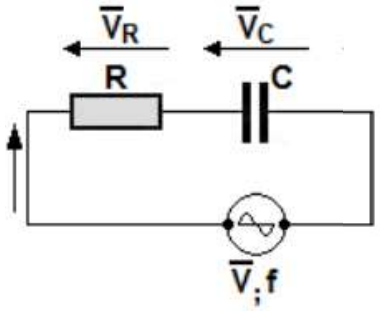
PRINCIPIOS ELÉCTRICOS
Circuitos de alterna FASORES

Circuitos en alterna

1- Circuito RC en serie

$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$C = 32\mu F$



Calcular:
a. La impedancia total del circuito
b. La intensidad que circula por el circuito
c. La caída de potencial en cada uno de los componentes
d. La potencia

Circuitos en alterna

$V = 100V_{ac}$
$f = 50Hz$
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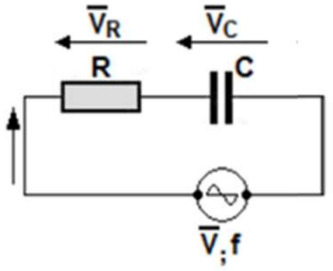


a. La impedancia total del circuito

$\omega = 2\pi f = 314.2\ \frac{rad}{s}$

$X_C = \frac{1}{C\omega} = \frac{1}{314{,}2\frac{rad}{s} 32\mu F} = 99.46\Omega$

$R = 100\Omega$

$$\bar{Z} = 141e^{-44.84j}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$Z = \sqrt{10000 + (99{,}46)^2} = 141\Omega$$

$$\varphi = arc\ tan\left[\frac{X_L - X_C}{R}\right]$$

$$\varphi = \arctan\left(\frac{-X_C}{R}\right) = -44.84º$$

b. La intensidad que circula por el circuito

$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = \frac{100e^{0j}}{141e^{-44{,}84j}} = 0.709e^{44.84j}$$

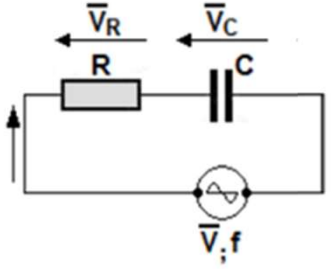
c. La tensión en cada componente

$X_C = 99.46e^{-90j}$ $\quad \bar{V}_C = \bar{X}_C\bar{I} = 99.46e^{-90j} \cdot 0.71e^{44{,}84j} = 70.62\ e^{-45.16j}$

$R = 100\Omega$ $\quad \bar{V}_R = R\bar{I} = 100 \cdot 0{,}71e^{44{,}84j} = 71\ e^{44.84}$

Circuitos en alterna

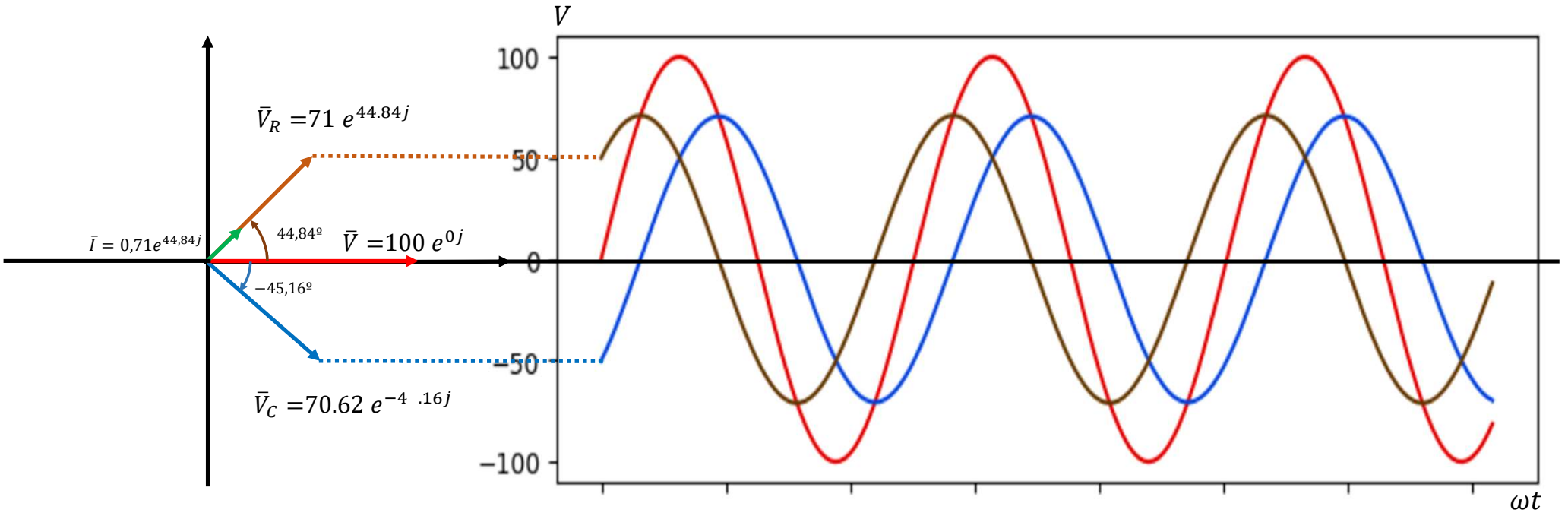
$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$C = 32\mu F$



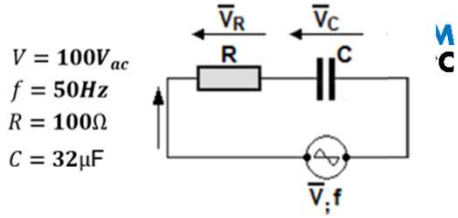
$$\bar{I} = 0.71e^{44.84j}$$

$$\bar{V}_C = 70.62\ e^{-4\ .16j}$$

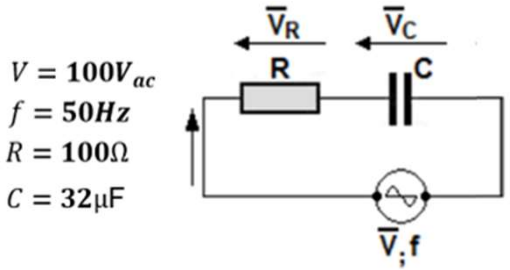
$$\bar{V}_R = 71\ e^{44.84}$$



Circuitos en alterna



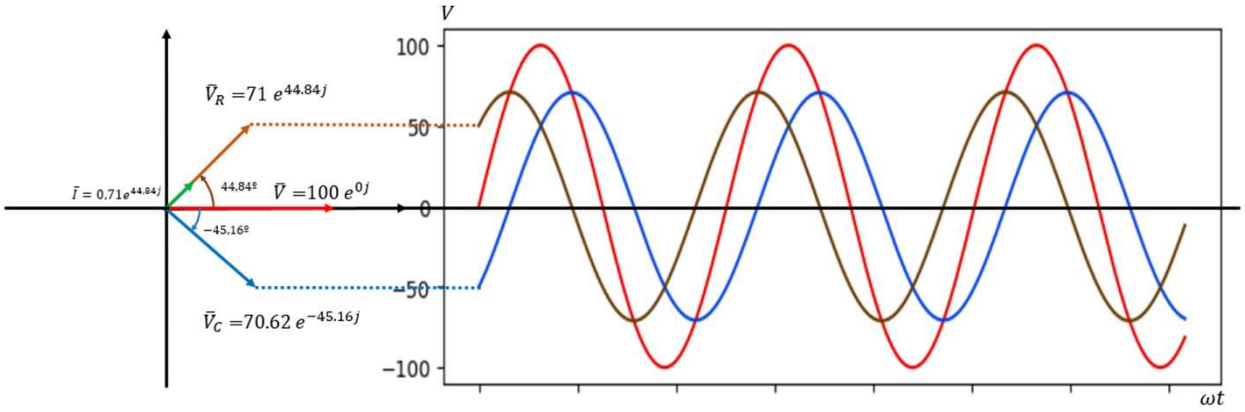
d. Calcular la potencia del circuito



$\bar{I} = 0.71e^{44.84}$

$\bar{V} = 100\, e^{0j}$

$\varphi = 44.84º$



Potencia total activa, reactiva: generada por la F.A.

Potencia activa total:

$$P = VIcos\varphi = I \cdot V \cdot cos(44.84) = 27W$$

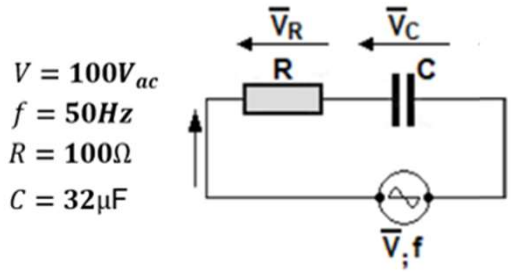
Potencia aparente total

$$S = \sqrt{P^2 + Q^2} = 35VA$$

Potencia reactiva total:

$$Q = VIsin\varphi = VI\ sin(44.84) = 23VA$$

Circuitos en alterna



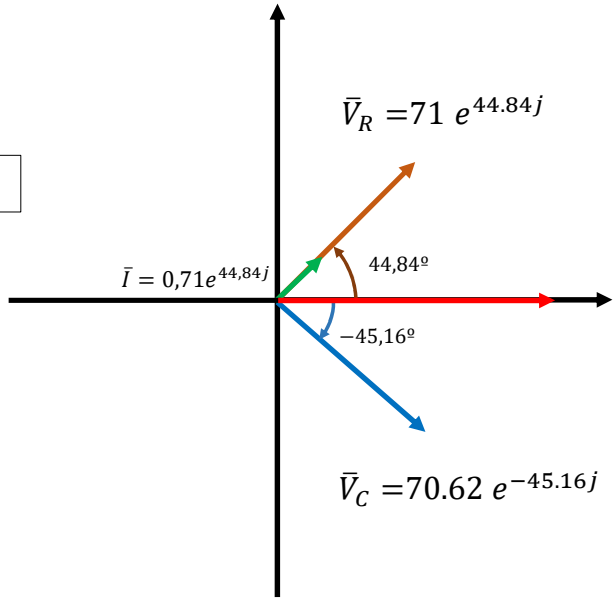
Potencia activa por componente: absorbida por cada componente

$$P_R = V_R I_R co\,s(\varphi_R) = VI\,cos(0) = 25W$$
$$P_C = V_C I_C\,cos(\varphi_C) = VI\,cos(-90) = 0$$

$$P = P_R + P_c = 25W$$

Potencia aparente total

$$S = \sqrt{P^2 + Q^2} = 35VA$$



Potencia reactiva por componente:

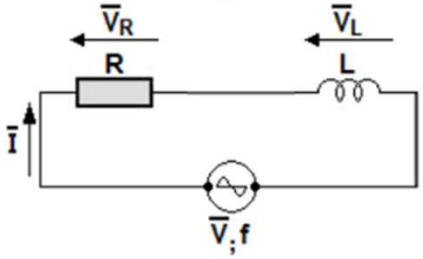
$$Q_R = V_R I_R\,sin(\varphi_R) = 25 \cdot sin(0) = 0$$
$$Q_C = V_C I_C\,sin(\varphi_C) = 25 \cdot sin(-90) = -25VA$$

$$Q = Q_R + Q_C = -25VA$$
$$|Q| = 25VA$$

Circuitos en alterna

2- Circuito RL en serie

$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$L = 0,75H$



Calcular:
a. La impedancia total del circuito
b. La intensidad que circula por el circuito
c. La caída de potencial en cada uno de los componentes
d. La potencia

Circuitos en alterna

$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$L = 0,75\text{H}$

Solución

a. La impedancia total del circuito

$\omega = 2\pi f = 314.2\ \frac{rad}{s}$

$X_L = L\omega = 0{,}75\text{H} * 314.2\frac{\text{rad}}{\text{s}} = 235.6\Omega$

$$\bar{Z} = 256e^{68.7j}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$Z = \sqrt{10000 + (235.6)^2} = 256\Omega$$

$$\varphi = arc\ tan\left[\frac{X_L - X_C}{R}\right]$$

$$\varphi = \text{arc tan}\left(\frac{X_L - X_C}{R}\right) = 68.7º$$

b. La intensidad que circula por el circuito

$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = \frac{100e^{0j}}{256e^{68.7j}} = 0.39e^{-6\ .7j}$$

c. La tensión en cada componente

$X_L = 235.6e^{90j}$

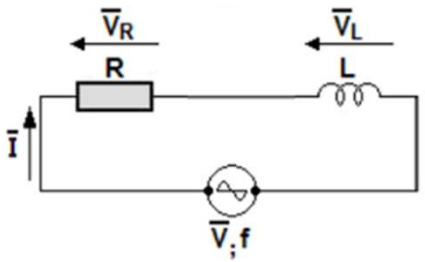
$$\bar{V}_L = \bar{X}_L\bar{I} = 235.6e^{90j} \cdot 0.39e^{-68.7j} = 91.88\ e^{21.3j}$$

$R = 100\Omega$

$$\bar{V}_R = R\bar{I} = 100 \cdot 0.39e^{-68,7j} = 39\ e^{-68.7j}$$

Circuitos en alterna

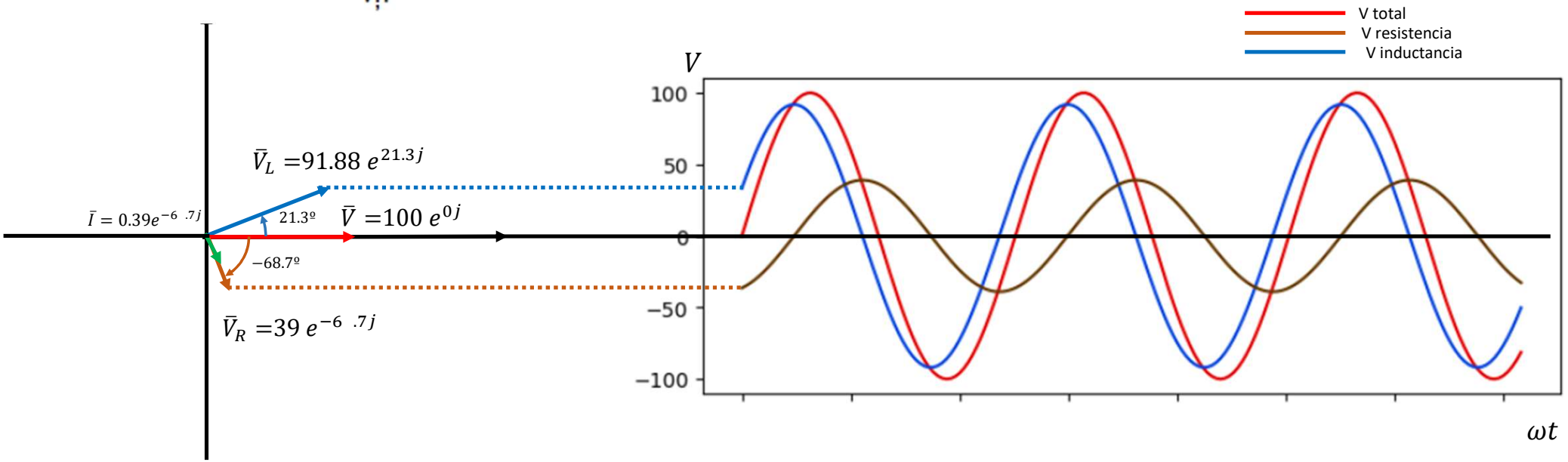
$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$L = 0,75\Omega$



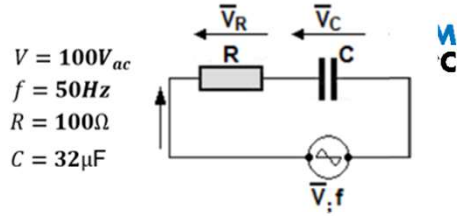
$\bar{I} = 0.39e^{-68.7j}$

$\bar{V}_L = 91.88\ e^{21.3j}$

$\bar{V}_R = 39\ e^{-6\ .7j}$

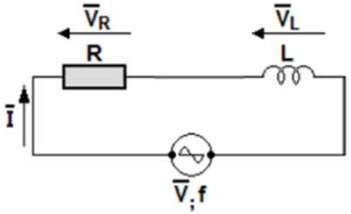


Circuitos en alterna



d. Calcular la potencia del circuito

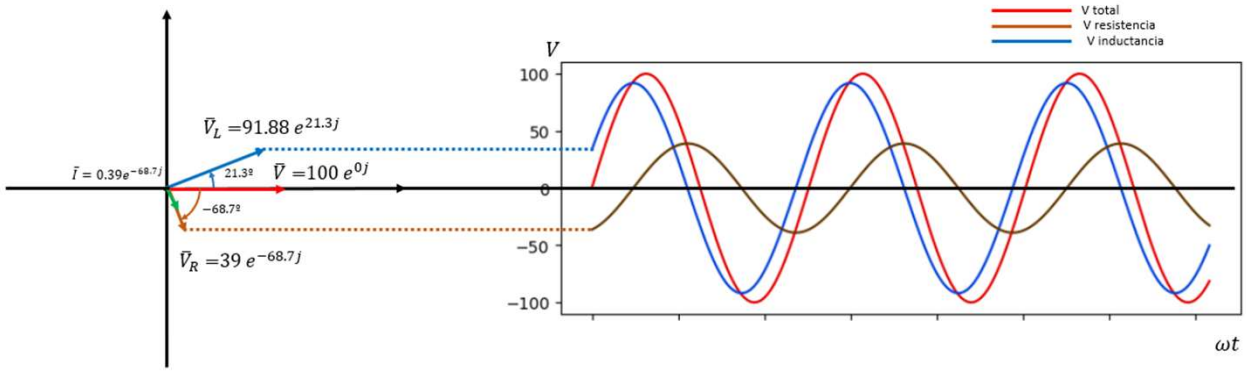
$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$L = 0,75\Omega$



$$\bar{I} = 0.39e^{-68.7j}$$

$$\bar{V} = 100\ e^{0j}$$

$$\varphi = -68.7º$$



Potencia total activa, reactiva: generada por la F.A.

Potencia activa total (valores eficaces):

$$P = VIcos\varphi = VI\ cos(-68.7) = 7.1W$$

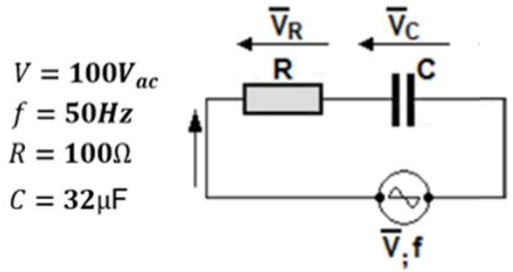
Potencia aparente total

$$S = \sqrt{P^2 + Q^2} = 20VA$$

Potencia reactiva total (valores eficaces): :

$$Q = VIsin\varphi = VI\ sin(-68.7) = -18VA$$

Circuitos en alterna



Potencia activa por componente: absorbida por cada componente

$$P_R = V_R I_R co\,s(\varphi_R) = VI\,cos(0) = 7.1W$$

$$P_L = V_L I_L\,cos(\varphi_L) = 0$$

$$P = P_R + P_L = 7.1W$$

Potencia aparente total

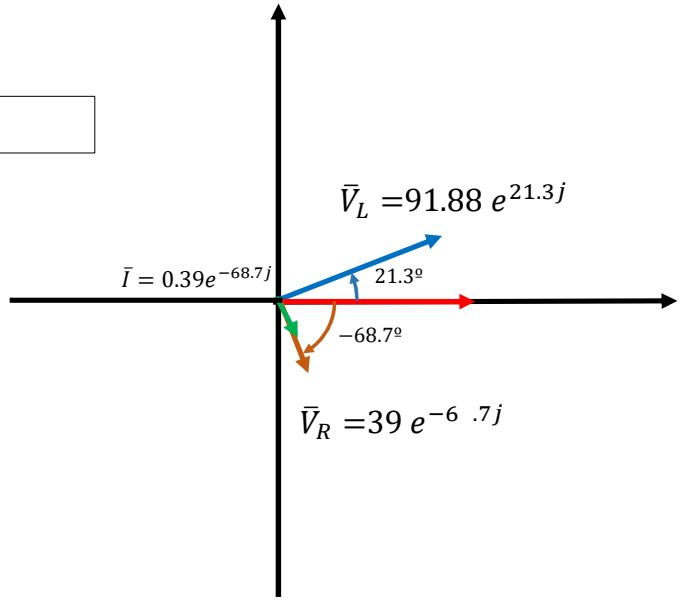
$$S = \sqrt{P^2 + Q^2} = 10VA$$

Potencia reactiva por componente:

$$Q_R = V_R I_R\,sin(\varphi_R) = 0$$

$$Q_L = V_L I_L\,sin(\varphi_L) = VI\,sin(90) = 17.5VA$$

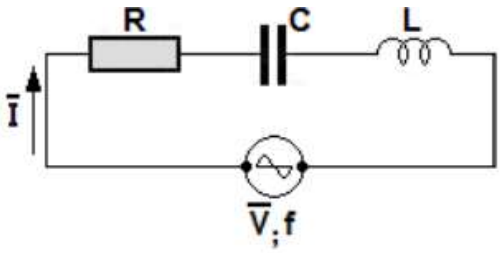
$$Q = Q_R + Q_L = 17.5VA$$
$$|Q| = 17.5VA$$



Circuitos en alterna

3- Circuito RLC en serie

$$V = 100V_{ac}$$
$$f = 50Hz$$
$$R = 100\Omega$$
$$L = 0,75\text{H}$$
$$C = 32\mu\text{F}$$



Calcular:
a. La impedancia total del circuito
b. La intensidad que circula por el circuito
c. La caída de potencial en cada uno de los componentes
d. La potencia

Circuitos en alterna

$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$L = 0,75\text{H}$
$C = 32\mu\text{F}$

Solución

a. La impedancia total del circuito

$\omega = 2\pi f = 314.2\ \frac{rad}{s}$

$X_C = \frac{1}{C\omega} = \frac{1}{314,2\frac{\text{rad}}{\text{s}} 32\mu\text{F}} = 99,5\Omega$

$X_L = L\omega = 0.75H * 314.2\frac{rad}{s} = 235,6\Omega$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$Z = \sqrt{10000 + (235.6 - 99.54)^2} = 168.9\Omega$

$$\varphi = arc\ tan\left[\frac{X_L - X_C}{R}\right]$$

$\varphi = \arctan\left(\frac{X_L - X_C}{R}\right) = 0.937\text{rad} = 53.7º$

$$\bar{Z} = 168.9e^{53,7j}$$

b. La intensidad que circula por el circuito

$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = \frac{100e^{0j}}{168.9e^{53,7j}} = 0.6e^{-5\ ,7j}$$

Circuitos en alterna

$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$L = 0,75\text{H}$
$C = 32\mu\text{F}$

c. La tensión en cada componente

$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = 0.6e^{-53,7j}$$

$X_L = 235.6e^{90j}$ $\quad \bar{V}_L = \bar{X}_L\bar{I} = 0.6e^{-53,7j}\ 235.6e^{90j} = 141.4\ e^{36.3j}$

$X_C = 99.5e^{-90j}$ $\quad \bar{V}_C = \bar{X}_C\bar{I} = 0.6e^{-5\ ,7j}\ 99.5e^{-90j} = 60\ e^{-143.7j}$

$R = 100$ $\quad \bar{V}_R = R\bar{I} = 0.6e^{-53,7j}\ 100 = 60\ e^{-53.7j}$

7. CORRIENTE ALTERNA

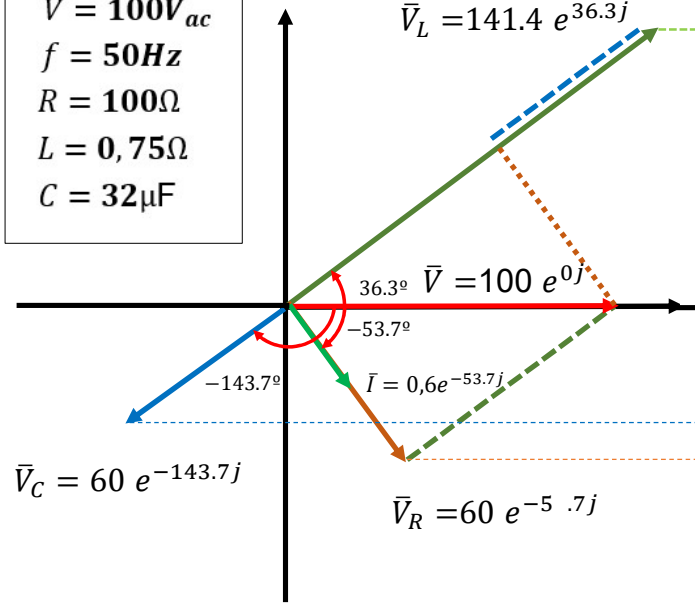
$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = 0.6e^{-53,7j}$$

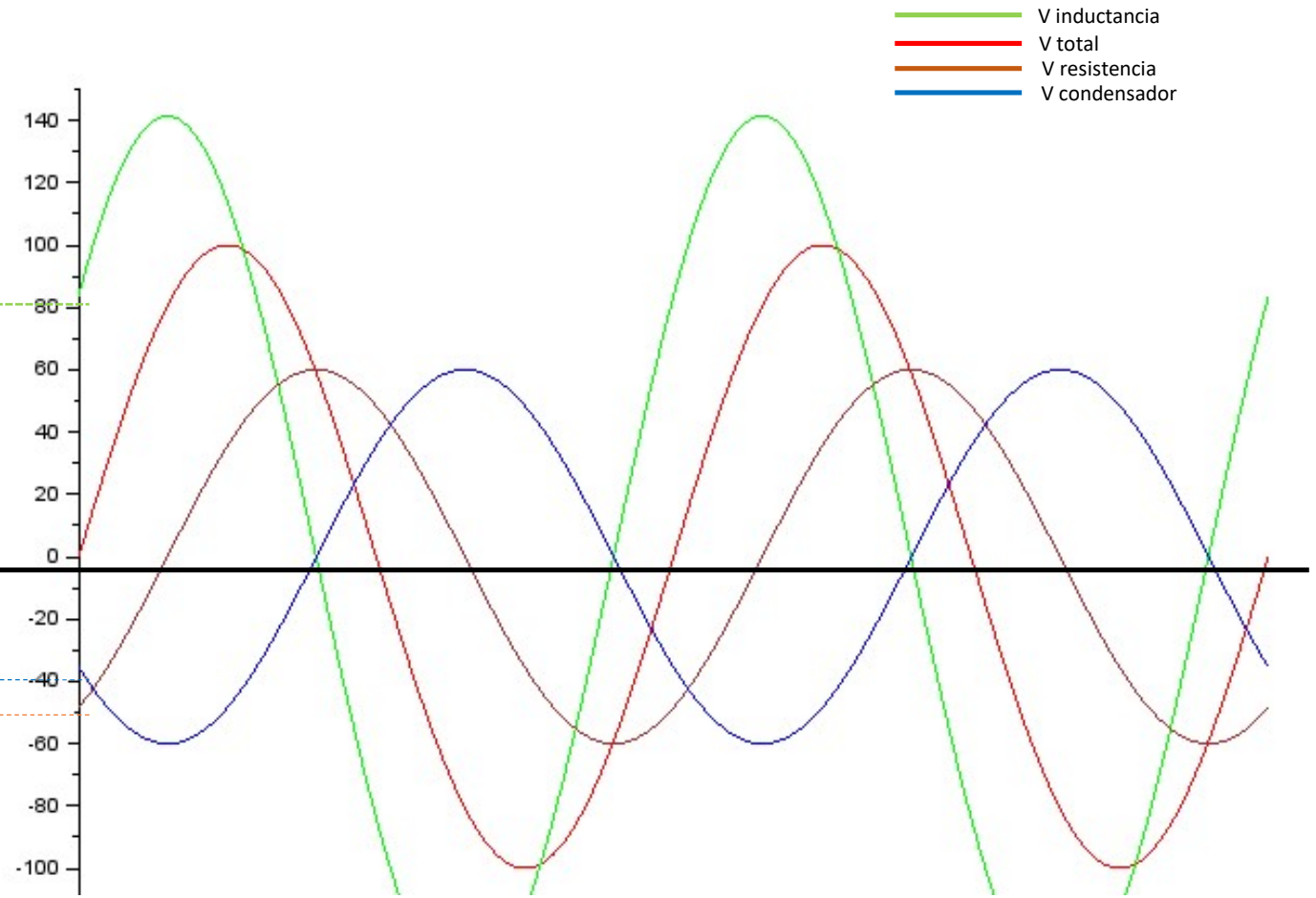
$\bar{V}_L = 141.4\ e^{36.3j}$

$\bar{V}_C = 60\ e^{-143.7j}$

$\bar{V}_R = 60\ e^{-53.7j}$

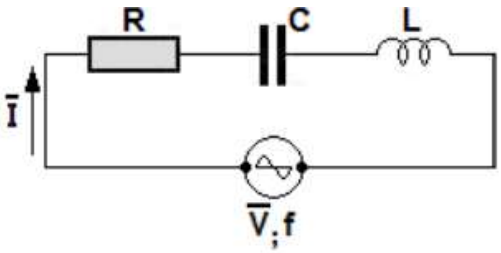
$V = 100V_{ac}$
$f = 50Hz$
$R = 100\Omega$
$L = 0,75\Omega$
$C = 32\mu F$



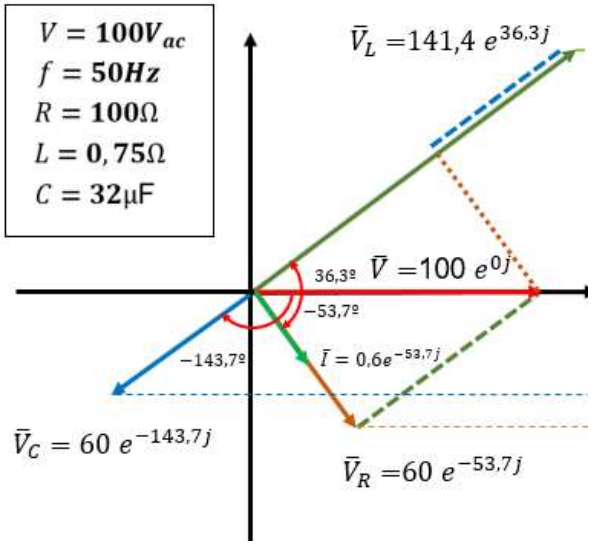


Circuitos en alterna

d. Calcular la potencia del circuito



$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = 0{,}6e^{-53{,}7j}$$



Potencia total activa, reactiva: generada por la F.A.

$$P = VIcos\varphi = VI * cos(53.7) \sim 18W$$

$$Q = VIsin\varphi = VIsin(53.7) = 24VA$$

$$S = \sqrt{P^2 + Q^2} = 31.4VA$$

Circuitos en alterna

Potencia activa por componente: absorbida por cada componente

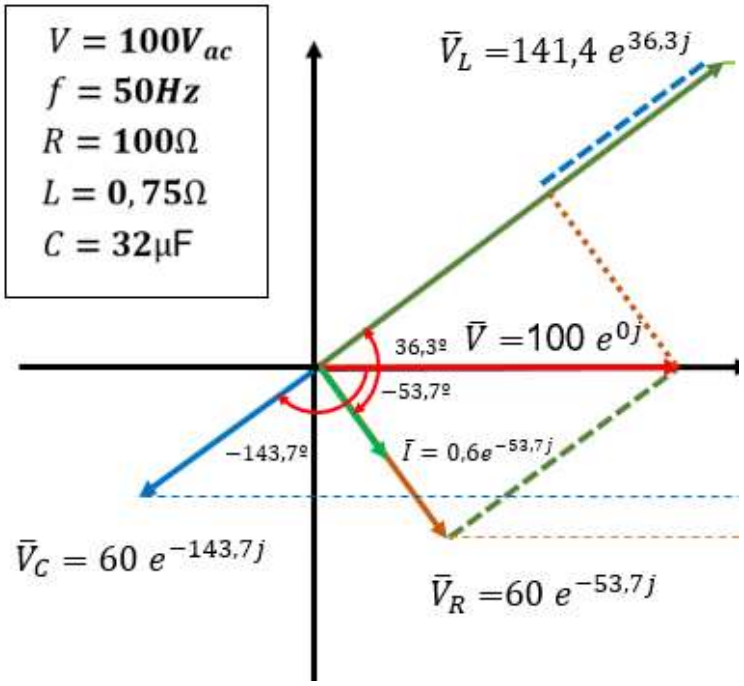
$$P_R = V_R I_R cos(\varphi_R) = 18\, cos(0) = 18W$$
$$P_C = V_C I_C\, cos(\varphi_C) = 0$$
$$P_L = V_L I_L\, cos(\varphi_L) = 0$$

$$P = P_R + P_R + P_R = 18W$$

Potencia reactiva por componente:

$$Q_R = V_R I_R\, sin(\varphi_R) = 0$$
$$Q_C = V_C I_C\, sin(\varphi_C) = 18\, sin(90) = 18$$
$$Q_L = V_L I_L\, sin(\varphi_L) = VI\, sin(-90) = -42.2$$

$$Q = Q_R + Q_C + Q_L = -24.2VA$$
$$|Q| = 24.2VA$$



$$S = \sqrt{P^2 + Q^2} = 31.4VA$$

Teorema de Boucherot