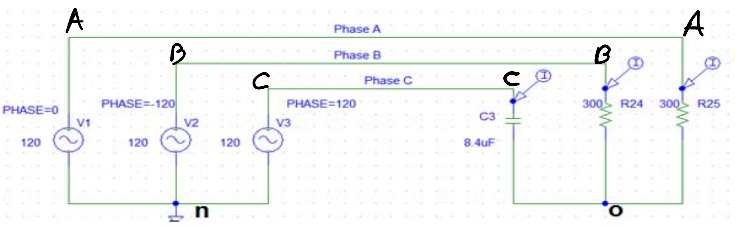
Lab 2 – Phase sequence determination

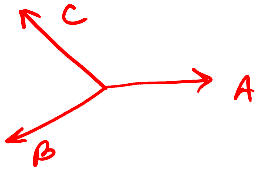
- How to find a sequence of Phase (ABC, ACB) when there is no marking
- Use unbalanced load situation



Balanced Source

Van, Vbn, Vcn

Van+Vbn+Vcn = 0



Unlabalnced Load

Balanced Line-to-Line Voltage
Vab Vbc Vca

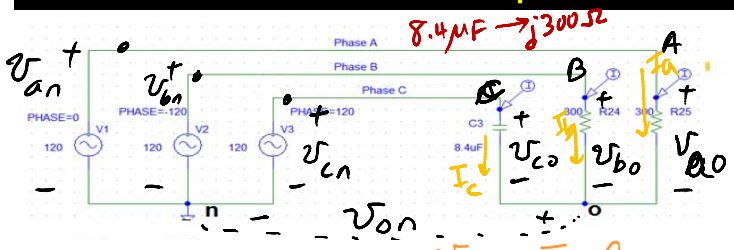
Unbalanced Line-to-point voltage
Vao, Vbo, Vco

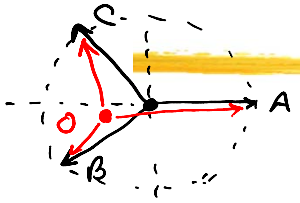
Vao + Vbo + Vco =\= 0

Ia + Ib + Ic = 0

So there is voltage developed between n and o

Lab 2 – Phase sequence determination





$v_{ao} = v_{an} - v_{on}$

$v_{bo} = v_{bn} - v_{on}$

$v_{co} = v_{cn} - v_{on}$

$v_{ao} = I_a \cdot R$

$v_{bo} = I_b \cdot R$

$v_{co} = I_c(-jR)$

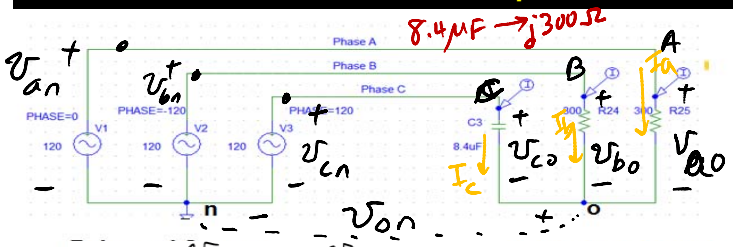
$I_a \cdot R = v_{an} - v_{on}$

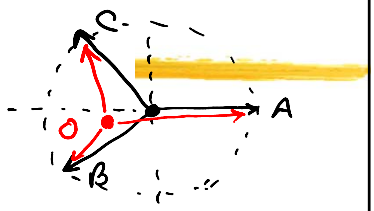
$I_b \cdot R = v_{bn} - v_{on}$

$I_c(-jR) = v_{cn} - v_{on}$

$C \rightarrow \frac{1}{j\omega C} = -j\left(\frac{1}{\omega C}\right)$ Cap. reactance

Lab 2 – Phase sequence determination





$$I_a = \frac{V_{an}}{R} - \frac{V_{on}}{R}$$

$$I_b = \frac{V_{bn}}{R} - \frac{V_{on}}{R}$$

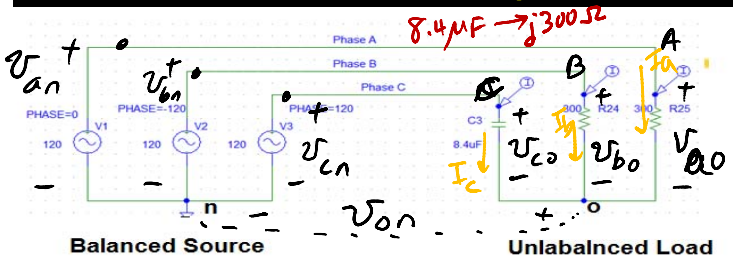
$$I_c = \frac{V_{cn}}{-jR} - \frac{V_{on}}{-jR}$$

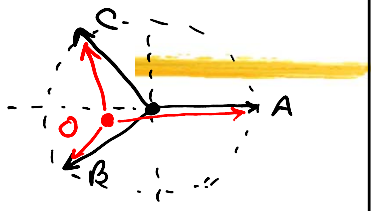
$$I_a + I_b + I_c = 0$$

$$\frac{1}{R}\left(V_{an} + V_{bn} + j V_{cn}\right) = \frac{1}{R}\left(V_{on} + V_{on} + j V_{on}\right)$$

$$\rightarrow V_{on} = \frac{V_{an} + V_{bn} + j V_{cn}}{2 + j} = \frac{V_{an}\left(1 + \angle -120^\circ + \angle 210^\circ\right)}{2 + j}$$

Lab 2 – Phase sequence determination





Balanced Source **Unlabalnced Load**

$\frac{V_{an}\left(1 + \angle -120^\circ + \angle 210^\circ\right)}{2 + j}$

Num = 1 · cos(−120 · π/180) + i · sin(−120 · π/180) · cos(210 · π/180) + i · sin(210 · π/180)

Num = −0.366 − 1.366 i

|Num| = 1.4142 arg(Num) · 180/π = −105

ON = Num/(2 + 1 · i) = −0.4196 − 0.4732 i |ON| = 0.6325 arg(ON) · 180/π = −131.5651

Van = 120

Vbn = 120 · (cos(−120) · π/180) + sin(−120) · π/180) i)

Vcn = 120 · (cos(120 · π/180) + sin(120 · π/180) i)

Von = Van · ON = −50.3538 − 56.7846 |Von| = 75.8947

Vao = Van − Von = 170.3538 + 56.7846 i

Vbo = Vbn − Von = −9.6462 − 47.1384 i

Vco = Vcn − Von = −9.6462 + 160.7077 i

|Vao| = 179.5687

|Vbo| = 48.1153

|Vco| = 160.9969

Lab 2 – Phase sequence determination

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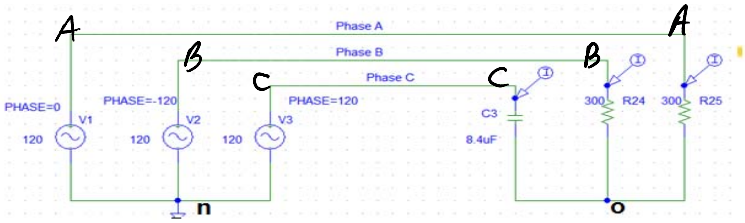
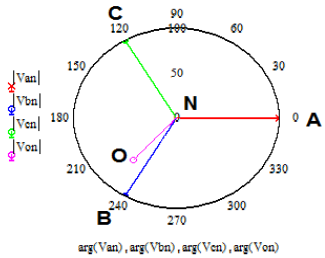
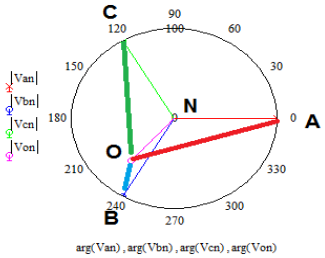


Phase sequence Rule

High – Low – C

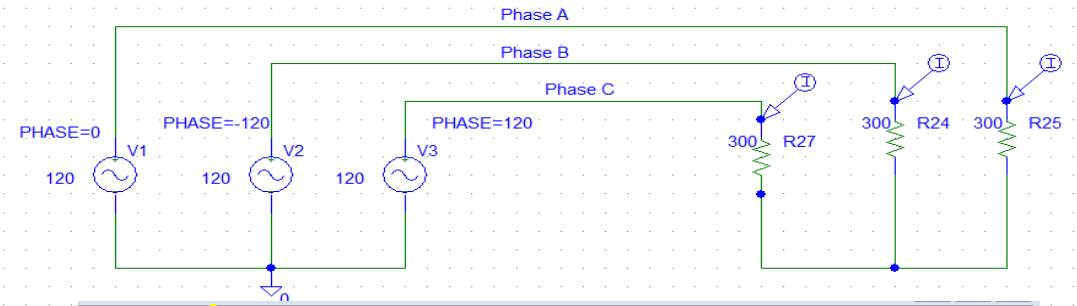
(A) (B) (C)

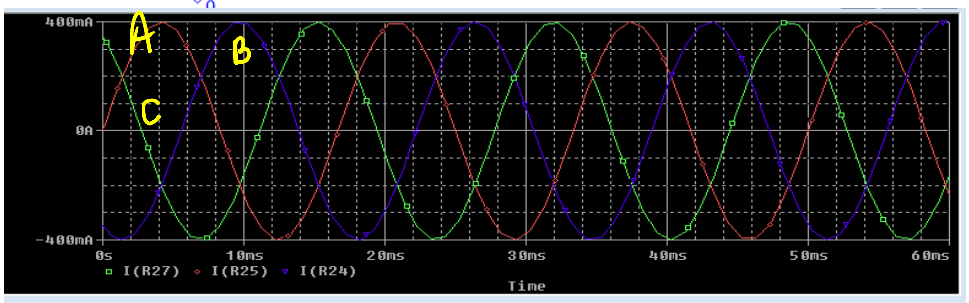




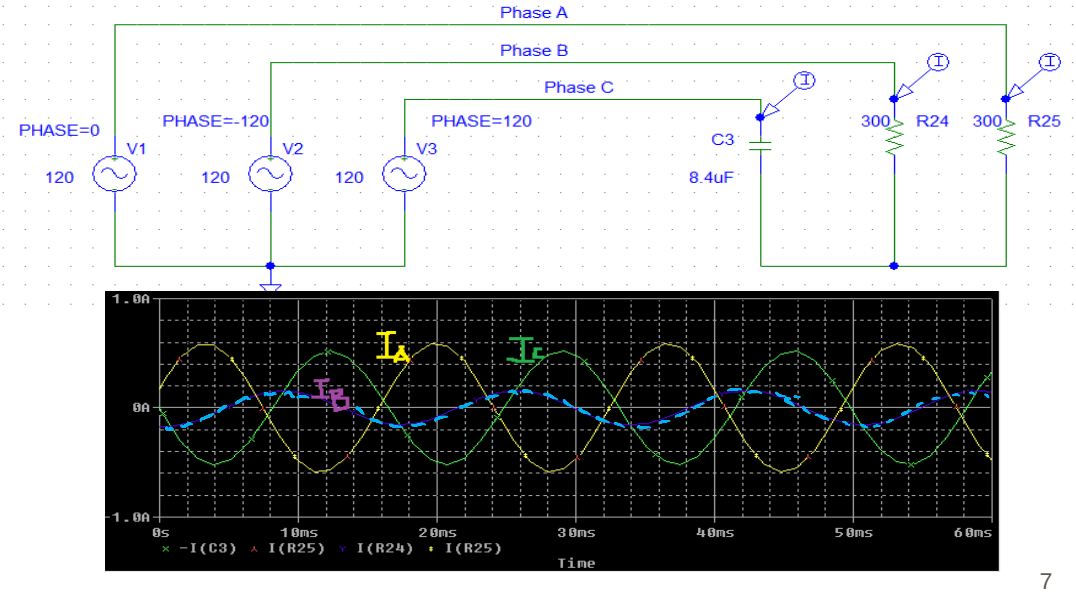
AO > BO

Lab 2 – Phase Sequence Determination

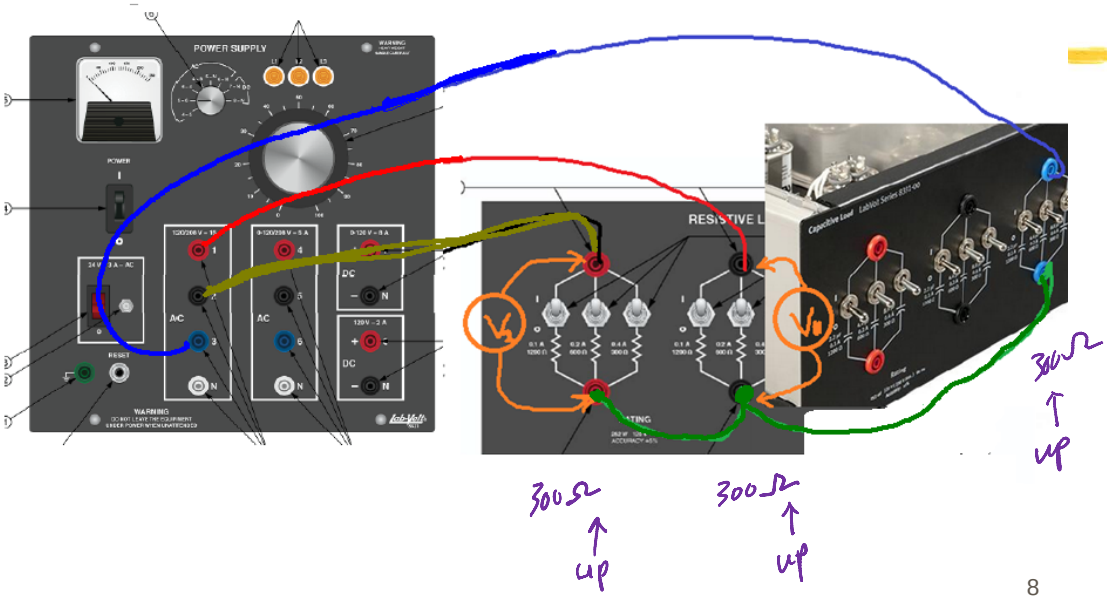




Lab 2 – Phase Sequence Determination



Lab 2 – Exp Part



Lab 2 – Exp Part 2

- **For light bulbs, for the best result and observation, use a capacitor of 2.2 uF(1200 ohm)**