -120^\circ + \underline{U}_P \angle -240^\circ = 0 \right]$$

$$\bar{U}_{AB} + \bar{U}_{BC} + \bar{U}_{CA} = 0$$

$$\underline{U}_L \angle 0^\circ + \underline{U}_L \angle -120^\circ + \underline{U}_L \angle +120^\circ = 0$$

\* For a balanced system -

$$\bar{U}_{AN} + \bar{U}_{BN} + \bar{U}_{CN} = 0$$

$$[ U_p \angle 0^\circ + U_p \angle -120^\circ + U_p \angle -240^\circ = 0 ]$$

$$\bar{U}_{AB} + \bar{U}_{BC} + \bar{U}_{CA} = 0$$

$$U_L \angle 0^\circ + U_L \angle -120^\circ + U_L \angle +120^\circ = 0$$

$$\rightarrow [ \underline{U_L \angle 30^\circ} + \underline{U_L \angle -90^\circ} + \underline{U_L \angle +150^\circ} = 0 ]$$

\* For a balanced system -

$$\bar{U}_{AN} + \bar{U}_{BN} + \bar{U}_{CN} = 0$$

$$[ U_p \angle 0^\circ + U_p \angle -120^\circ + U_p \angle -240^\circ = 0 ]$$

$$\bar{U}_{AB} + \bar{U}_{BC} + \bar{U}_{CA} = 0$$

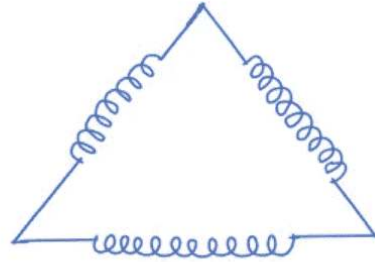
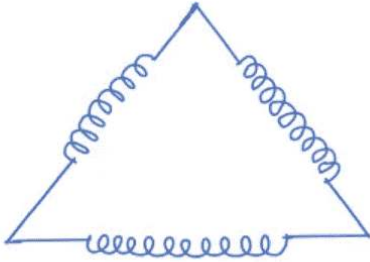
$$U_L \angle 0^\circ + U_L \angle -120^\circ + U_L \angle +120^\circ = 0$$

$$[ U_L \angle 30^\circ + U_L \angle -90^\circ + U_L \angle +150^\circ = 0 ]$$

$$[ \underline{\bar{I}_A} + \underline{\bar{I}_B} + \underline{\bar{I}_C} = \underline{\bar{I}_N} = \underline{0A} ]$$

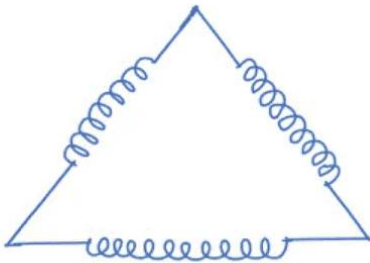
(ii)  $\Delta$  - Connection -

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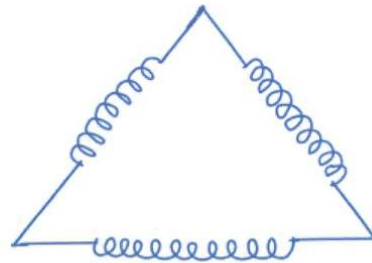




(ii)  $\Delta$  - Connection -

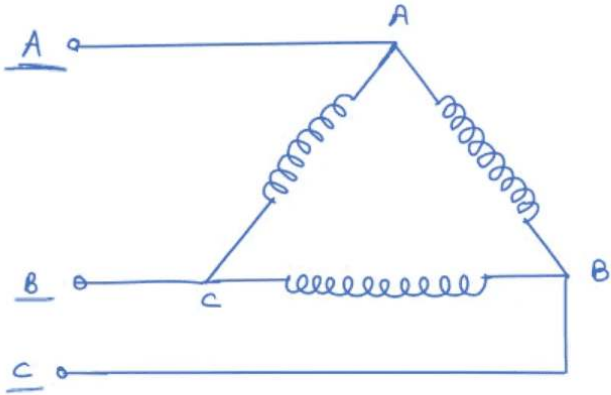


(3- $\phi$   $\Delta$  - Load)

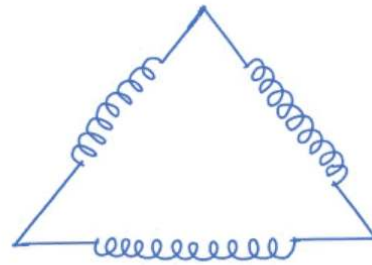


(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -

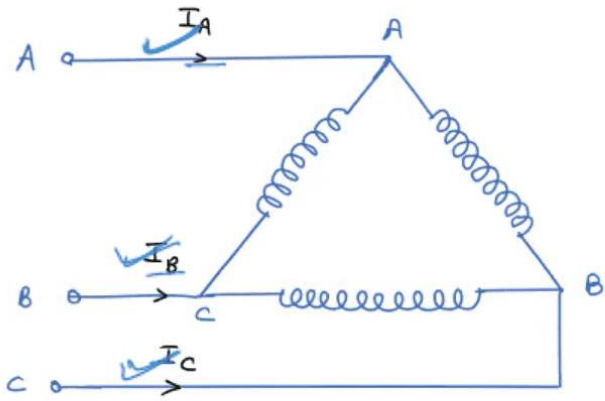


(3- $\phi$   $\Delta$  - Load)



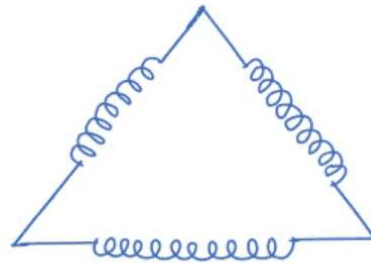
(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -



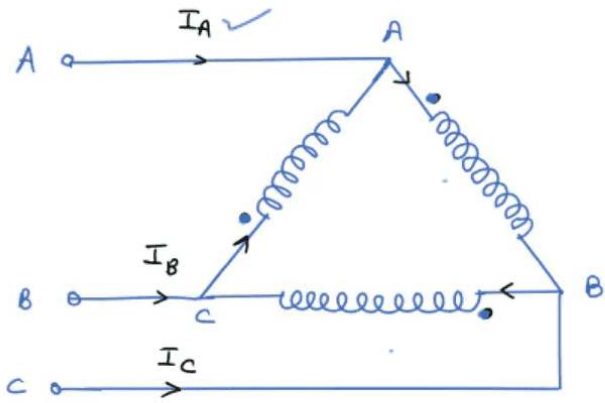
(3- $\phi$   $\Delta$  - Load)

Here  $\underline{I_A}, \underline{I_B}, \underline{I_C} \rightarrow$  Line Current



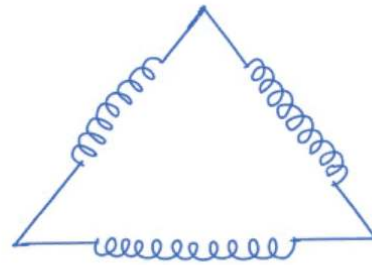
(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -



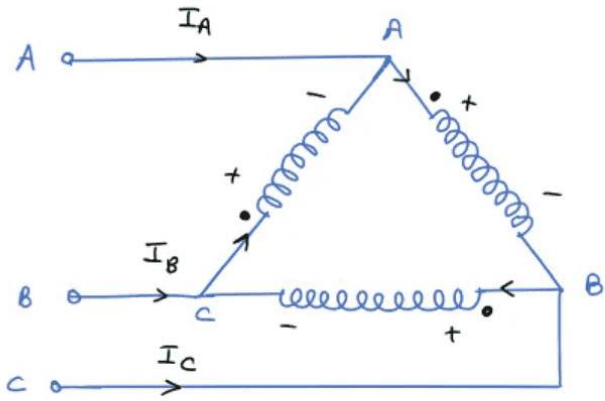
(3- $\phi$   $\Delta$  - Load)

Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current



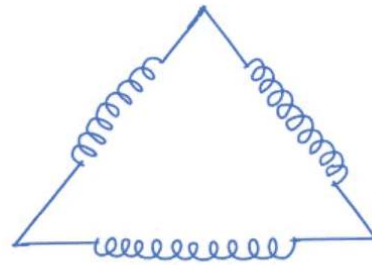
(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -



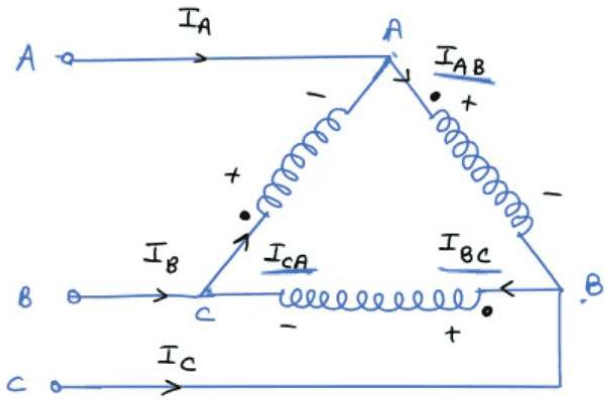
(3- $\phi$   $\Delta$  - Load)

Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current



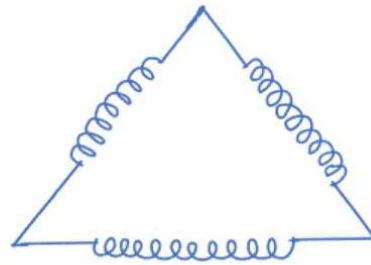
(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -



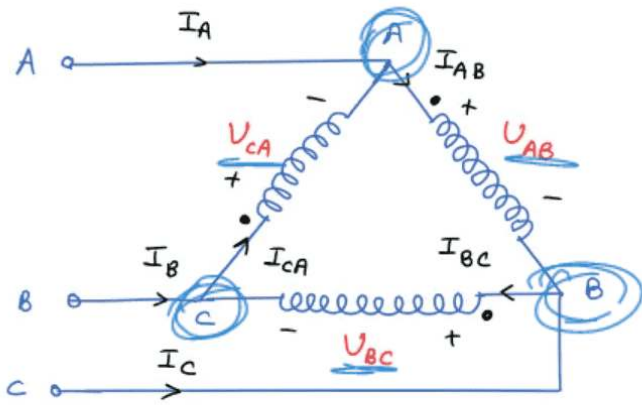
(3- $\phi$   $\Delta$  - Load)

Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current



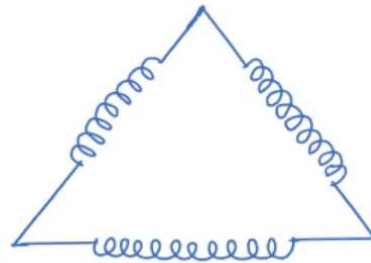
(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -



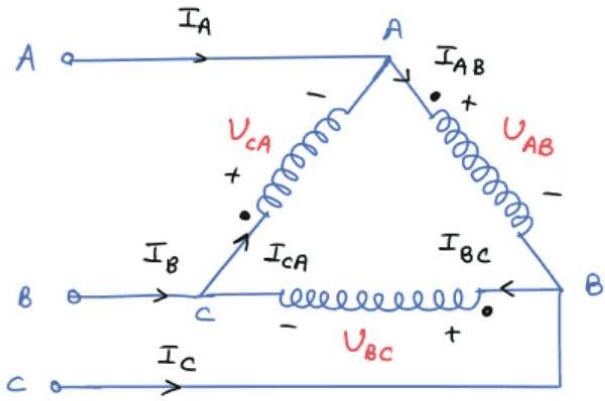
(3- $\phi$   $\Delta$  - Load)

Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current

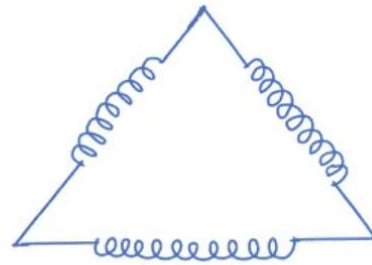


(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -



(3- $\phi$   $\Delta$  - Load)



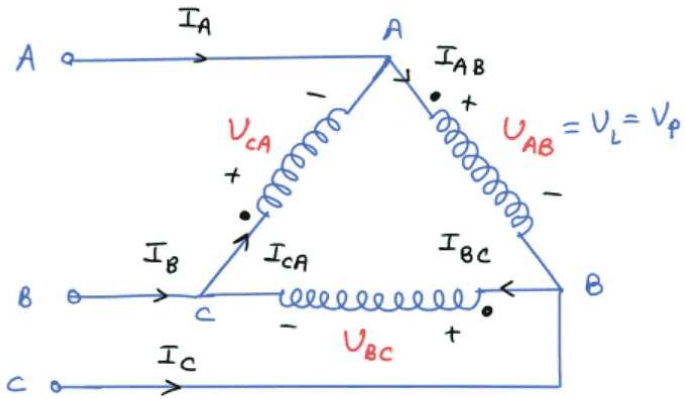
(3- $\phi$   $\Delta$  - Supply)

\* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current

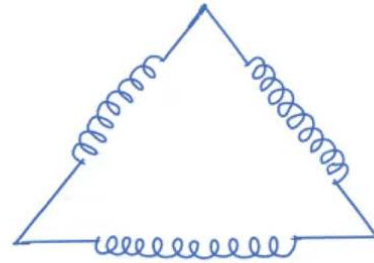
\* For  $\Delta$ -connection  $[V_L = V_p]$



(ii)  $\Delta$  - Connection -



(3- $\phi$   $\Delta$  - Load)

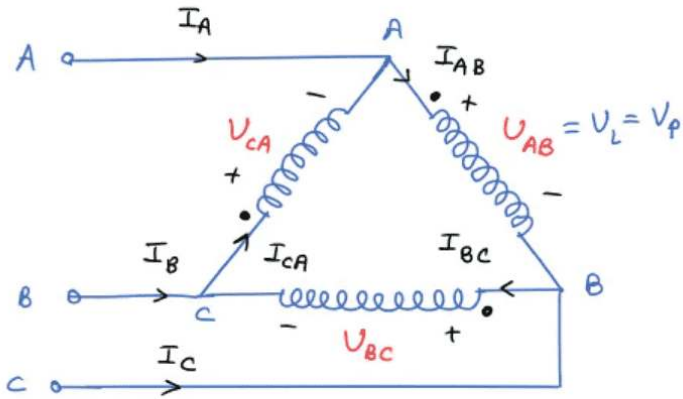


(3- $\phi$   $\Delta$  - Supply)

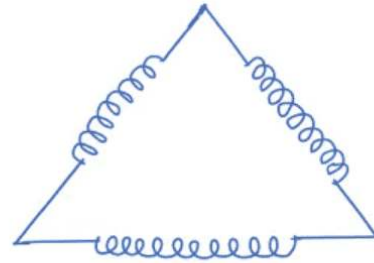
\* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current

\* For  $\Delta$ -connection  $[U_L = U_p]$

(ii)  $\Delta$  - Connection -



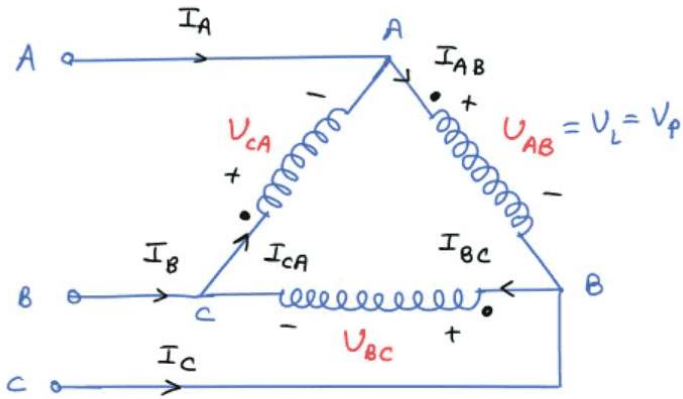
(3- $\phi$   $\Delta$  - Load)



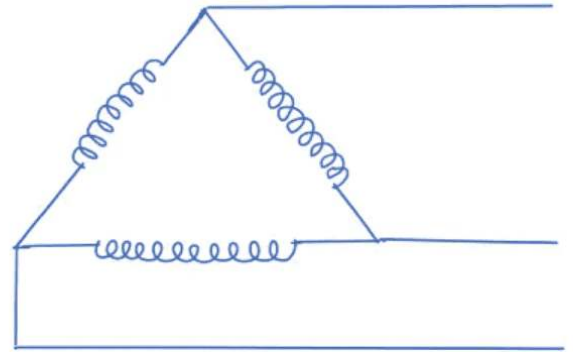
(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[U_L = V_p]$
- $$\left. \begin{array}{l} \underline{V_{AB}} = \underline{V_L} \angle 0^\circ \text{ or } \underline{V_p} \angle 0^\circ \\ \underline{V_{BC}} = \underline{V_L} \angle -120^\circ \text{ or } \underline{V_p} \angle -120^\circ \\ \underline{V_{CA}} = \underline{V_L} \angle -240^\circ \text{ or } \underline{V_p} \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -



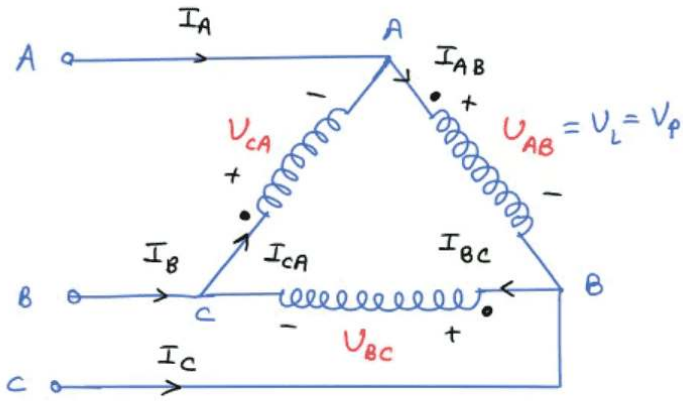
(3- $\phi$   $\Delta$  - Load)



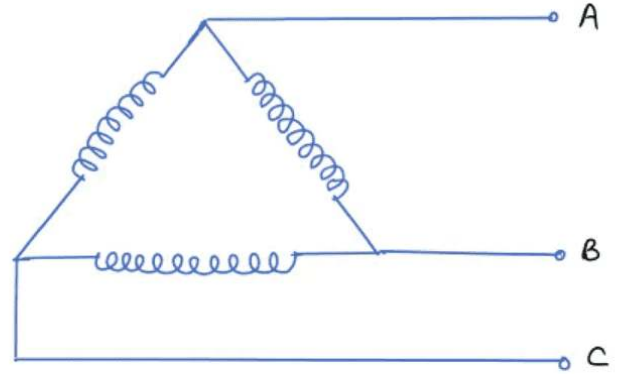
(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
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(ii)  $\Delta$  - Connection -



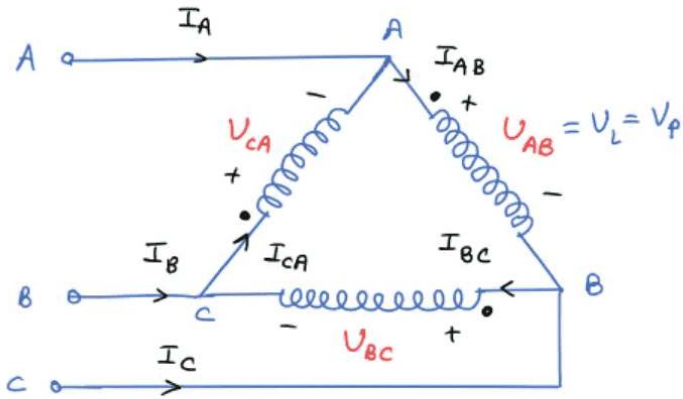
(3- $\phi$   $\Delta$  - Load)



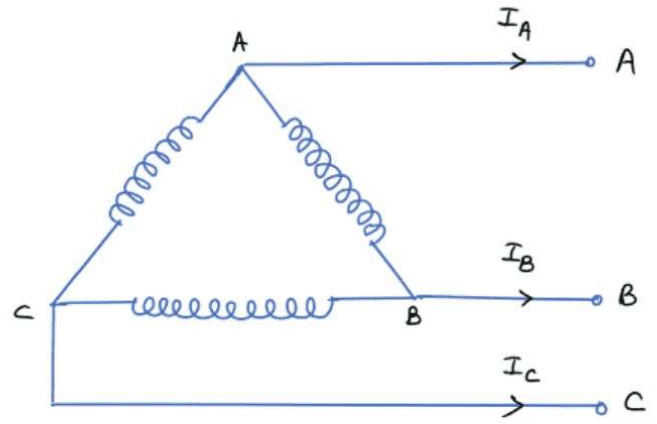
(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[V_L = V_p]$
- $$\left. \begin{array}{l} V_{AB} = V_L \angle 0^\circ \text{ or } V_p \angle 0^\circ \\ V_{BC} = V_L \angle -120^\circ \text{ or } V_p \angle -120^\circ \\ V_{CA} = V_L \angle -240^\circ \text{ or } V_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -



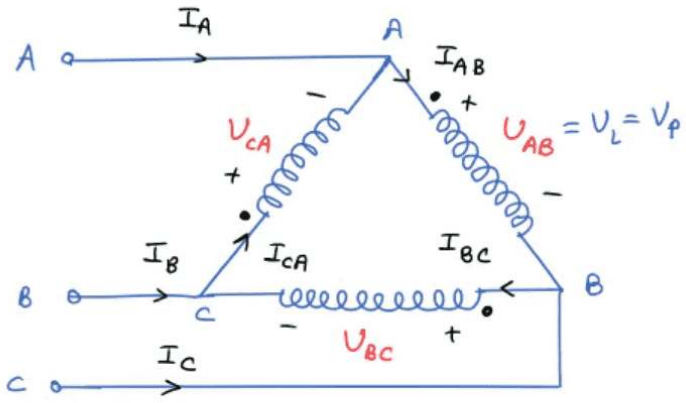
(3- $\phi$   $\Delta$  - Load)



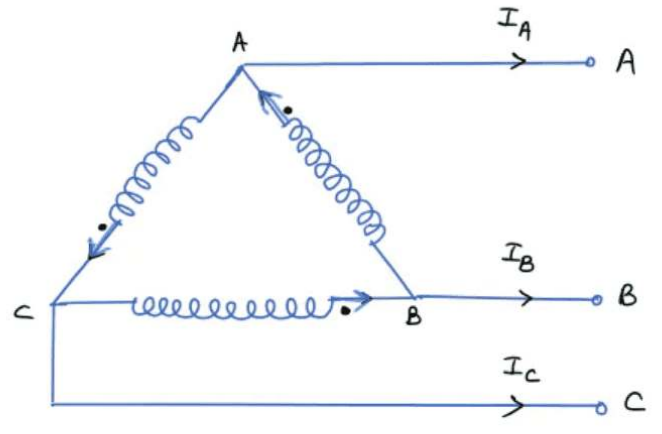
(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[U_L = U_p]$
- $$\left. \begin{array}{l} V_{AB} = U_L \angle 0^\circ \text{ or } U_p \angle 0^\circ \\ V_{BC} = U_L \angle -120^\circ \text{ or } U_p \angle -120^\circ \\ V_{CA} = U_L \angle -240^\circ \text{ or } U_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -



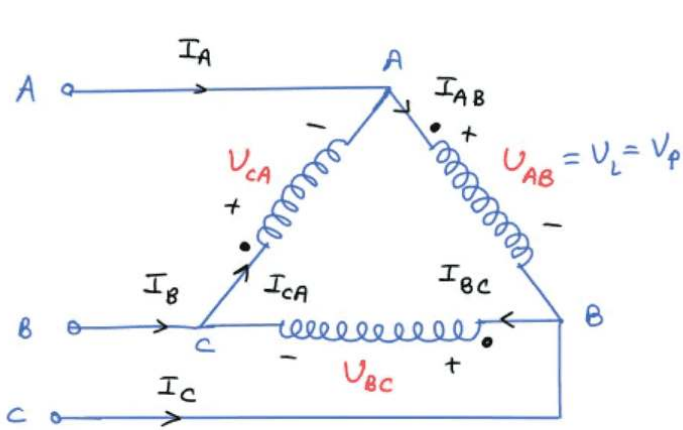
(3- $\phi$   $\Delta$  - Load)



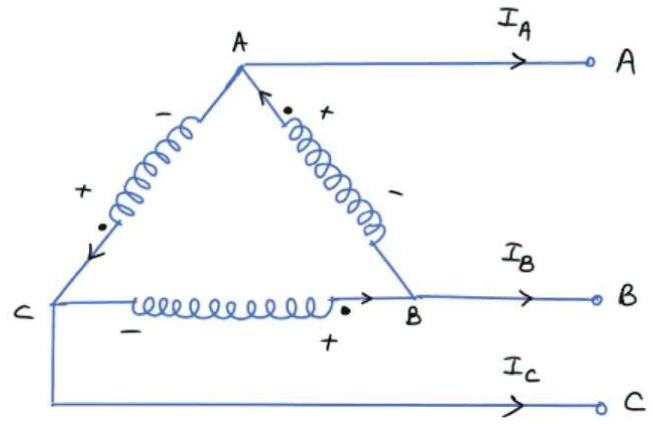
(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[U_L = U_p]$
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(ii)  $\Delta$  - Connection -



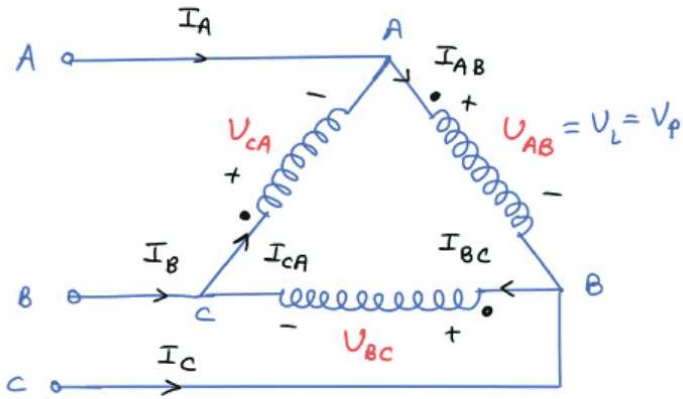
(3- $\phi$   $\Delta$  - Load)



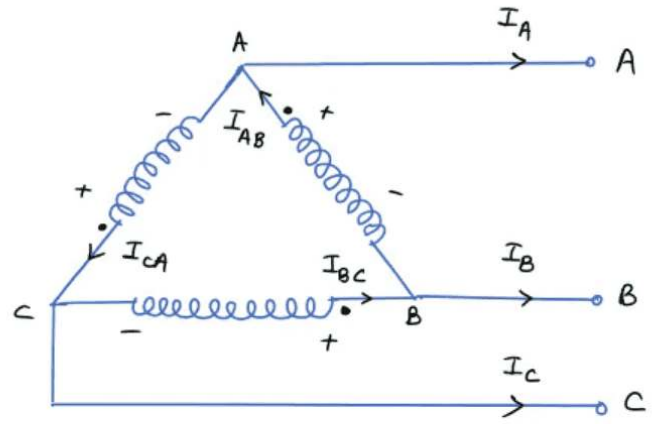
(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[U_L = U_p]$
- $$\left. \begin{array}{l} V_{AB} = U_L \angle 0^\circ \text{ or } U_p \angle 0^\circ \\ V_{BC} = U_L \angle -120^\circ \text{ or } U_p \angle -120^\circ \\ V_{CA} = U_L \angle -240^\circ \text{ or } U_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -



(3- $\phi$   $\Delta$  - Load)

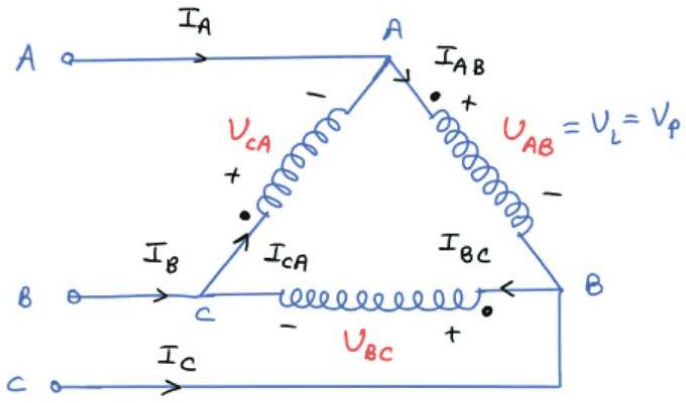


(3- $\phi$   $\Delta$  - Supply)

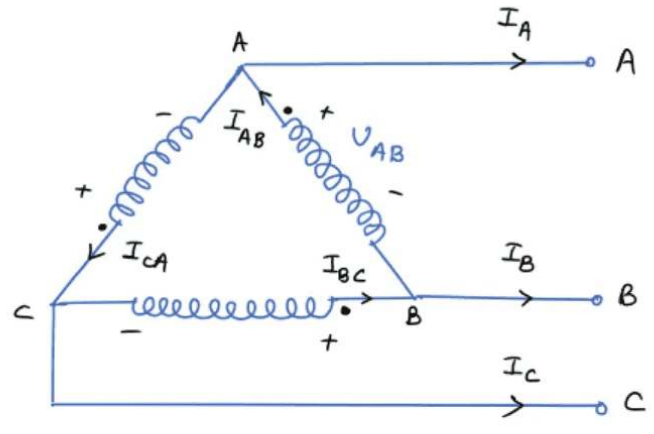
- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[U_L = U_p]$
- $$\left. \begin{array}{l} V_{AB} = U_L \angle 0^\circ \text{ or } U_p \angle 0^\circ \\ V_{BC} = U_L \angle -120^\circ \text{ or } U_p \angle -120^\circ \\ V_{CA} = U_L \angle -240^\circ \text{ or } U_p \angle -240^\circ \end{array} \right\}$$



(ii)  $\Delta$  - Connection -



(3- $\phi$   $\Delta$  - Load)



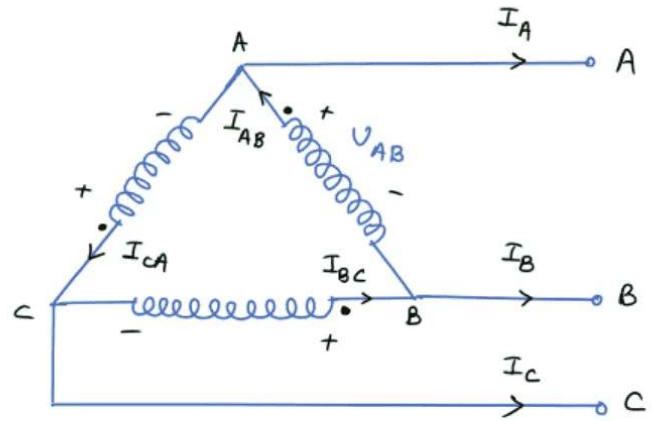
(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[U_L = U_p]$
- $$\left. \begin{array}{l} V_{AB} = U_L \angle 0^\circ \text{ or } U_p \angle 0^\circ \\ V_{BC} = U_L \angle -120^\circ \text{ or } U_p \angle -120^\circ \\ V_{CA} = U_L \angle -240^\circ \text{ or } U_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

Let assume  $\Delta$  - Supply -



(3- $\phi$   $\Delta$  - Supply)

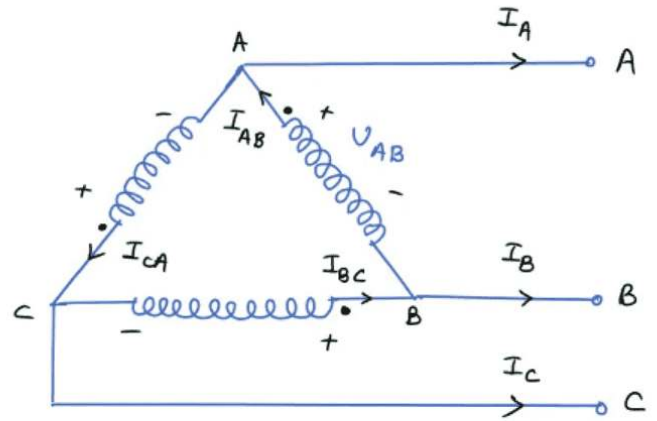
- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[V_L = V_p]$
- $$\left. \begin{array}{l} V_{AB} = V_L \angle 0^\circ \text{ or } V_p \angle 0^\circ \\ V_{BC} = V_L \angle -120^\circ \text{ or } V_p \angle -120^\circ \\ V_{CA} = V_L \angle -240^\circ \text{ or } V_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

Let assume  $\Delta$  - Supply -

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$



(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[V_L = V_p]$
- $$\left. \begin{array}{l} V_{AB} = V_L \angle 0^\circ \text{ or } V_p \angle 0^\circ \\ V_{BC} = V_L \angle -120^\circ \text{ or } V_p \angle -120^\circ \\ V_{CA} = V_L \angle -240^\circ \text{ or } V_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

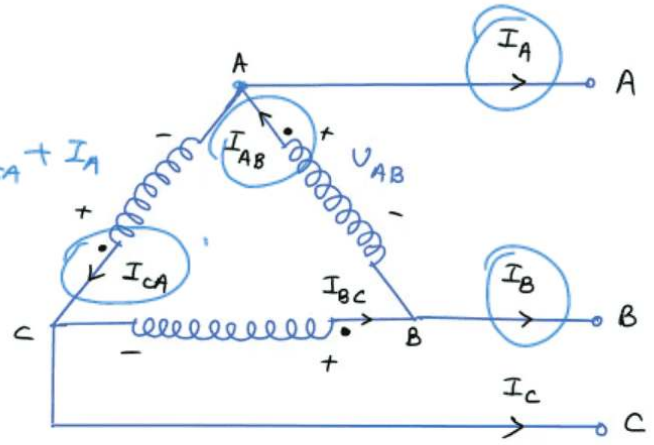
Let assume  $\Delta$  - Supply -

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$\bar{I}_B = \bar{I}_{BC} - \bar{I}_{AB}$$

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$\bar{I}_{AB} = \bar{I}_{CA} + \bar{I}_A$$



(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[V_L = V_p]$
- $$\left. \begin{array}{l} V_{AB} = V_L \angle 0^\circ \text{ or } V_p \angle 0^\circ \\ V_{BC} = V_L \angle -120^\circ \text{ or } V_p \angle -120^\circ \\ V_{CA} = V_L \angle -240^\circ \text{ or } V_p \angle -240^\circ \end{array} \right\}$$

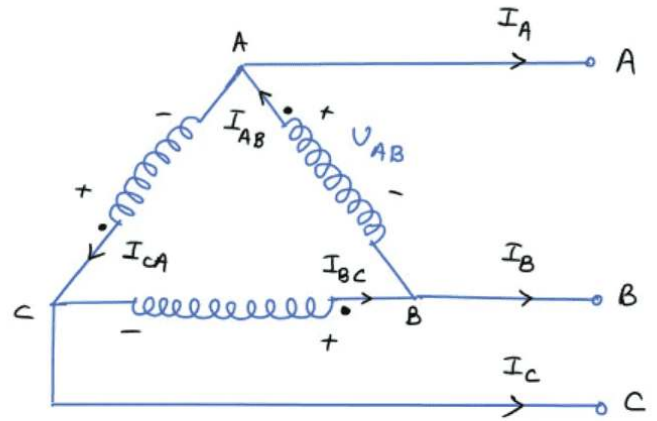
(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

Let assume  $\Delta$  - Supply -

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$\bar{I}_B = \bar{I}_{BC} - \bar{I}_{AB}$$



(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[V_L = V_p]$
- $$\left. \begin{array}{l} V_{AB} = V_L \angle 0^\circ \text{ or } V_p \angle 0^\circ \\ V_{BC} = V_L \angle -120^\circ \text{ or } V_p \angle -120^\circ \\ V_{CA} = V_L \angle -240^\circ \text{ or } V_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -

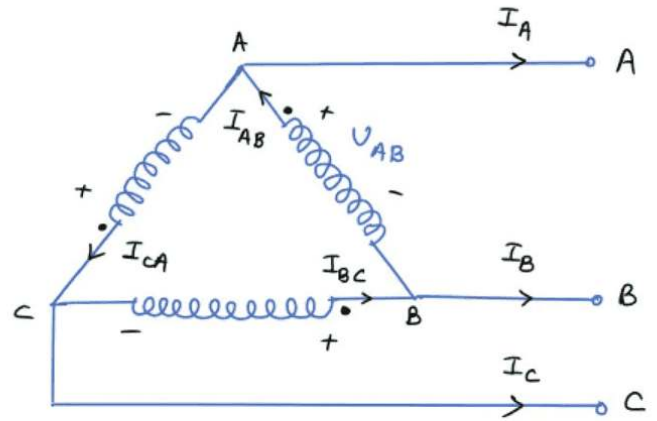
Currents in  $\Delta$  - Connection

Let assume  $\Delta$  - Supply -

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$\bar{I}_B = \bar{I}_{BC} - \bar{I}_{AB}$$

$$\bar{I}_C = \bar{I}_{CB} - \bar{I}_{BC}$$



(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$  - Connection  $[V_L = V_p]$
- $$\left. \begin{array}{l} V_{AB} = V_L \angle 0^\circ \text{ or } V_p \angle 0^\circ \\ V_{BC} = V_L \angle -120^\circ \text{ or } V_p \angle -120^\circ \\ V_{CA} = V_L \angle -240^\circ \text{ or } V_p \angle -240^\circ \end{array} \right\}$$

(ii)  $\Delta$  - Connection -

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Currents in  $\Delta$  - Connection

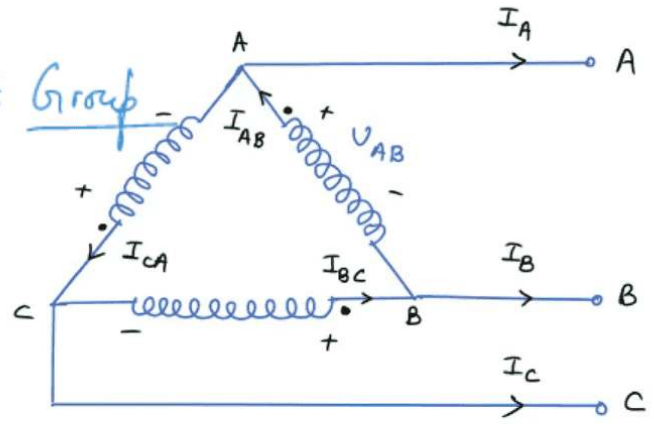
Let assume  $\Delta$  - Supply -

Broadcast Group

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$\bar{I}_B = \bar{I}_{BC} - \bar{I}_{AB} \quad \text{a. } I_L \text{ lead } I_p \text{ by } 30^\circ$$

$$\bar{I}_C = \bar{I}_{CA} - \bar{I}_{BC} \quad \text{b. } I_L \text{ lag } I_p \text{ by } 30^\circ$$



(3- $\phi$   $\Delta$  - Supply)

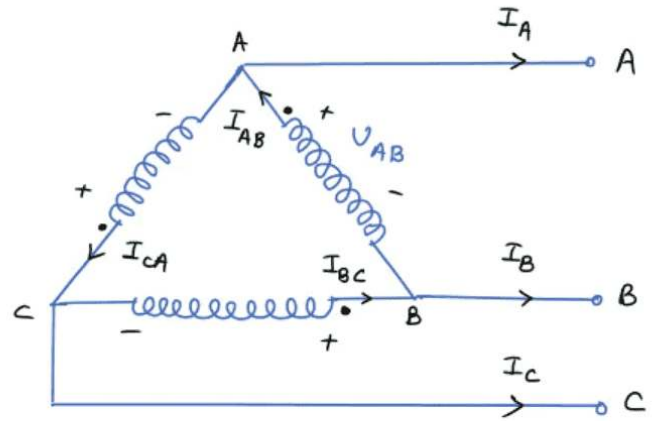
- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[U_L = U_p]$
- $$\left. \begin{aligned} V_{AB} &= U_L \angle 0^\circ \text{ or } U_p \angle 0^\circ \\ V_{BC} &= U_L \angle -120^\circ \text{ or } U_p \angle -120^\circ \\ V_{CA} &= U_L \angle -240^\circ \text{ or } U_p \angle -240^\circ \end{aligned} \right\}$$

(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

Let assume  $\Delta$  - Supply -

$$\left. \begin{aligned} \bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\ \bar{I}_B &= \bar{I}_{BC} - \bar{I}_{AB} \\ \bar{I}_C &= \bar{I}_{CA} - \bar{I}_{BC} \end{aligned} \right\} \text{Line currents}$$



(3- $\phi$   $\Delta$  - Supply)

- \* Here  $\bar{I}_A, \bar{I}_B, \bar{I}_C \rightarrow$  Line Current
  - \* For  $\Delta$ -connection  $[V_L = V_p]$
- $$\left. \begin{aligned} V_{AB} &= V_L \angle 0^\circ \text{ or } V_p \angle 0^\circ \\ V_{BC} &= V_L \angle -120^\circ \text{ or } V_p \angle -120^\circ \\ V_{CA} &= V_L \angle -240^\circ \text{ or } V_p \angle -240^\circ \end{aligned} \right\}$$



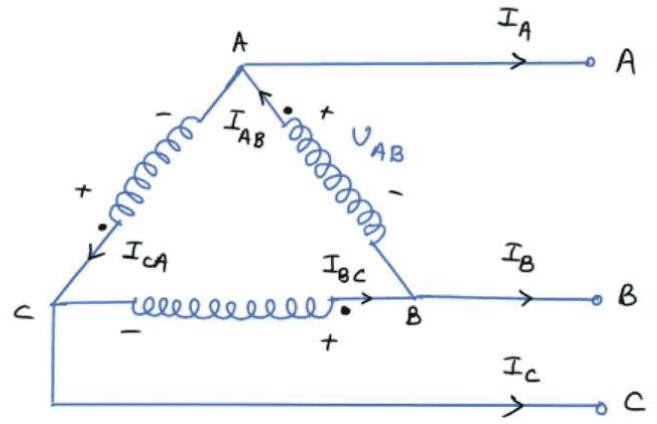
(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

\* Let assume  $\Delta$  - Supply -

$$\left. \begin{aligned} \bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\ \bar{I}_B &= \bar{I}_{BC} - \bar{I}_{AB} \\ \bar{I}_C &= \bar{I}_{CA} - \bar{I}_{BC} \end{aligned} \right\} \text{line currents}$$

\*  $\bar{I}_{AB} = \underline{I_p} \angle 0^\circ$   
 $\bar{I}_{BC} =$



(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

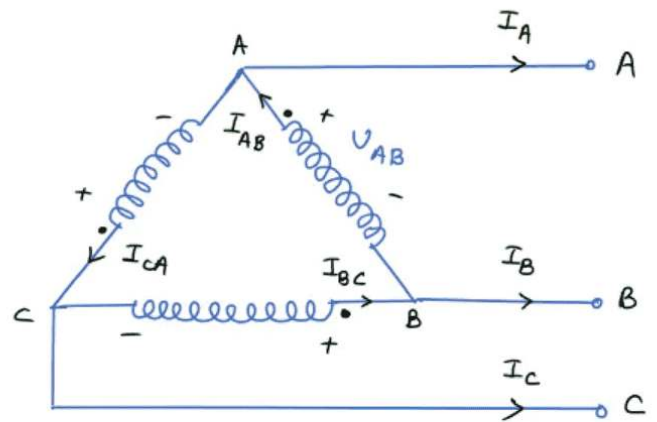
\* Let assume  $\Delta$  - Supply -

$$\left. \begin{aligned} \underline{I}_A &= \underline{I}_{AB} - \underline{I}_{CA} \\ \underline{I}_B &= \underline{I}_{BC} - \underline{I}_{AB} \\ \underline{I}_C &= \underline{I}_{CA} - \underline{I}_{BC} \end{aligned} \right\} \text{Line currents}$$

\*  $\underline{I}_{AB} = I_p \angle 0^\circ$

$\underline{I}_{BC} = I_p \angle -120^\circ$

$\underline{I}_{CA} = I_p \angle -240^\circ$  or  $\angle +120^\circ$



(3- $\phi$   $\Delta$  - Supply)

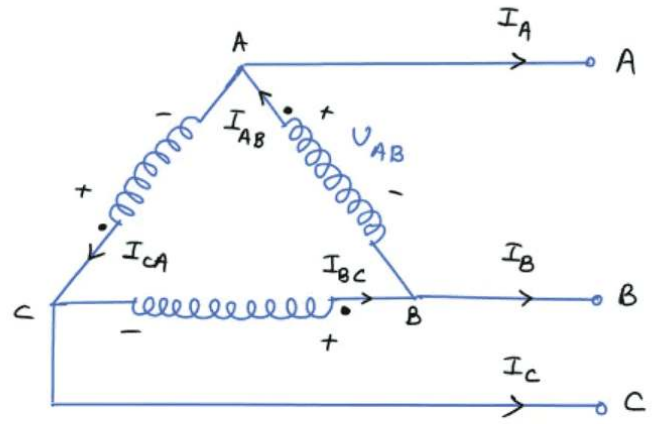
(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

\* Let assume  $\Delta$  - Supply -

$$\left. \begin{aligned} \bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\ \bar{I}_B &= \bar{I}_{BC} - \bar{I}_{AB} \\ \bar{I}_C &= \bar{I}_{CA} - \bar{I}_{BC} \end{aligned} \right\} \text{line currents}$$

$$\left. \begin{aligned} \bar{I}_{AB} &= I_p \angle 0^\circ \\ \bar{I}_{BC} &= I_p \angle -120^\circ \\ \bar{I}_{CA} &= I_p \angle -240 \text{ or } \angle +120^\circ \end{aligned} \right\} \text{phase currents.}$$



(3- $\phi$   $\Delta$  - Supply)

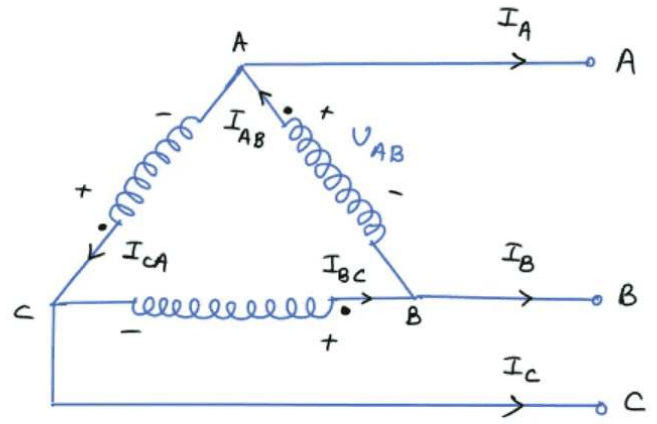
(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

\* Let assume  $\Delta$  - Supply -

$$\left. \begin{aligned} \bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\ \bar{I}_B &= \bar{I}_{BC} - \bar{I}_{AB} \\ \bar{I}_C &= \bar{I}_{CA} - \bar{I}_{BC} \end{aligned} \right\} \text{line currents}$$

$$\left. \begin{aligned} \bar{I}_{AB} &= I_p \angle 0^\circ - \text{reference.} \\ \bar{I}_{BC} &= I_p \angle -120^\circ \\ \bar{I}_{CA} &= I_p \angle -240 \text{ or } \angle +120^\circ \end{aligned} \right\} \text{phase currents.}$$



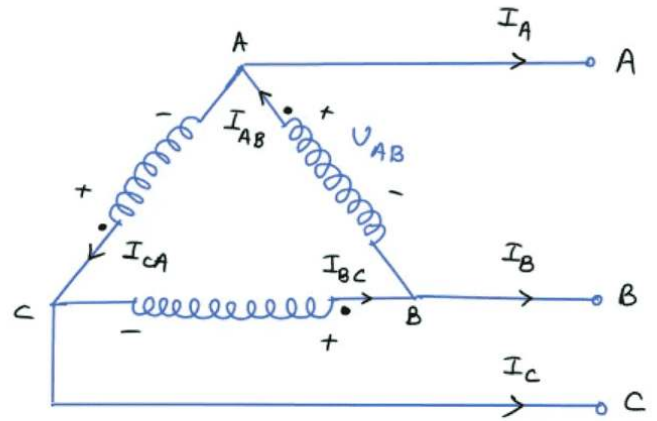
(3- $\phi$   $\Delta$  - Supply)

(ii)  $\Delta$  - Connection -

Currents in  $\Delta$  - Connection

\* Let assume  $\Delta$  - Supply -

$$\left. \begin{aligned} \bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\ \bar{I}_B &= \bar{I}_{BC} - \bar{I}_{AB} \\ \bar{I}_C &= \bar{I}_{CA} - \bar{I}_{BC} \end{aligned} \right\} \text{Line currents}$$



\*  $\left. \begin{aligned} \bar{I}_{AB} &= I_p \angle 0^\circ \text{ - reference. } = \underline{I_{mp} \sin(\omega t + 0^\circ)} \\ \bar{I}_{BC} &= I_p \angle -120^\circ = \underline{I_{mp} \sin(\omega t - 120^\circ)} \\ \bar{I}_{CA} &= I_p \angle -240 \text{ or } \angle +120^\circ = \underline{I_{mp} \sin(\omega t - 240^\circ)} \\ &\quad \text{or} \\ &\quad \underline{I_{mp} \sin(\omega t + 120^\circ)} \end{aligned} \right\} (3-\phi \Delta \text{ - Supply})$

$$\underline{\bar{I}_A} = \underline{\bar{I}_{AB}} - \underline{\bar{I}_{CA}}$$

$$\overline{I}_A = \overline{I}_{AB} - \overline{I}_{CA}$$

$$= \underline{I_{mp}} \underline{\sin(\omega t)} - \underline{I_{mp}} \underline{\sin(\omega t + 120^\circ)}$$

$$\overline{I}_A = \overline{I}_{AB} - \overline{I}_{CA}$$

$$= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ)$$

$$= I_{mp} \left[ \underline{\sin(\omega t)} - \underline{\sin(\omega t + 120^\circ)} \right]$$



$$\overline{I}_A = \overline{I}_{AB} - \overline{I}_{CA}$$

$$= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ)$$

$$= I_{mp} \left[ \sin(\omega t) - \sin(\omega t + 120^\circ) \right]$$

$$= I_{mp} \left[ \underline{2} \cdot \cos(\underline{\omega t} + \underline{60^\circ}) \right]$$

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ)$$

$$= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)]$$

$$= I_{mp} [2 \cdot \cos(\omega t + 60^\circ) \underline{\sin(-60^\circ)}]$$

$$\sin(-\theta) = \underline{\underline{-\sin\theta}}$$

$$\overline{I}_A = \overline{I}_{AB} - \overline{I}_{CA}$$

$$= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ)$$

$$= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)]$$

$$= I_{mp} [2 \cdot \cos(\omega t + 60^\circ) \sin(-60^\circ)]$$

$$= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ$$

$$\begin{aligned}\bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\ &= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ) \\ &= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)] \\ &= I_{mp} [2 \cdot \cos(\omega t + 60^\circ) \sin(-60^\circ)] \\ &= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ \\ &= -\cancel{2} I_{mp} \times \frac{\sqrt{3}}{\cancel{2}} \cos(\omega t + 60^\circ)\end{aligned}$$

$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ)$$

$$= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)]$$

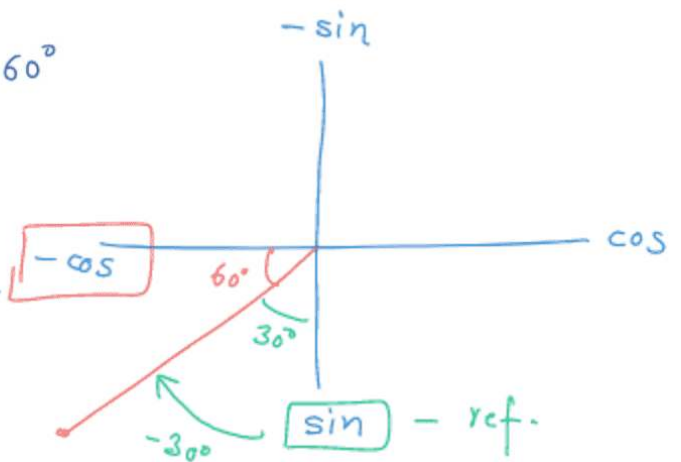
$$= I_{mp} [2 \cos(\omega t + 60^\circ) \sin(-60^\circ)]$$

$$= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ$$

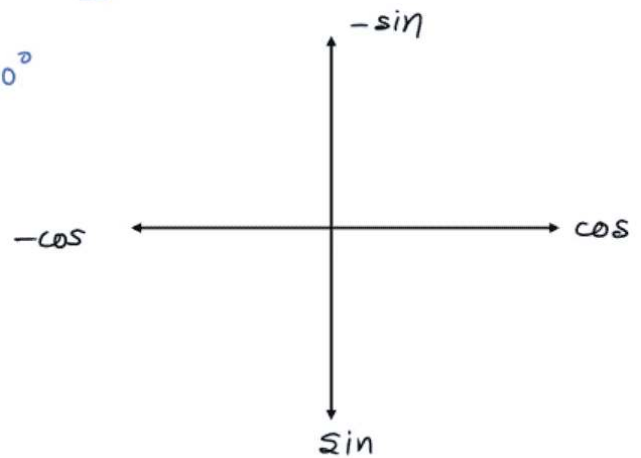
$$= -2 I_{mp} \times \frac{\sqrt{3}}{2} \cos(\omega t + 60^\circ)$$

$$= -\sqrt{3} I_{mp} \cos(\omega t + 60^\circ)$$

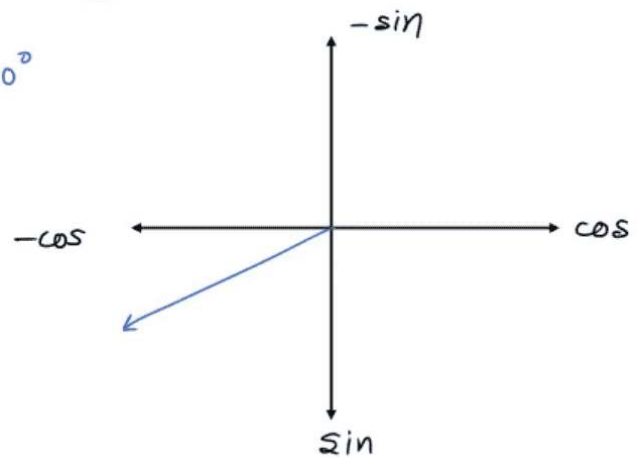
$$= \sqrt{3} I_{mp} \sin(\omega t - 30^\circ)$$



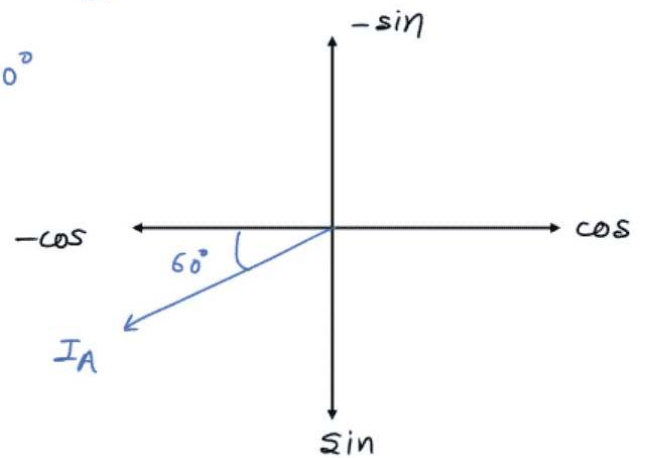
$$\begin{aligned}
\bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\
&= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ) \\
&= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)] \\
&= I_{mp} [2 \cos(\omega t + 60^\circ) \sin(-60^\circ)] \\
&= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ \\
&= -2 I_{mp} \times \frac{\sqrt{3}}{2} \cos(\omega t + 60^\circ) \\
&= -\sqrt{3} I_{mp} \cos(\omega t + 60^\circ)
\end{aligned}$$



$$\begin{aligned}
\bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\
&= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ) \\
&= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)] \\
&= I_{mp} [2 \cos(\omega t + 60^\circ) \sin(-60^\circ)] \\
&= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ \\
&= -2 I_{mp} \times \frac{\sqrt{3}}{2} \cos(\omega t + 60^\circ) \\
&= -\sqrt{3} I_{mp} \cos(\omega t + 60^\circ)
\end{aligned}$$

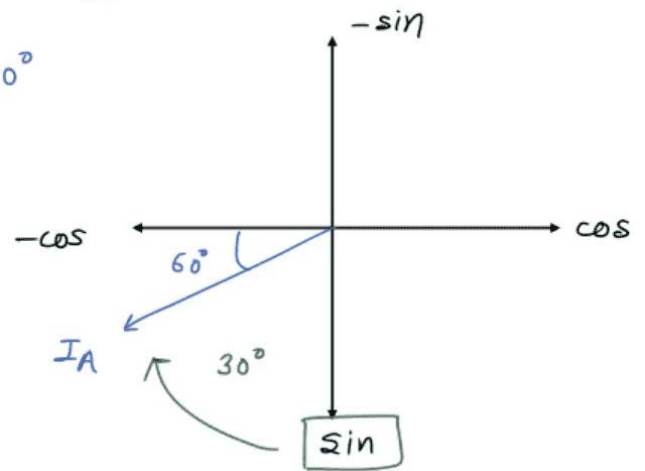


$$\begin{aligned}
\bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\
&= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ) \\
&= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)] \\
&= I_{mp} [2 \cos(\omega t + 60^\circ) \sin(-60^\circ)] \\
&= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ \\
&= -2 I_{mp} \times \frac{\sqrt{3}}{2} \cos(\omega t + 60^\circ) \\
&= -\sqrt{3} I_{mp} \cos(\omega t + 60^\circ)
\end{aligned}$$





$$\begin{aligned}
\bar{I}_A &= \bar{I}_{AB} - \bar{I}_{CA} \\
&= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ) \\
&= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)] \\
&= I_{mp} [2 \cos(\omega t + 60^\circ) \sin(-60^\circ)] \\
&= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ \\
&= -2 I_{mp} \times \frac{\sqrt{3}}{2} \cos(\omega t + 60^\circ) \\
&= -\sqrt{3} I_{mp} \cos(\omega t + 60^\circ)
\end{aligned}$$



$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA}$$

$$= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ)$$

$$= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)]$$

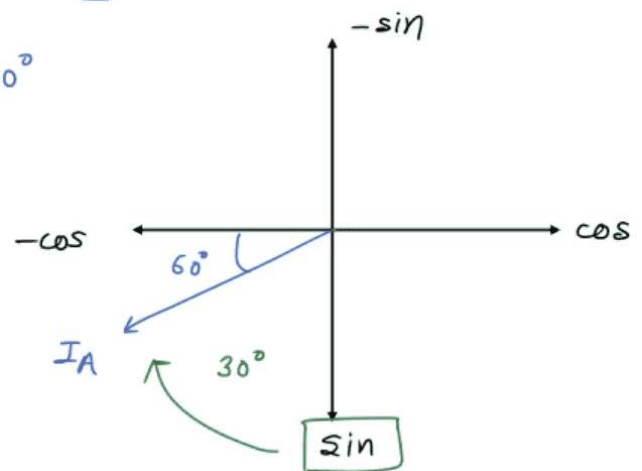
$$= I_{mp} [2 \cos(\omega t + 60^\circ) \sin(-60^\circ)]$$

$$= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ$$

$$= -2 I_{mp} \times \frac{\sqrt{3}}{2} \cos(\omega t + 60^\circ)$$

$$= -\sqrt{3} I_{mp} \cos(\omega t + 60^\circ)$$

$$I_A = \underline{\sqrt{3} I_{mp} \sin(\omega t - 30^\circ)}$$



$$\bar{I}_A = \bar{I}_{AB} - \bar{I}_{CA} \quad I_m \sin(\omega t)$$

$$= I_{mp} \sin(\omega t) - I_{mp} \sin(\omega t + 120^\circ)$$

$$= I_{mp} [\sin(\omega t) - \sin(\omega t + 120^\circ)]$$

$$= I_{mp} [2 \cos(\omega t + 60^\circ) \sin(-60^\circ)]$$

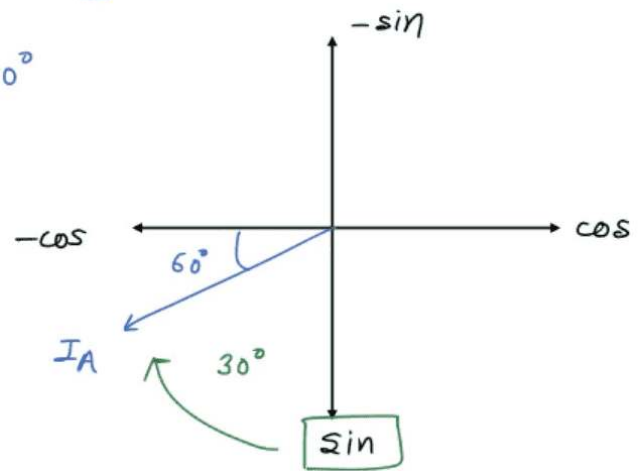
$$= -2 I_{mp} \cos(\omega t + 60^\circ) \sin 60^\circ$$

$$= -2 I_{mp} \times \frac{\sqrt{3}}{2} \cos(\omega t + 60^\circ)$$

$$= -\sqrt{3} I_{mp} \cos(\omega t + 60^\circ)$$

$$I_A = \sqrt{3} I_{mp} \sin(\omega t - 30^\circ)$$

$\hookrightarrow$  lag



$$\bar{I}_A = \bar{I}_L = \sqrt{3} I_{mp} \sin(\omega t - 30^\circ)$$

$$\bar{I}_A = \bar{I}_L = \sqrt{3} I_{mp} \sin(\omega t - 30^\circ)$$

$$\underline{\bar{I}_B} = \underline{\bar{I}_L} = \sqrt{3} I_{mp} \sin(\underline{\omega t} - \underline{150^\circ})$$

$$\bar{I}_A = \bar{I}_L = \sqrt{3} I_{mp} \sin(\omega t - 30^\circ)$$

$$\bar{I}_B = \bar{I}_L = \sqrt{3} I_{mp} \sin(\omega t - 150^\circ)$$

$$\bar{I}_C = \bar{I}_L = \sqrt{3} I_{mp} \sin(\omega t - 270^\circ) \text{ or } \sqrt{3} I_{mp} \sin(\omega t + 30^\circ)$$