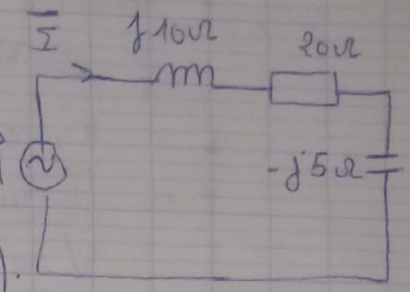
Solution TD N° 02

Exercice N° 1



1. Valeur efficace du courant I.

pour un circuit R, L, C en serie

$\bar{V} = \bar{Z}\,\bar{I}$ / $\bar{Z} = R + j\left(Lw - \frac{1}{Cw}\right)$.

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

$\bar{Z} = 10 + j10 - 5j = 20 + 5j$

$Z = \sqrt{20^2 + 5^2} = 20,61\ \Omega$

$\bar{V} = \bar{Z}\,\bar{I} \Rightarrow \bar{I} = \frac{\bar{V}}{\bar{Z}}$ On peut dire $I = \frac{V}{Z}$.

$I = \frac{100}{20,61} = 4,85$ A.

2/ La phase du courant.

Si on considere $\bar{V}$ à l'origine des phase $\Rightarrow \bar{V} = 100 \angle 0$

$\bar{Z} = 20,61 \angle 14°$ $\quad \arctg \varphi_z = \frac{5}{20}$.

$$\varphi_c = \varphi_v - \varphi_z = 0 - 14° = -14° \left(\bar{I} = \frac{\bar{V}}{\bar{Z}}\right).$$

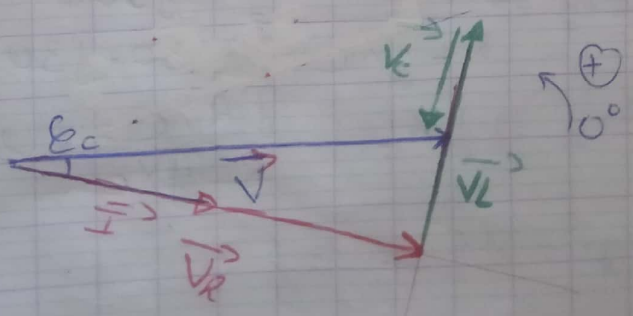
$v(t) = \sqrt{2}\,100 \sin(100\pi t)$

$i(t) = \sqrt{2}\,4,85 \sin\left(100\pi t - \frac{7\pi}{90}\right)$

3/ $v(t) = R\,i(t) + \bar{X}_L\,i(t) + \bar{X}_C\,i(t)$

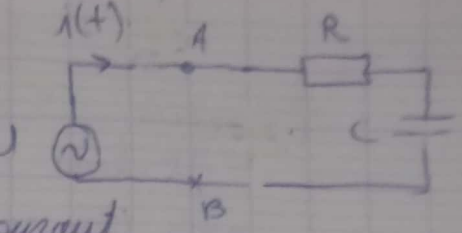
$= R\,i(t) + j X_L\,i(t) - j X_C\,i(t)$

$\bar{V} = R\,\bar{I} + j X_L\,\bar{I} - j X_C\,\bar{I}$



Exercice N° 02

$f = 50\,Hz$. $U = 150\,V$



I. $R = 0,1\,K\Omega$, $C = 20\,\mu F$

I.1. L'intensité efficace du courant

$\overline{V} = \overline{Z}\,\overline{I} \Rightarrow \overline{I} = \dfrac{\overline{V}}{\overline{Z}}$ / $\overline{Z} = R - j\dfrac{1}{C\omega}$

$I = \dfrac{V}{Z}$ en valeur efficace

$\overline{Z} = 100 - \dfrac{1 \cdot 10^{+6}}{20\ 100\pi} j = 100 - j\,160 \Rightarrow Z = 189\,\Omega$

$I = \dfrac{150}{189} = 0,8\,A$

I.2 $V_R = RI = 100 \times 0,8 = 80\,V$

$V_C = X_C I = 160 \times 0,8 = 128\,V$

II.1. La valeur de l'inductance L

le courant est en phase avec la tension

$L\omega = \dfrac{1}{C\omega} = 160 \Rightarrow L = \dfrac{160}{100\pi} = 0,5\,H$

II.2.1 La valeur efficace du courant

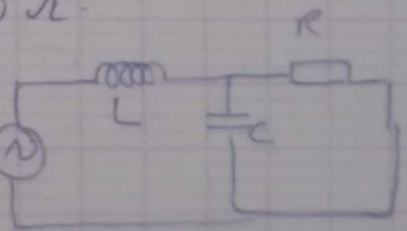
$I = \dfrac{V}{Z} = \dfrac{150}{100} = 1,5\,A$

~~II.2.1~~

II.2.2 La valeur efficace de tension aux bornes de la bobine

$V_L = X_L I = 160 \times 1,5 = 240\,\Omega$

Exercice N° 03



1. L'impédance complexe

$Z_{eq_1} = R \,//\, C$

$\overline{Z_{eq}} = \dfrac{R X_C}{R - jX_C} = \dfrac{-j30 \times 30}{30 - j30} = 15 - j15$

$Z_{eq} = jX_L + Z_{eq_1} = 20j + 15 - j15$

$Z_{eq} = 15 + 5j$

Suite ex 03

2. la valeur de courant $\bar{I}$ / $\bar{U} = 150 \angle 0°$ V

$\bar{U} = \bar{Z}\,\bar{I} \Rightarrow \bar{I} = \dfrac{\bar{U}}{\bar{Z}}$

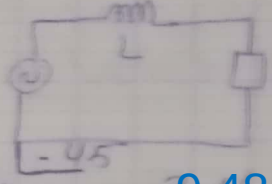
$\bar{Z} = Z_{eq} = 15 + 5j = (5\sqrt{10}) \angle 18{,}43°$

$\bar{I} = \dfrac{150 \angle 0}{5\sqrt{10} \angle 18{,}43} = 30/\sqrt{10} \angle -18{,}43° = 9.48 \angle -18{,}43°$

3°/ La tension aux bornes des deux dérivations

$\bar{V}_R = \bar{V}_C$

($\bar{U} = \bar{V}_L + \bar{V}_C \Rightarrow \bar{V}_C = \bar{U} - \bar{V}_L$)

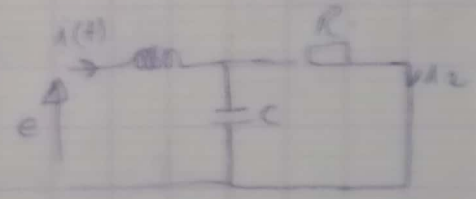


$\bar{V}_R = \bar{V}_C = \bar{V}_{Zeq_1}$

$V_{Zeq_1} = \bar{Z}_{eq_1}\,\bar{I}_1 = 21{,}21 \angle -63{,}43° \cdot 9.48$

$\bar{V}_R = \bar{V}_C = \bar{V}_{Zeq_1} = 201.25$

Exercice N° 4



Circuit 1

$Z_{eq_1} = R // C \Rightarrow Z_{eq_1} = \dfrac{R X_C}{R - jX_C}$

$Z_{eq_1} = \dfrac{-2j \cdot \frac{1}{10 \cdot 10^{-6} 10^5}}{2 - j\frac{1}{10 \cdot 10^{-6} 10^5}} = \dfrac{-2j}{2-j} = \dfrac{2}{5} - \dfrac{4}{5}j = 0{,}4 - j0{,}8$

$Z_{eq_1} = 0{,}89 \angle -63{,}43°$

$Z_{eq} = X_L + Z_{eq_1} = 5 \cdot 10^{-6} 10^5 j + \dfrac{2}{5} - \dfrac{4}{5}j$

$\bar{Z}_{eq} = \dfrac{1{,}5}{5}j + \dfrac{2}{5} - \dfrac{4}{5}j = \dfrac{2}{5} - \dfrac{1{,}5}{5}j = 0{,}4 - 0{,}3j$

$\angle -36{,}86°$

$Z_{eq} = 0{,}5$

2- les courants

$e(t) = 10 \sin(10^5 t) = 7{,}07$ V $\angle 0°$

$\bar{I} = \frac{\bar{E}}{\bar{Z}} = \frac{7{,}07 \angle 0}{0{,}5 \angle -36{,}86} = 14{,}14 \angle 36{,}86$

$\bar{V}_R = \bar{V}_C = \bar{Z}_{eq_1} \cdot \bar{I} = 0{,}89 \angle -63{,}43 \cdot 14{,}14 \angle 36{,}86$

$= 12{,}58 \angle -26{,}57$ V

$\bar{I}_2 = \frac{\bar{V}_R}{R} = \frac{12{,}58 \angle -26{,}57}{2} = 6{,}3 \angle -26{,}57$ A

$\bar{I}_1 = \frac{\bar{V}_C}{X_C} = \frac{12{,}58 \angle -26{,}57}{1 \angle -90} = 12{,}58 \angle 63{,}43$

Circuit 2: 3-/ $\bar{V}_R = R \bar{I}_2 = 25{,}16 \angle -116{,}57°$

$\bar{Z}_{eq_1} = \bar{Z}_{eq_2} = 0{,}4 - 0{,}8j = 0{,}89 \angle -63{,}43$

$\bar{Z}_{eq} = \bar{X}_C + \bar{Z}_{eq_1} = -j + 0{,}4 - 0{,}8j = 0{,}4 - 1{,}8j$

$\bar{Z}_{eq} = 1{,}84 \angle -77{,}47°$

2- les courants

$\bar{I} = \frac{\bar{E}}{\bar{Z}} = \frac{7{,}07 \angle 0°}{1{,}84 \angle -77{,}47} = 3{,}84 \angle 77{,}47°$ (A)

$\bar{V}_R = \bar{V}_C = \bar{Z}_{eq_1} \cdot \bar{I} = 3{,}84 \angle 77{,}47 \cdot 0{,}89 \angle -63{,}43$

$= 3{,}41 \angle 14{,}04$ (V)

$\bar{I}_1 = \frac{\bar{V}_C}{X_C} = \frac{3{,}41 \angle 14{,}04}{1 \angle -90°} = 3{,}41 \angle 124{,}04$ A

$\bar{I}_2 = \frac{\bar{V}_R}{R} = \frac{3{,}41 \angle 14{,}04}{2} = 1{,}705 \angle 14{,}04$ A

3/ Tension aux bornes de R

$\bar{V}_R = R \bar{I}_2 = 2 \cdot 1{,}705 \angle 14{,}04 = 3{,}4 \angle 14{,}04$ V