1.1 Polyphase Circuits

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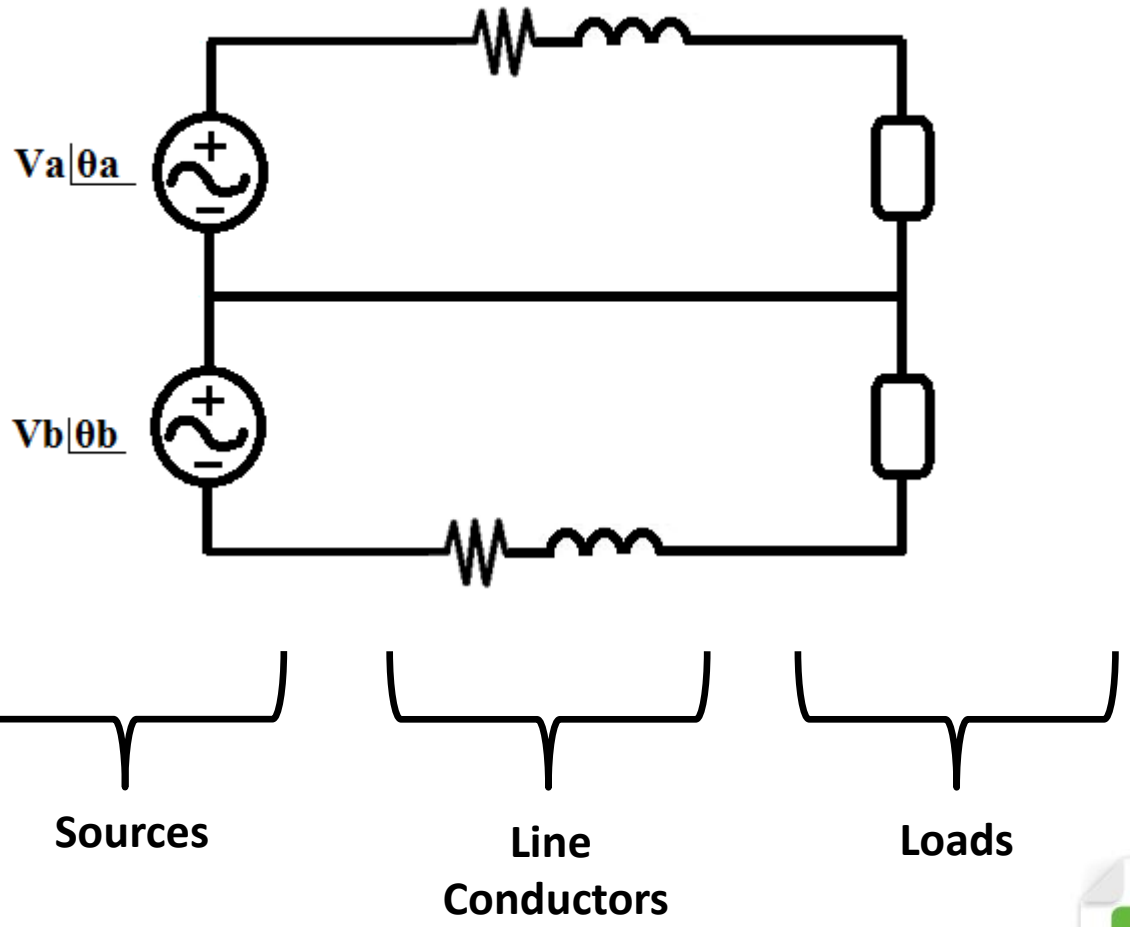
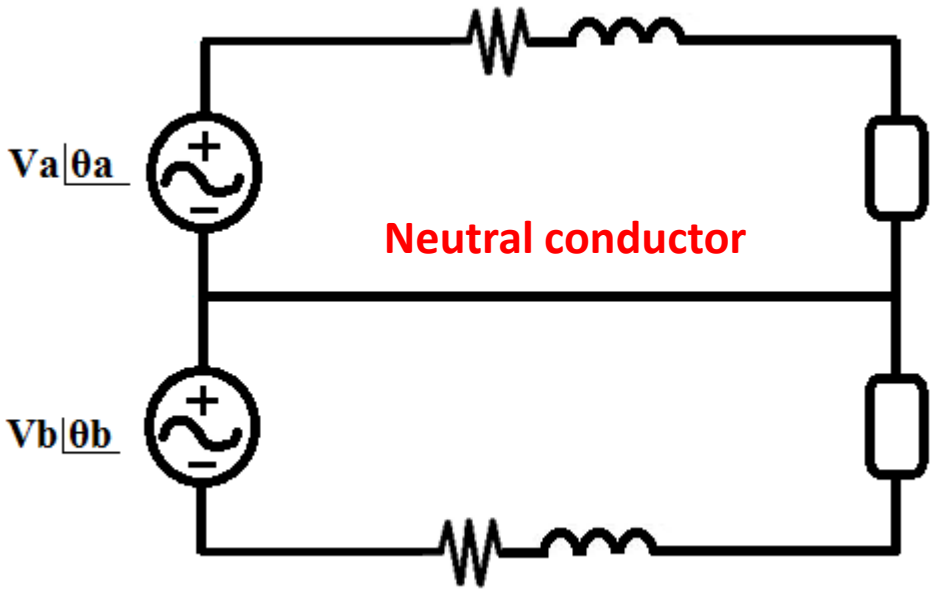
¿Polyphase circuits?

- «Polyphase circuits / systems : in which AC sources operate at the same frequency but different phase» [Sadiku]

Polyphase circuits



Single-phase circuits

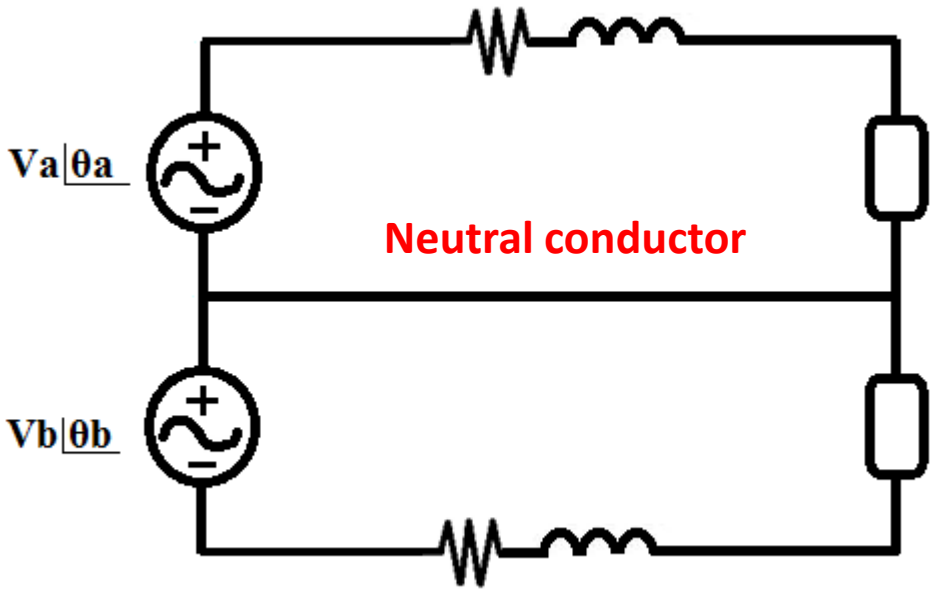


Single-phase three-wire

$Va = Vb$ {

- $|Va| = |Vb|$
- $\Theta a = \Theta b$

Bi-phase circuits



+

¿ Vab?

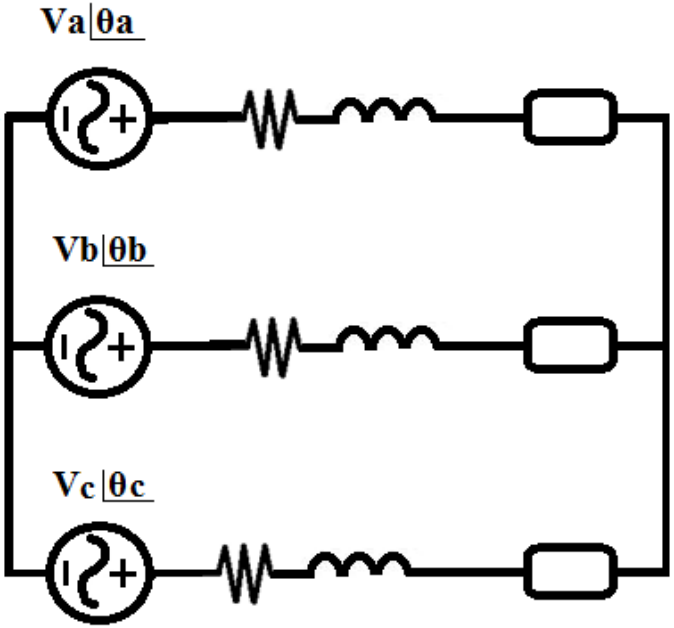
-

Bi-phase three-wire

$|Va| = |Vb|$

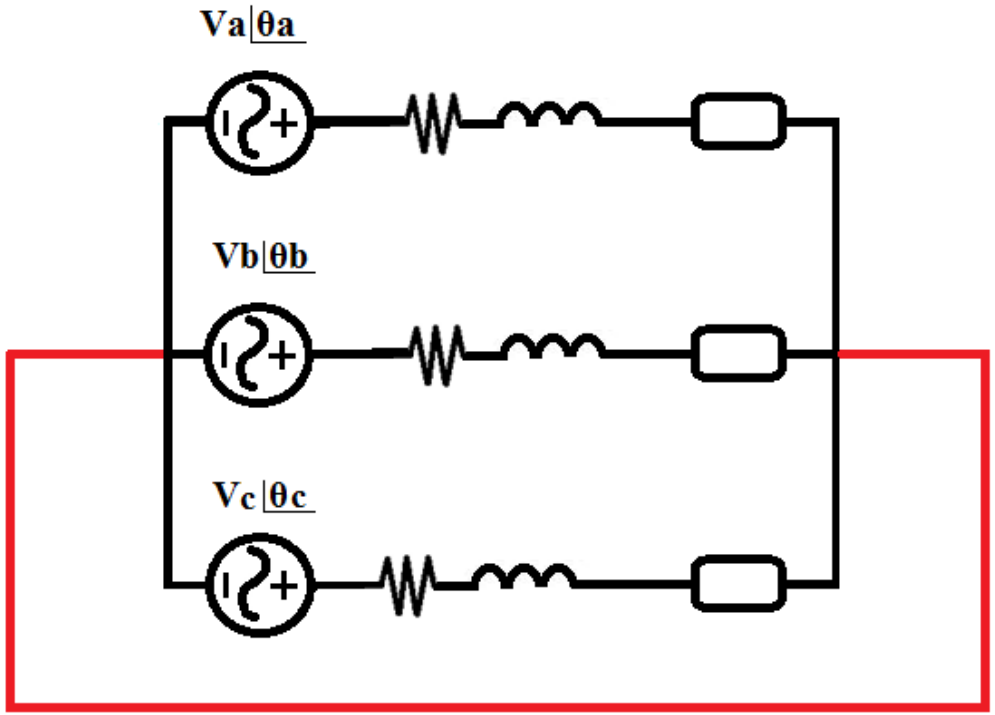
$\Theta a - \Theta b = 90^{o}$

Three-phase circuits



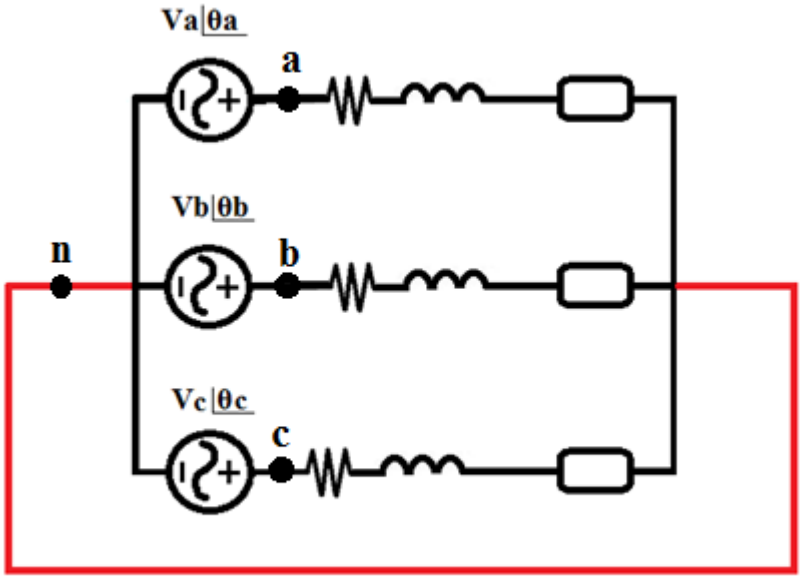
Three-phase three-wire

Substations (RST)
Motors (UVW)
Transformers (XYZ)



Three-phase four-wire
Neutral conductor

Three-phase circuits



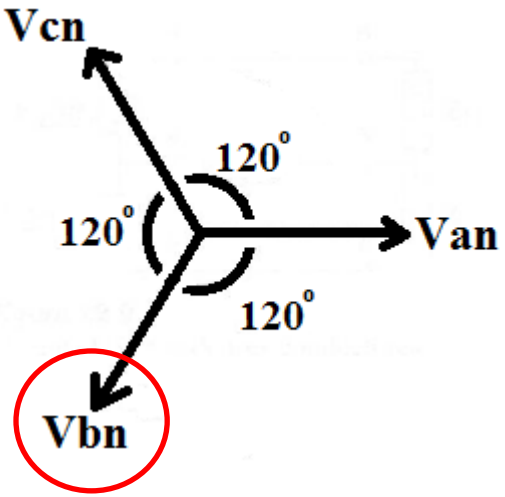
$|Van| = |Vbn| = |Vcn|$

Positive sequence	Negative sequence
$\Theta an = \Theta^o$	$\Theta an = \Theta^o$
$\Theta bn = \Theta^o - 120^o$	$\Theta bn = \Theta^o + 120^o$
$\Theta cn = \Theta^o + 120^o$	$\Theta cn = \Theta^o - 120^o$

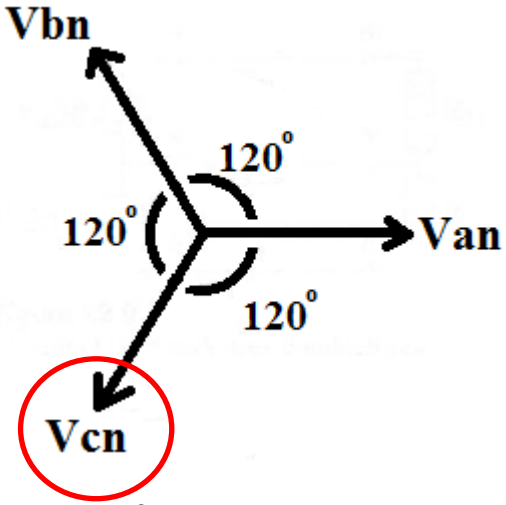
Neutral conductor

If the voltage source have the same amplitude and frequency ω and they are out of phase with each other by 120^o, the voltages are said to be balanced.

Three-phase circuits



Positive sequence

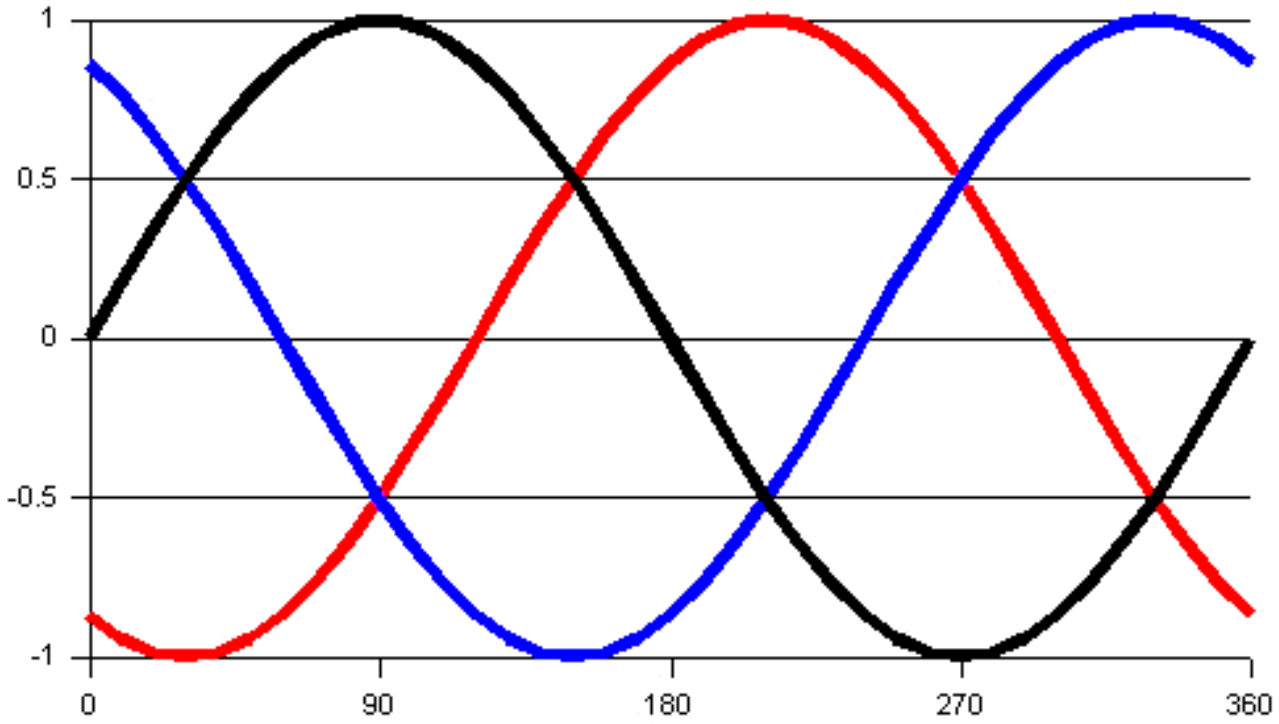


Negative sequence

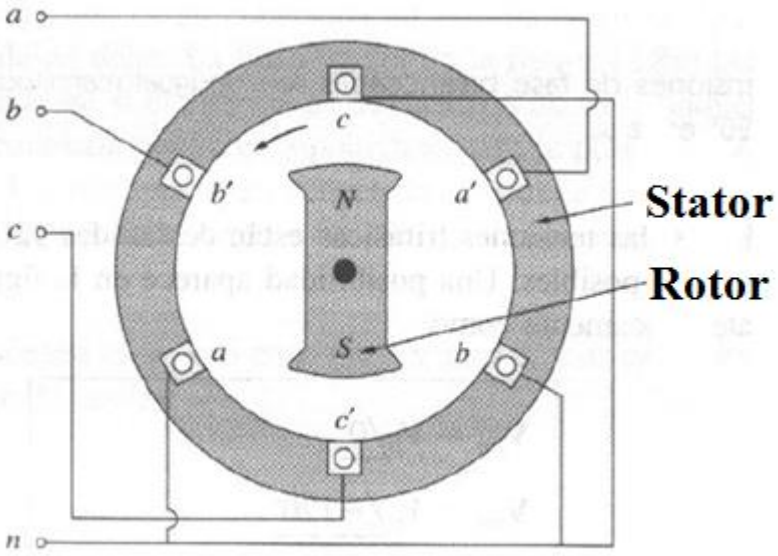
$$|Van| = |Vbn| = |Vcn|$$

Positive sequence (ABC)	Negative sequence (ACB)
$\Theta an = \Theta^o$	$\Theta an = \Theta^o$
$\Theta bn = \Theta^o - 120^o$	$\Theta bn = \Theta^o + 120^o$
$\Theta cn = \Theta^o + 120^o$	$\Theta cn = \Theta^o - 120^o$

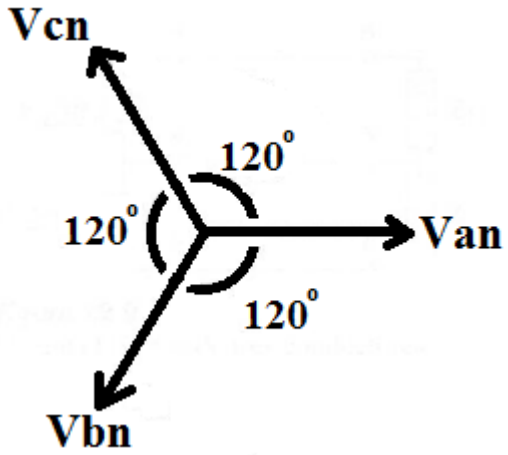
Three-phase circuits



Three-phase circuits



Source [Sadiku]

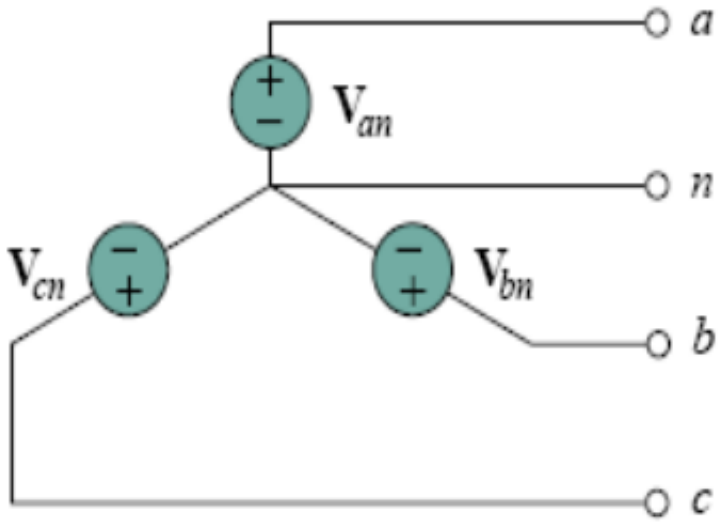


¿How much these voltages add?

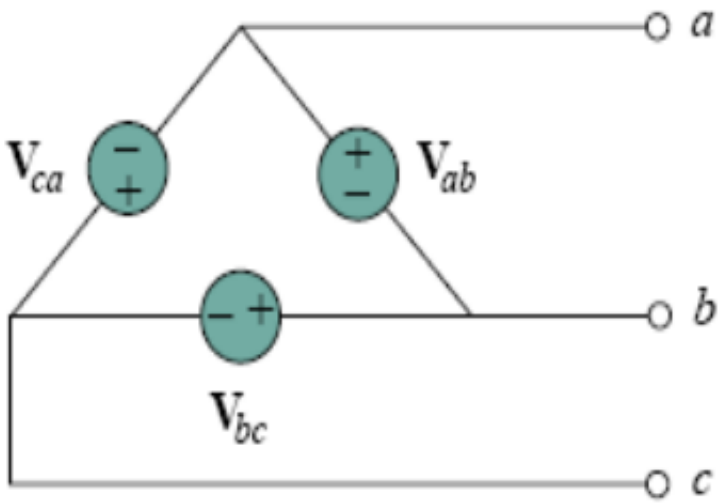
Excercise:

Van = 100 ∟170º Sec (+) ¿Vcn?
Vnc = 50 ∟-30º Sec (-) ¿Van?

Three-phase circuits

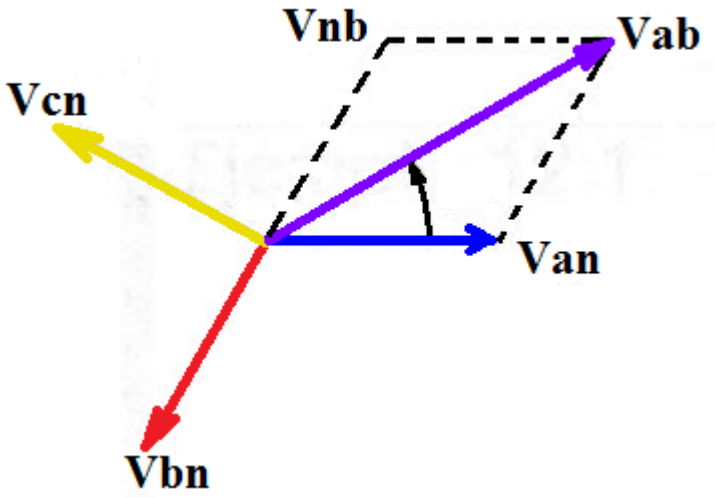


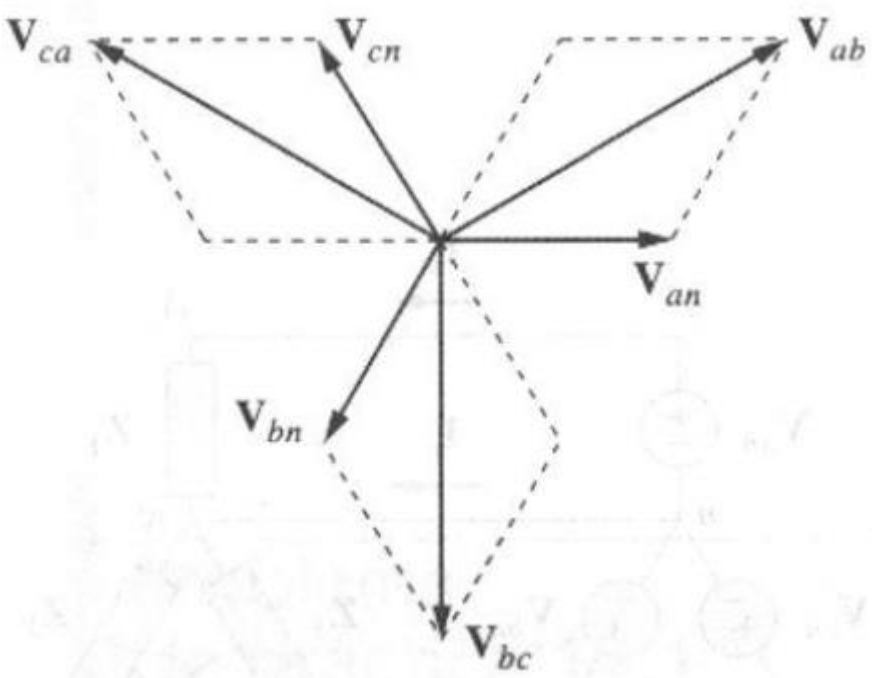
Wye-connected source



Delta-connected source

Three-phase circuits





$VL = \sqrt{3}\, Vph \angle\ 30º$ Sec (+)
$VL = \sqrt{3}\, Vph \angle -30º$ Sec (-)

Excercise:

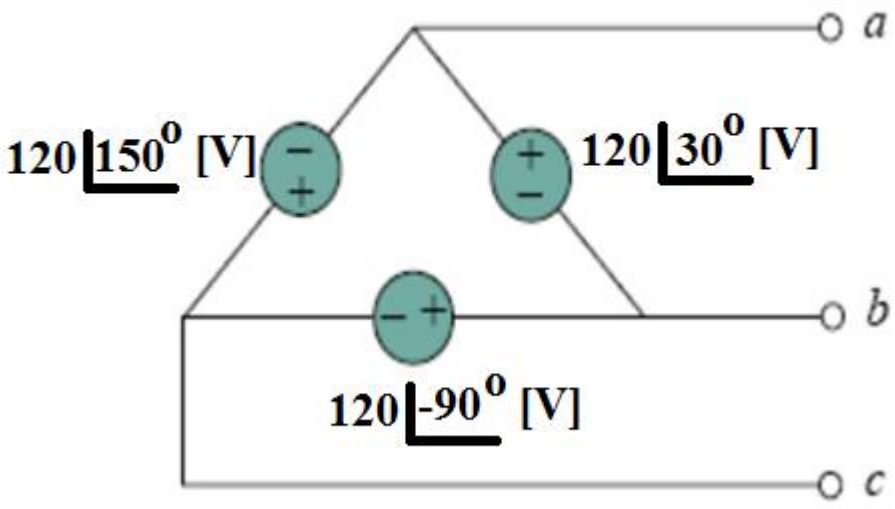
Vbn = 30 ∟-10º Sec (+) ¿Vca?
Vca= 400 ∟20º Sec (-) ¿Vnb?

Three-phase circuits

- The power is generated and distributed in three-phase circuits.
- Single-phase voltages are obtained from three-phase systems. (ex: residential electrical installations)
- Less transmission losses.

Homework

Find the values of the equivalent wye-connected sources:



Thank you for your attention