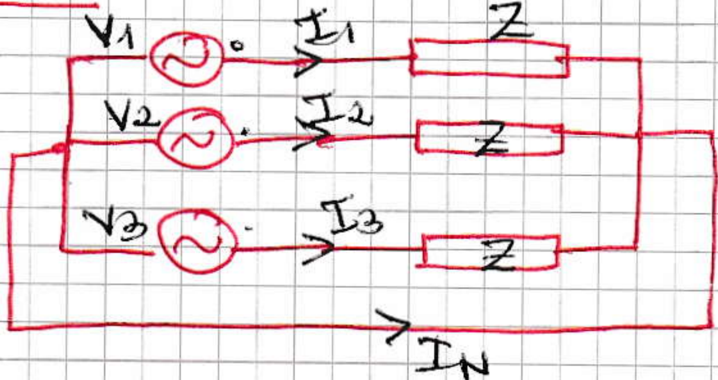
Exo1



avec
$\underline{Z} = R + jL\omega$

$v_1(t) = V\sqrt{2}\sin\omega t$
$v_2(t) = V\sqrt{2}\sin(\omega t - 2\pi/3)$
$v_3(t) = V\sqrt{2}\sin(\omega t - 4\pi/3)$

$V = 240V$
$f = 50Hz$
$L = 16mH$, $R = 25\Omega$

1°/ Dans la phase (1) $\underline{Z}_1 = R + jL\omega$

$\underline{Z}_1 = 25 + j\,0{,}016 \times 314 = 25 + j5$

$\omega = 2\pi f = 2\pi \times 50 = 314\ rad\,s^{-1}$

module: $Z_1 = \sqrt{25^2 + 5^2} = 25{,}5\,\Omega$

argument: $\varphi_1 = \tan^{-1}(5/25) = 0{,}198\ rad$

donc l'impédance complexe

$$\boxed{\underline{Z}_1 = [25{,}5\,;\,0{,}198]}$$

2°/ $\underline{I}_1 = \dfrac{\underline{V}_1}{\underline{Z}_1} = \dfrac{[V,0]}{[25{,}5\,;\,0{,}198]} = \dfrac{[240,0]}{[25{,}5\,;\,0{,}198]}$

$\underline{I}_1 = \left[\dfrac{240}{25{,}5}, 0 - 0{,}198\right] = [9{,}42\ A\,;\,-0{,}198]$

valeur efficace $\boxed{I_1 = 9{,}42A}$

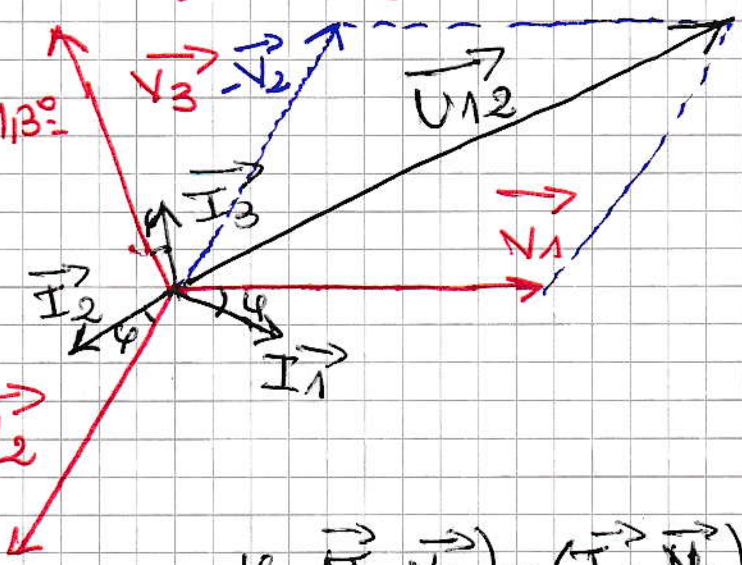
3°/ Diagramme de Fresnel

$V = 240\,V \Rightarrow 2\,cm/100\,V \Rightarrow 4{,}8\,cm$

$1\,cm/10\,A \Rightarrow I = 9{,}42\,A \simeq 1\,cm$

$\varphi = 0{,}198\,rad$

$\simeq 0{,}198 \times 57 = 11{,}3°$



$\varphi = (\vec{I_1}, \vec{V_1}) = (\vec{I_2}, \vec{V_2}) = (\vec{I_3}, \vec{V_3})$

$\vec{U_{12}} = \vec{V_1} - \vec{V_2} = \vec{V_1} + (-\vec{V_2})$

(on additionne $\vec{V_1}$ avec l'opposé de $\vec{V_2}$)

4°/ Puissance active absorbée par une charge Z

$P_1 = V.I_1 \cos\varphi_1 = 240 \times 9{,}42 \times \cos 0{,}198$

$\boxed{P_1 = 2215\,W}$

5°/ Puissance réactive d'une charge Z

$Q_1 = V.I_1 \sin\varphi_1 = P_1 . \tan\varphi_1$

$Q_1 = 240 \times 9{,}42 \times \sin(0{,}198) =$

$\boxed{Q_1 = 445\,Var}$

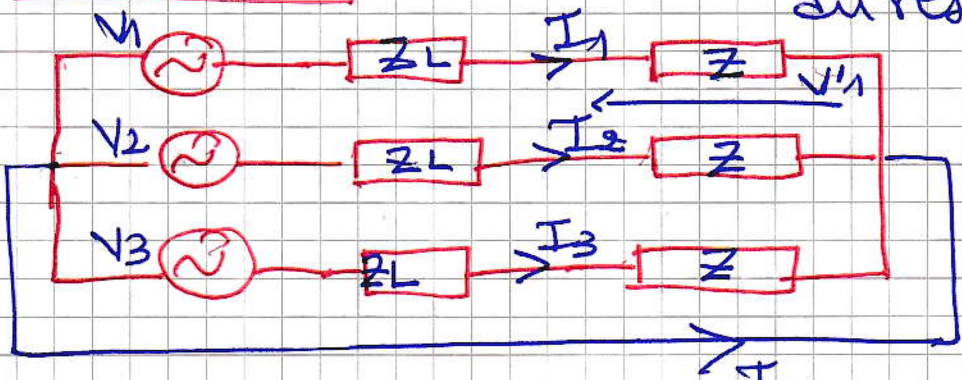
6°/ $P_t = 3P_1 = 3 \times 2215 = 6645\,W$

$Q_t = 3Q_1 = 445 \times 3 = 1335\,Var$

7°/ $S = \sqrt{P_t^2 + Q_t^2} = \sqrt{6645^2 + 1315^2}$

$\boxed{S = 6674\,VA}$

Exercice2 on tient compte de l'impédance du réseau



$Z = R + jL\omega$ $\quad f = 50Hz$

$Z_L = 2 + 1j$ $\quad V = 240V$

$$\left.\begin{array}{l} V_1 = V\sqrt{2}\sin\omega t \\ V_2 = V\sqrt{2}\sin(\omega t - \frac{2\pi}{3}) \\ V_3 = V\sqrt{2}\sin(\omega t - 4\pi/3) \end{array}\right\} \Rightarrow \left\{\begin{array}{l} \underline{V_1} = [V; 0] \\ \underline{V_2} = [V; -\frac{2\pi}{3}] \\ \underline{V_3} = [V; -\frac{4\pi}{3}] \end{array}\right.$$

1°/ $I_1 = \frac{V_1}{Z_t}$ $\quad \underline{Z_1} = 12 + 0{,}018 \times 314$

$\underline{Z_1} = 12 + j5{,}65$

$\underline{Z_{t_1}} = \underline{Z_1} + \underline{Z_{L_1}}$

$\underline{Z_{t_1}} = \underbrace{12 + 5{,}65j}_{\underline{Z_1}} + \underbrace{2 + j}_{\underline{Z_{L_1}}} = 14 + 6{,}65j$

module de $\underline{Z_{t_1}}$: $Z_{t_1} = \sqrt{14^2 + 6{,}65^2} = 15{,}5\,\Omega$

$I_1 = \frac{240}{15{,}5} = 15{,}5$ A

2°/ $V'_1 = Z_1 \times I_1$, il faut calculer le module de Z_1.

$Z_1 = \sqrt{12^2 + 5{,}65^2} = 13{,}3\,\Omega$

donc $V'_1 = 13{,}3 \times 15{,}5 = 205{,}6V$

$V'_1 = 205{,}6$ V on a une chute de tension de 34,4 V

3°/ Puissance active dans la charge triphasée

$P_{char} = 3 V'_1 I_1 \cos\varphi_1$

$Z_1 = 12 + j\,5{,}65$

$\varphi_1 = \tan^{-1}\left(\frac{5{,}65}{12}\right) = 0{,}44 \text{ rad}$

$P_{char} = 3 \times 205{,}6 \times 15{,}5 \times \cos(0{,}44)$

$\boxed{P_{char} = 8650 \text{ W}}$

4°/ Puissance réactive absorbée par la charge triphasée

$Q_{char} = 3 V'_1 I_1 . \sin\varphi_1 = P_{char} \times \tan\varphi_1$

$Q_{char} = 8650 \times \tan 0{,}44 = 4072 \text{ Var}$

$\boxed{Q_{char} = 4072 \text{ Var}}$

5°/ Puissance active fournie par le générateur

$P_G = 3 \times V I \cos\varphi_t$

$Z_t = 14 + 6{,}65 j \qquad \varphi_t = \tan^{-1}\left(\frac{6{,}65}{14}\right)$

$\varphi_t = 0{,}4435$

$P_G = 3 \times 240 \times 15{,}5 \times \cos(0{,}4435)$

$\boxed{P_G = 10080 \text{ W}}$

6°/ Puissance réactive fournie par le générateur

$Q_G = 3 V . I . \sin\varphi_t = P_G \times \tan\varphi_t$

$Q_G = 10080 \times \tan(0{,}4435) = 4789 \text{ Var}$

$\boxed{Q_G = 4789 \text{ Var}}$

7°/ Pertes $= P_G - P_{char} =$

Pertes $= 10080 - 8650 = 1430$ W

C'est aussi égale à $3 \times R_L \times I^2 = 2 \times 15{,}5^2 \times 3 = 1441{,}2 \text{ W}$