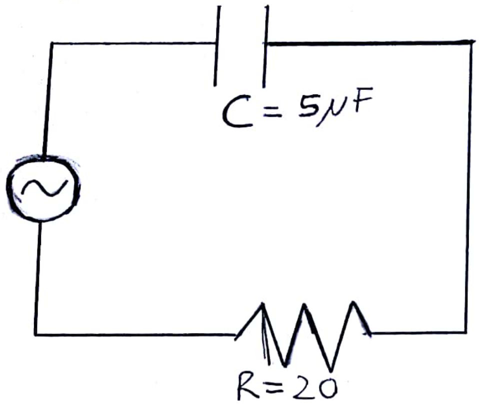
Tema 8: Circuitos de corriente alterna.

Problemas propuestos.

1) Circuito RC



Calcular la intensidad que circula por el circuito.

$C = 5\mu F = 5 \cdot 10^{-6}\ F$

$R = 200\ \Omega$

$V = \underbrace{200\sqrt{2}}\ \text{sen}\ 1000t$ Voltios.

$V = V_0\ \text{sen}\ (wt + \theta)$ ↳ Fase inicial

$- \bar{V} = V_e \underline{\angle \theta}$

$V_e = \frac{V_0}{\sqrt{2}} = \frac{200\sqrt{2}}{\sqrt{2}} = 200$

Como podemos observar no existe fase inicial.

$\bar{V} = 200 \underline{\angle 0}$

- Ahora calculamos la impedancia. $(\bar{Z})$

$\bar{Z} = \bar{R} + \bar{X}_L + \bar{X}_C$

$\bar{Z} = R + j\left(Lw - \frac{1}{Cw}\right)$

$\bar{Z} = 200 + j\left(0 - \frac{1}{5 \cdot 10^{-6} \cdot 10^{3}}\right) = 200 - 200j$

El valor obtenido lo pasamos a su forma polar. $Z \underline{\angle \varphi}$

$Z = \sqrt{200^2 + (-200)^2} = 200\sqrt{2}$

$\varphi = \text{arc tg}\ \frac{-200}{200} = -45$

$\bar{Z} = 200\sqrt{2} \underline{\angle -45°}$

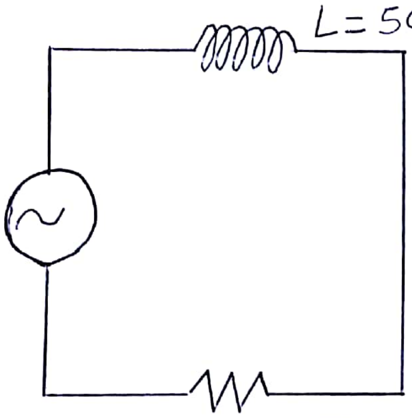
$-\bar{I} = \dfrac{\bar{V}}{\bar{Z}} = \dfrac{200\angle 0^\circ}{200\sqrt{2}\angle -45} = \underbrace{\dfrac{\sqrt{2}}{2}}_{I_e} \angle 45^\circ \ A$

$I_e = \dfrac{I_o}{\sqrt{2}} \Rightarrow I_o = \dfrac{\sqrt{2}}{2} \cdot \sqrt{2} = 1A$

$I = I_o \ \text{sen}(wt + \varphi)$

$I = 1 \ \text{sen}(1000t + 45^\circ)$

2) Circuito RL



$L = 50mH = 50 \cdot 10^{-3} \ H$

$R = 20\sqrt{3} \ \Omega$

$I = \underbrace{0{,}5}_{I_o} \ \text{sen}(400t + 30^\circ) A$

• $I_e = \dfrac{I_o}{\sqrt{2}} = \dfrac{0{,}5}{\sqrt{2}} = \dfrac{\sqrt{2}}{4} \ A$

$\bar{I} = \dfrac{\sqrt{2}}{4} \angle 30^\circ$

• $\bar{Z} = R + j\left(Lw - \dfrac{1}{cw}\right)$

$\bar{Z} = 20\sqrt{3} + j(50 \cdot 10^{-3} \cdot 400 - 0) = 20\sqrt{3} + 20j$

Ahora lo pasamos a forma polar.

$Z = \sqrt{(20\sqrt{3})^2 + 20^2} = 40$

$\varphi = \text{arc tg} \ \dfrac{20}{20\sqrt{3}} = 30^\circ$

$\bar{Z} = 40\angle 30^\circ$

• $\bar{I} = \dfrac{\bar{V}}{\bar{Z}} \Rightarrow \bar{V} = \bar{I} \cdot \bar{Z} = \dfrac{\sqrt{2}}{4}\angle 30^\circ \cdot 40\angle 30^\circ = \underbrace{10\sqrt{2}}_{V_e} \angle 60^\circ$

$V = V_o \ \text{sen}(wt + \varphi)$

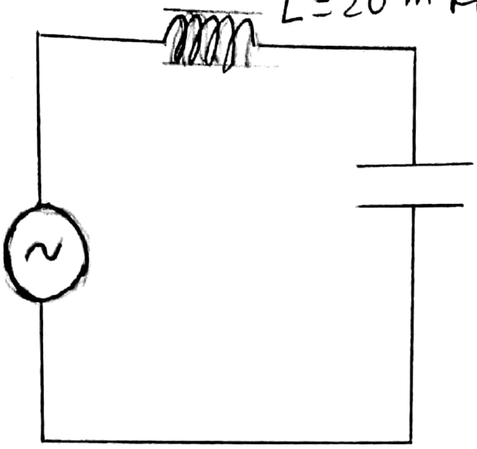
$V_e = \dfrac{V_o}{\sqrt{2}} \Rightarrow V_o = 10\sqrt{2} \cdot \sqrt{2} = 20V$

$\boxed{V = 20 \ \text{sen}(400t + 60) \ V}$

Scanned by CamScanner

3)

Circuito LC



$L = 20\ m\cancel{H} = 20 \cdot 10^{-3} H$

$C = 25 \mu F = 25 \cdot 10^{-6}$

$V = \underbrace{100\sqrt{2}}_{V_0} \text{ sen} (\underbrace{2000}_{w} t + 45°)$ Voltios

$Ve = \frac{V_0}{\sqrt{2}} = \frac{100 \cdot \cancel{\sqrt{2}}}{\cancel{\sqrt{2}}} = 100$

• $\bar{V} = Ve \angle \theta$

$\bar{V} = 100 \angle 45°$

• $\bar{Z} = R + j\left(Lw - \frac{1}{Cw}\right)$

$\bar{Z} = 0 + j\left(20 \cdot 10^{-3} \cdot 2000 - \frac{1}{25 \cdot 10^{-6} \cdot 2000}\right) = 20j$

$Z = \sqrt{0^2 + (20)^2} = 20$

$\varphi = \text{arc tg } \frac{20}{0} \Rightarrow 90°$

El angulo es 90° ya que el único ángulo donde la tangente es infinita.

IMP En nº complejos no existe 270°, existe 90° o −90°

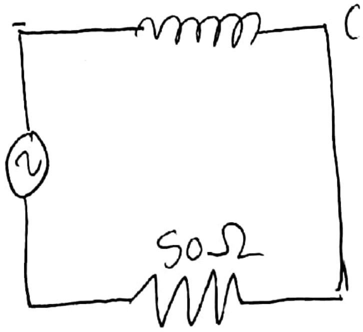
En forma polar $\Rightarrow \bar{Z} = 20 \angle 90°$

• $\bar{I} = \frac{\bar{V}}{\bar{Z}} = \frac{100 \angle 45°}{20 \angle 90°} = \underbrace{5}_{I_e} \angle -45$

$I_e = \frac{I_0}{\sqrt{2}} \Rightarrow I_0 = 5\sqrt{2}$

$I = 5\sqrt{2} \text{ sen} (2000t - 45°) A$

4 Tema 8



Datos

$V = 200\sqrt{2}\,sen(5000t + 45°)\,V$ 4

La intensidad esta desfasada 45° con respecto a la tensión

$R = 50$

$$V = \underbrace{200\sqrt{2}}_{V_0}\,sen(\underbrace{5000}_{w = 5000\ rad/s}t + 45°)$$

$$V_e = \frac{V_0}{\sqrt{2}} = \frac{200\cancel{\sqrt{2}}}{\cancel{\sqrt{2}}} = 200$$

$$\bar{V} = 200\angle 45°$$

Calculamos la impedancia.

$$\bar{Z} = R + j\left(Lw - \frac{1}{Cw}\right) = 50 + j(L \cdot 5000 = 50 + 5000Lj$$

$$\varphi = arc\,tg\,\frac{5000L}{50}$$

$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = \frac{200\angle 45°}{}$$

$$45° = arc\,tg\,\frac{5000L}{50}$$

$$\frac{tg\,45 \cdot 50}{5000} = L$$

$$L = 0{,}01$$

Sabemos que $\bar{I}$ está desfasado 45° con V, así pues $\theta = 0°$

Para que $\theta = 0° \Rightarrow \varphi = 45°$

$$\bar{Z} = 50 + 5000\,L\,j = \underbrace{50 + 50j}$$

$$L = 0{,}01\,H$$

$$Z = \sqrt{50^2 + 50^2} = 50\sqrt{2}$$

$$\bar{I} = \frac{200 \angle 45°}{50\sqrt{2} \angle 45°} = 2\sqrt{2} \angle 0°$$

$$I_e = \frac{I_0}{\sqrt{2}}$$

$$I_0 = 2\sqrt{2} \cdot \sqrt{2} = 4$$

$$I = 4\,\mathrm{sen}(5000t + 0°)$$

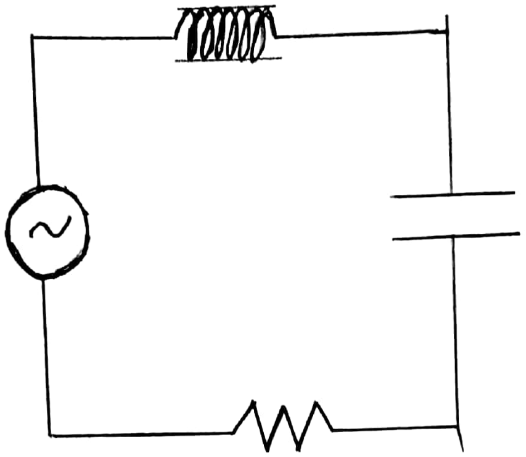
4

3

5)

Circuito RLC

$L = 190 mH = 190 \cdot 10^{-3} H$



$C = 20 \mu F = 20 \cdot 10^{-6} F$

$R = 100 \Omega$

$I = \cancel{200} \underbrace{\sqrt{2}}_{I_0} \text{sen}(100\pi t + 30°) A$

$I_e = \frac{I_0}{\sqrt{2}} = \frac{\sqrt{2}}{\sqrt{2}} = 1 A$

$\bar{I} = I_e \angle \varphi = 1 \angle 30°$

a) $\bar{Z} = ?$

$\bar{Z} = R + j\left(Lw - \frac{1}{Cw}\right) = 100 + j\left(0{,}19 \cdot 100\pi - \frac{1}{20 \cdot 10^{-6} \cdot 100\pi}\right) =$

$= 100 - j \cdot 99{,}46$

Ahora lo pasamos a forma polar

$Z = \sqrt{100^2 + (-99{,}46)^2} = 141$

$\varphi = \text{arc tg} \frac{-99{,}46}{100} = -44{,}84 = -45°$

$\bar{Z} = 141 \angle 45° \ \Omega$

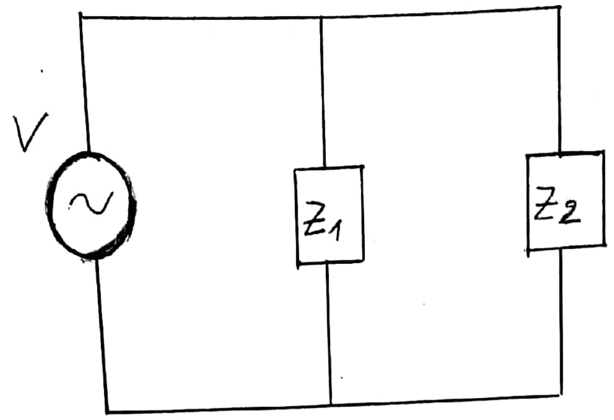
b)

$\bar{I} = \frac{\bar{V}}{\bar{Z}} \Rightarrow \bar{V} = \bar{I} \cdot \bar{Z} = 1 \angle 30° \cdot 141 \angle -45 = \underbrace{141}_{V_e} \angle -15°$

$V_e = \frac{V_0}{\sqrt{2}} \Rightarrow V_0 = 141\sqrt{2}$

$V = 141\sqrt{2} \ \text{sen}(100\pi t - 15°)$ Voltios

6)



$\bar{V} = 220 \angle 0^\circ$ V

$\bar{Z}_1 = 40 \angle 60^\circ \ \Omega$

$\bar{Z}_2 = 30 \angle -30^\circ \ \Omega$

a) Z_e

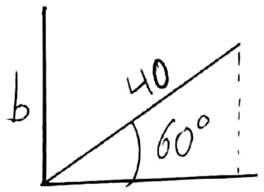
$$\frac{1}{Z_e} = \frac{1}{Z_1} + \frac{1}{Z_2} \Rightarrow \frac{1}{Z_e} = \frac{Z_2 + Z_1}{Z_1 \cdot Z_2} \Rightarrow Z_e = \frac{Z_1 \cdot Z_2}{Z_1 + Z_2}$$

$$Z_e = \frac{40 \angle 60 \cdot 30 \angle -30}{\underbrace{40 \angle 60 + 30 \angle -30}} = \frac{1200 \angle 30^\circ}{\underbrace{45,98 + 19,64j}} = \frac{1200 \angle 30^\circ}{50 \angle 23,13} = 24 \angle 6,87$$

2- Lo pasamos a su forma polar

1- Lo pasamos a forma binomica

$\underline{Z_1}$

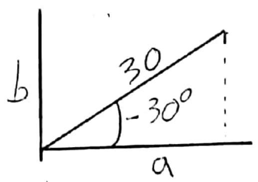


$a = 40 \cdot \cos 60^\circ = 20$

$b = 40 \ \text{sen} \ 60^\circ = 20\sqrt{3}$

$\bar{Z}_1 = 20 + 20\sqrt{3}j$

$\underline{Z_2}$



$a = 30 \cos -30 = 15\sqrt{3}$

$b = 30 \ \text{sen} -30 = -15$

$\bar{Z}_2 = 15\sqrt{3} - 15j$

$\bar{Z}_e = 45,98 + 19,64j$

2-

$Z_e = \sqrt{45,98^2 + 19,64^2} = 50$

$\varphi = \text{arc tg} \ \frac{19,64}{45,98} = 23,13$

$\bar{Z}_e = 50 \angle 23,13$

b) Intensidad por cada rama.

$$\bar{I} = \frac{\bar{V}}{\bar{Z}}$$

$$\left[\bar{I}_1 = \frac{\bar{V}}{\bar{Z}_1} = \frac{220\angle 0^\circ}{40\angle 60^\circ} = 5{,}5\angle -60^\circ\right]$$

$$\left[\bar{I}_2 = \frac{\bar{V}}{\bar{Z}_2} = \frac{220\angle 0^\circ}{30\angle -30^\circ} = 7{,}3\angle 30^\circ\right]$$

c) Potencia activa de la fuente (P_{AC})

$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = \frac{220\angle 0^\circ}{24\angle 6{,}87} = \underbrace{9{,}17}_{I_e}\angle -6{,}87$$

$$\left[I_e = \frac{I_o}{\sqrt{2}} \Rightarrow I_o = 9{,}17\sqrt{2}\right]$$ Innecesario.

$P = I_e^2 R$

↳ Potencia disipada en una resistencia.

$P_{AC} = I_e V_e \cos \varphi$.

↙ Pactiva

$$\left[P_{AC} = 9{,}17 \cdot 220 \cos 6{,}87 = 2002{,}92 = 2002\ W\right]$$

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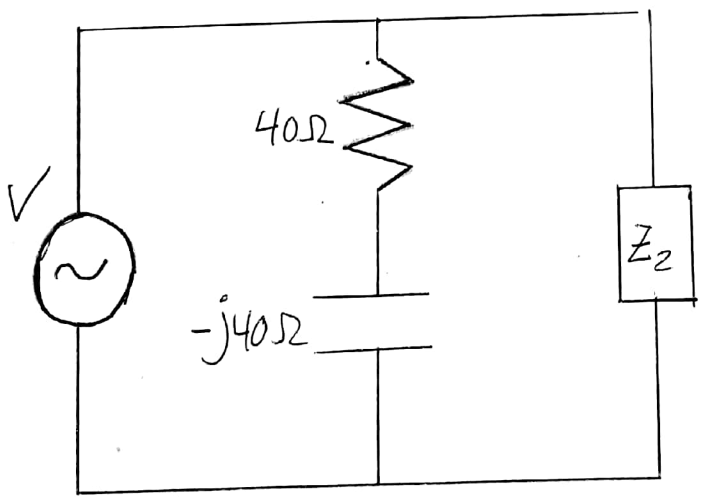


$V = 100\angle 30^\circ\ V$

$I_t = 2{,}15\angle 47{,}6^\circ\ A$

- Empezamos calculando $\bar{Z}_1$

$$\bar{Z}_1 = R + j\left(L\omega - \frac{1}{C\omega}\right) =$$
$$= 40 - j40$$

Ahora lo pasamos a forma polar

$$Z_1 = \sqrt{40^2 + (-40)^2} = 40\sqrt{2}$$
$$\varphi = \operatorname{arctg}\frac{-40}{40} = -45$$
$$\Big\}\ \bar{Z}_1 = 40\sqrt{2}\angle -4$$

Ahora calculamos I_1

$$I_1 = \frac{\bar{V}}{\bar{Z}_1} = \frac{100\angle 30}{40\sqrt{2}\angle -45} = \frac{5\sqrt{2}}{4}\angle 75^\circ$$

$$I_2 = I_t + I_1 = 2{,}15 \angle 47{,}6^\circ - \frac{5\sqrt{2}}{4} \angle 75^\circ = 1{,}45 + 1{,}59j - (0{,}46 + 1{,}71j) =$$
$$= 0{,}99 - 0{,}12j$$

Para efectuar esta operación lo pasamos a forma binómica

$\underline{I_t}$

$$\left.\begin{aligned} a &= 2{,}15 \cos 47{,}6^\circ = 1{,}45 \\ b &= 2{,}15 \operatorname{sen} 47{,}6^\circ = 1{,}59 \end{aligned}\right\} \bar{I}_t = 1{,}45 + 1{,}59j$$

$\underline{I_1}$

$$\left.\begin{aligned} a &= \frac{5\sqrt{2}}{4} \cos 75^\circ = 0{,}46 \\ b &= \frac{5\sqrt{2}}{4} \operatorname{sen} 75^\circ = 1{,}71 \end{aligned}\right\} \bar{I}_1 = 0{,}46 + 1{,}71j$$

$$I_2 = \sqrt{0{,}99^2 + (-0{,}12)^2} = 1$$

$$\varphi = \operatorname{arctg} \frac{-0{,}12}{0{,}99} = -6{,}9$$

$$\bar{Z}_2 = \frac{\bar{V}}{\bar{I}_2} = \frac{100 \angle 30^\circ}{1 \angle -6{,}9} =$$

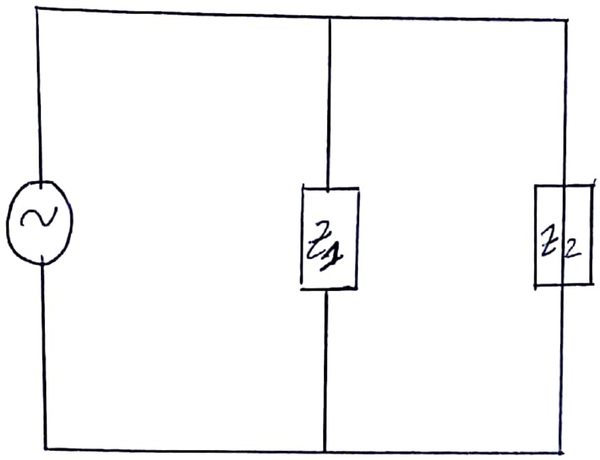
$$= 100 \angle 36{,}9^\circ$$

$$a = 100 \cos 36{,}9^\circ = 80$$
$$b = 100 \operatorname{sen} 36{,}9^\circ = 60$$

$$\bar{Z}_2 = 80 + 60j \ \Omega$$

8) $V_e = 220\ V$ $\quad \nu = 50\ Hz$

$\bar{Z}_i = 200 \angle 60^\circ \ \Omega$



Datos

$\bar{V} = 100 \angle 45° \, V$

$\vec{Z}_1 = 40\sqrt{3} + j40 \, \Omega$

$\vec{Z}_2 = 50 - j50\sqrt{3} \, \Omega$

Calcula la potencia aparente, activa y reactiva de cada una de las ramas del circuito.

$|\bar{S}| = P.\ aparente = I_e \cdot V_e$

$P = P\ activa = I_e V_e \cos\varphi$

$Q = P\ reactiva = I_e V_e \operatorname{sen}\varphi$

$|\bar{S}| = P + jQ$

Pasamos las impedancias a forma polar.

- $\vec{Z}_1 = 40\sqrt{3} + j40$

$Z_1 = \sqrt{(40\sqrt{3})^2 + (40)^2} = 80$

$\varphi = \operatorname{arc\,tg} \frac{40}{40\sqrt{3}} = 30°$

$[\bar{Z}_1 = 80 \angle 30°]$

- $\vec{Z}_2 = 50 - j50\sqrt{3}$

$Z_2 = \sqrt{50^2 + (-50\sqrt{3})^2} = 100$

$\varphi = \operatorname{arc\,tg} \frac{-50\sqrt{3}}{50} = -60$

$[\bar{Z}_2 = 100 \angle -60°]$

Rama 1

Primero calculamos la intensidad $(\bar{I}_1)$ que circula por esta rama.

$$\bar{I}_1 = \frac{\bar{V}}{\bar{Z}_1} = \frac{100 \angle 45°}{80 \angle 30} = 1{,}25 \angle 15° \, A$$

Una vez calculada ya podemos calcular lo que nos piden.

$P.aparente = I_e V_e = 1{,}25 \cdot 100 = 125\ W$

$P_{activa} = I_e V_e \cos\varphi = 1{,}25 \cdot 100 \cdot \cos 30^\circ = 108{,}25\ W$

$P_{reactiva} = I_e V_e \operatorname{sen}\varphi = 1{,}25 \cdot 100 \cdot \operatorname{sen} 30^\circ = 62{,}5\ W.$

Ahora pasamos a la rama 2.

<u>Rama 2</u>

Al igual que en la rama 1 calculamos la intensidad que circula.

$$\bar{I}_2 = \frac{\bar{V}}{\bar{Z}_2} = \frac{100\angle 45^\circ}{100\angle -60^\circ} = 1\angle 105^\circ \iff 1\angle 45^\circ$$

$P.aparente = I_e \cdot V_e = 1 \cdot 100 = 100\ W$

$P.activa = I_e V_e \cdot \cos\varphi = 1 \cdot 100 \cdot \cos -60 = 50\ W$

$P.reactiva = I_e V_e \operatorname{sen}\varphi = 1 \cdot 100 \cdot \operatorname{sen} -60 = -50\sqrt{3} = -86{,}6\ W$

Ahora que hemos calculado los valores tanto de la rama 1 y la rama 2, pasamos a calcular los valores de la fuente.

<u>Fuente.</u>

Como las impedancias están en paralelo lo que tenemos que hacer es calcular la impedancia total ($\bar{Z}_e$).

$$\frac{1}{\bar{Z}_e} = \frac{1}{Z_1} + \frac{1}{Z_2} \Rightarrow Z_e = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

$$\bar{Z}_e = \frac{80\angle 30 \cdot 100\angle -60}{(40\sqrt{3}+j40)+(50-j50\sqrt{3})} = \frac{8000\angle -30}{119 - 46{,}6j} = \frac{8000\angle -30^\circ}{128\angle -21^\circ} = 62{,}5\angle -9^\circ$$

$$Z_e = \sqrt{119^2 + (-46{,}6)^2} = 128$$

$$\varphi = \operatorname{arctg}\frac{-46{,}6}{119} = -21^\circ$$

$$I_e = \frac{\bar{V}}{\bar{Z}_e} = \frac{100 \angle 45°}{62,5 \angle -9} = 1,6 \angle 54° \ A$$

$$P.aparente = I_e \cdot V_e = 1,6 \cdot 100 = 160 \ W$$

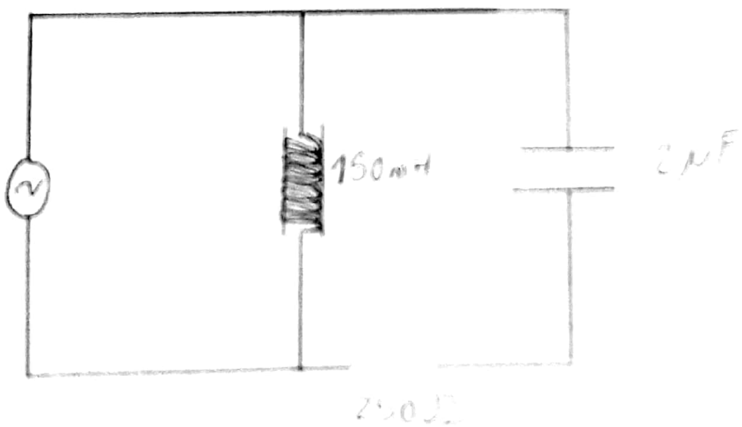
$$P.activa = I_e V_e \cos \varphi = 1,6 \ 100 \ \cos -9 = 158 \ W$$

$$P \ reactiva = I_e V_e \operatorname{sen} \varphi = 1,6 \cdot 100 \cdot \operatorname{sen} -9 = -25 \ W$$

Ya que tenemos todos los datos los organizamos de forma más clara en una tabla

	Rama 1	Rama 2	Fuente
$S(P_{ap})$	125	100	160
$P(P_{act})$	108,25	50	158
$Q(P_{reac})$	62,5	-86,6	-25

10



Datos

$L = 150 \ mH = 0,15 \ H$

$R = 250 \ \Omega$

$C = 2 \ \mu F = 2 \cdot 10^{-6} \ F$

$V = \underbrace{300\sqrt{2}}_{V_0} \operatorname{sen}(2000t + 60°)$

$$V_e = \frac{V_0}{\sqrt{2}} = \frac{300\cancel{\sqrt{2}}}{\cancel{\sqrt{2}}} = 300$$

$$\bar{V} = 300 \angle 60°$$

a) Las corrientes (I) que circulan por la bobina y por el condensador.

$\bar{I}_1 = \frac{\bar{V}}{\bar{Z}_1} = \frac{300\angle 60^\circ}{300\angle 90^\circ} = 1\angle -30 \Rightarrow I_e = 1 \qquad I_e = \frac{I_0}{\sqrt{2}} \Rightarrow I_0 = 1\cdot\sqrt{2}$

Calculamos $\bar{Z}_1$.

$\bar{Z}_1 = \underbrace{0}_{} + j(L\omega - 0) = jL\omega = j(0{,}15\cdot 2000) = 300j$

ya que no hay resistencia.

Ahora lo pasamos a la forma polar

$Z_1 = \sqrt{0^2 + 300^2} = 300$

$\varphi = \text{arctg}\frac{300}{0} = 90^\circ$

$\boxed{\bar{Z}_1 = 300\angle 90^\circ}$

$I_1 = \sqrt{2}\,\text{sen}(2000t - 30^\circ)$

$I_2 = \frac{\bar{V}}{\bar{Z}_2} = \frac{300\angle 60^\circ}{250\sqrt{2}\angle -45^\circ} = \frac{1{,}2}{\sqrt{2}}\angle 105^\circ = \frac{1{,}2}{\sqrt{2}}\angle 15^\circ$

• Calculamos $\bar{Z}_2$

$\bar{Z}_2 = 250 + j\left(0 - \frac{1}{C\omega}\right) = 250 + j\left(-\frac{1}{2\cdot 10^{-6}\cdot 2000}\right) = 250 - 250j\ \Omega$

Lo pasamos a la forma polar.

$Z_2 = \sqrt{250^2 + (-250)^2} = 250\sqrt{2}$

$\varphi = \text{arctg}\frac{-250}{250} = -45^\circ$

$\bar{Z}_2 = 250\sqrt{2}\angle -45^\circ$

• $I_e = \frac{1{,}2}{\sqrt{2}}$

$I_e = \frac{I_0}{\sqrt{2}} \Rightarrow I_0 = \frac{1{,}2\cdot\cancel{\sqrt{2}}}{\cancel{\sqrt{2}}} = 1{,}2\,A$

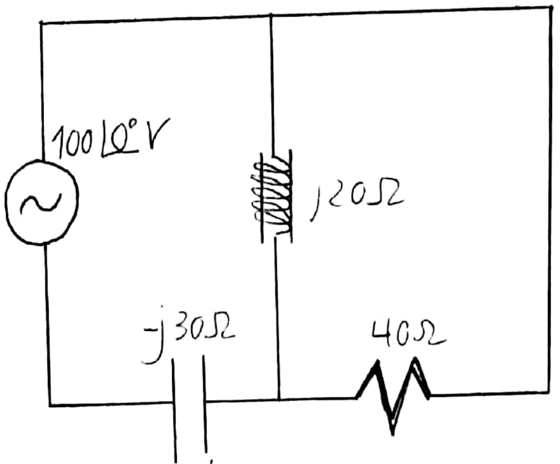
$I_2 = 1{,}2\,\text{sen}(2000t + 15^\circ)\,A.$

b) La potencia disipada en la resistencia.

$$P = I_e^2 R = \left(\frac{1,2}{\sqrt{2}}\right)^2 \cdot 250 = 180\ W$$

11)

Datos



a) La impedancia equivalente.

$$\bar{Z}_1 = 0 + (-j30) + (j20) = \bar{Z}_1 = 0 - j10$$

$$Z_1 = \sqrt{(-10)^2} = 100$$

$$\varphi = \text{arc tg} \frac{-10}{0} = 90 \Bigg\} \bar{Z}_1 = 100 \angle 90$$

$$\bar{Z}_2 = 40 + j20$$

$$Z_2 = \sqrt{40^2 + 20^2} = 20\sqrt{5}$$

$$\varphi = \text{arc tg} \frac{20}{40} = 27° \text{ ó } 26,6° \Bigg\} \bar{Z}_2 = 20\sqrt{5} \angle 26,6$$

$$\bar{Z}_e = \frac{Z_1 \cdot Z_2}{Z_1 + Z_2} = \frac{100 \angle 90° \cdot 20\sqrt{5} \angle 26,6°}{(-j10) + (40 + j20)} = \frac{4472,14 \angle 26,6}{40 + j10} =$$

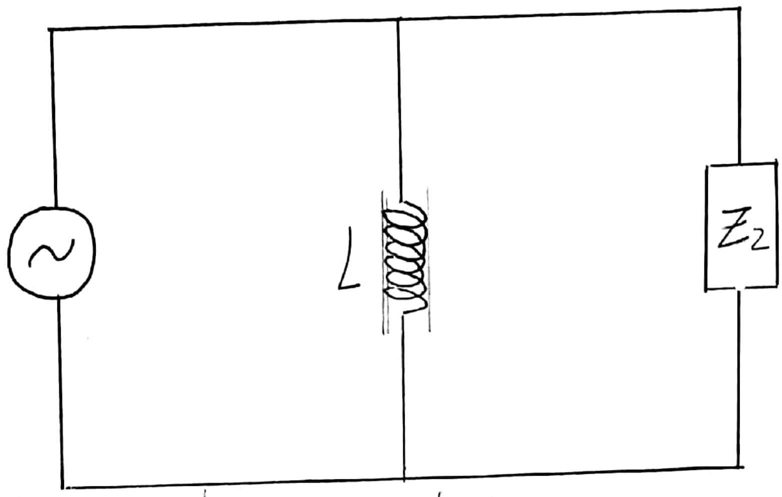
$$\bar{Z} = \sqrt{40^2 + 10^2} = 10\sqrt{17} \qquad = \frac{4472,14 \angle 26,6}{10\sqrt{17} \angle 14}$$

$$\varphi = \frac{10}{40} = 14°$$

b) La potencia disipada en la resistencia

$P = I_e^2 R$

12)



Datos

$V = 220\sqrt{2}\ \text{sen}(250t - 30°)\ V$

$L = 80\ mH$

$\bar{Z}_2 = 40\angle{-60°}\ \Omega$

a) La impedancia equivalente ($\bar{Z}_e$).

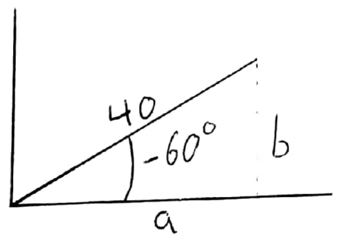
- Como tenemos $\bar{Z}_2$ lo que haremos será calcular $\bar{Z}_1$

$\bar{Z} = R + j\left(L\omega - \frac{1}{C\omega}\right) \Rightarrow \bar{Z}_1 = 0 + j(80\cdot 10^{-3}\cdot 250 - 0) = 20j$

$$\left.\begin{array}{l} Z = \sqrt{0^2 + 20^2} = 20 \\ \varphi = \text{arc tg}\ \frac{20}{0} = 90° \end{array}\right\} \bar{Z}_1 = 20\angle{90°}\ \Omega$$

- Ya que tenemos $\bar{Z}_2$ en forma polar lo pasaremos a forma binómica para efectuar la suma a la hora de calcular $\bar{Z}_e$

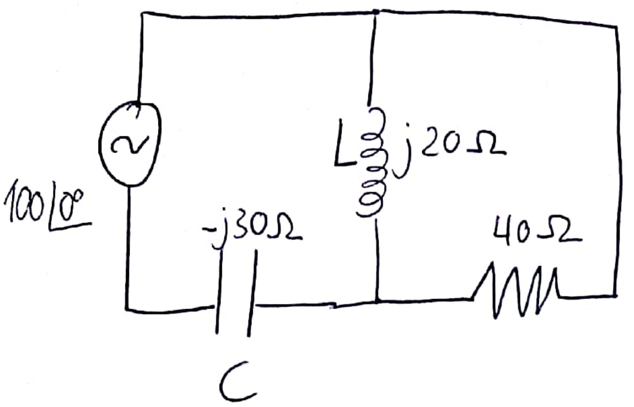
$\bar{Z}_2 = 40\angle{-60°}$



$$\left.\begin{array}{l} \cos\alpha = \frac{a}{40} \\ \text{sen}\ \alpha = \frac{b}{40} \end{array}\right\} \left.\begin{array}{l} a = 40\cos -60 = 20 \\ b = 40\,\text{sen} -60 = -20\sqrt{3} \end{array}\right\} \Rightarrow$$

$\Rightarrow \bar{Z}_2 = 20 - 20\sqrt{3}j\ \Omega$

11 Tema 8



Datos

$V = 100\angle 0°$

$R = 40\,\Omega$

$\bar{Z}_L = 20j$

$\bar{Z}_C = -30j$

a) $\bar{Z}_e$?

Primero calculamos la impedancia entre R y L

$$Z_{RL} = \frac{Z_R \cdot Z_L}{Z_R + Z_L} = \frac{40\angle 0° \cdot 20\angle 90°}{\underbrace{40 + 20j}} = \frac{800\angle 90°}{20\sqrt{5}\angle 26{,}57°} = 8\sqrt{5}\angle 63{,}43°$$

~~$Z_e = 40 - 40j$~~

$\bar{Z}_L = 20j$

$Z = 20$, $\varphi = 90°$ $\}$ $20\angle 90°$

$Z = 20\sqrt{5}$

$\varphi = \text{arc tg}\,\frac{20}{40} = 26{,}57$

Ahora sumamos $\bar{Z}_C$ con $\bar{Z}_{RL}$ para calcular $\bar{Z}_e$

$$\bar{Z}_e = Z_{RL} + Z_C = 8 + 16j + (-30j) = \underbrace{8 - 14j}$$

$\bar{Z}_e = \sqrt{8^2 + (-14)^2} = 16{,}125$

$\varphi = \text{arc tg}\,\frac{-14}{8} = -60{,}26$ $\}$ $\Rightarrow$

$\bar{Z}_{RL} = 8\sqrt{5}\angle 63{,}43$

$a = 8\sqrt{5}\cos 63{,}43 = 8$

$b = 8\sqrt{5}\,\text{sen}\, 63{,}43 = 16$

$\}$ $8 + 16j = \bar{Z}_{RL}$

$\Rightarrow$ $\boxed{\bar{Z}_e = 16{,}125\angle -60{,}26°}$

Z_C:

b) Potencia disipada en la resistencia

$P_R = I_e^2 \cdot R$

Para calcular la Potencia que disipa la resistencia tenemos que calcular I_2

$$I_2 = \frac{\bar{V}}{\bar{Z}_{RL}} = \frac{100 \angle 0}{8\sqrt{5} \angle 63{,}43} = 5{,}59 \angle -63{,}43$$

$P_R = 5{,}59^2 \cdot 40 =$

$2{,}77 = \frac{100 \angle 0}{}$

$2{,}77 = I_2$

36,10

Ahora que ya tenemos calculado $\bar{Z}_1$ y $\bar{Z}_2$ en ambas formas (polar y binómica) procedemos a calcular $\bar{Z}_e$

$$\frac{1}{\bar{Z}_e} = \frac{1}{\bar{Z}_1} + \frac{1}{\bar{Z}_2} \Rightarrow \frac{1}{\bar{Z}_e} = \frac{Z_1 + Z_2}{Z_1 \cdot Z_2} \Rightarrow \bar{Z}_e = \frac{Z_1 \cdot Z_2}{Z_1 + Z_2}$$

$$\left[\bar{Z}_e = \frac{20\angle 90^\circ \cdot 40\angle -60}{20j + (20 - 20\sqrt{3}j)} = \frac{800\angle 30^\circ}{\underbrace{20 - 14,64}} = \frac{800\angle 30^\circ}{24,79\angle -36,2} = 32,27\angle 66,2\right.$$

$\bar{Z}/$

$$Z = \sqrt{20^2 + (-14,64)^2} = 24,79$$

$$\varphi = \text{arc}\,tg^{-1}\,\frac{-14,64}{20} = -36,2$$

$$\left.\right\} 24,79\angle -36,2$$

b) La potencia disipada en la impedancia $\bar{Z}_2$

Para calcular la potencia que ~~pasa~~ disipa $\bar{Z}_2$ tenemos que calcular la intensidad primero.

$$I_2 = \frac{\bar{V}}{\bar{Z}_2} = \frac{220\angle 0}{40\angle -60} = \underbrace{\frac{11}{2}}_{I_e}\angle 60^\circ$$

$$V_0 = 220\sqrt{2}$$

$$V_e = \frac{V_0}{\sqrt{2}} = \frac{220\cancel{\sqrt{2}}}{\cancel{\sqrt{2}}} = 220\,V$$

$$P = I_e^2 \cdot R = \left(\frac{11}{2}\right)^2 \cdot 20 = 605\,W$$

$$\bar{Z}_2 = 40\angle -60 \Rightarrow \underbrace{20}_{R} - 20\sqrt{3}\,j = \bar{Z}_2$$