Correction

Exercice 1 : $U = 240V$.

M1 : $N = 3$: $P_{u1} = 2kW$; $\eta = 0,8$; $\cos\varphi_1 = 0,707$

M2 : $N = 1$: $P_{u2} = 4kW$, $\eta = 0,75$, $\cos\varphi_2 = 0,8$

1 Four $P_3 = 8kW$

1°/ P_1 ? $P_1 = U \underbrace{I_1}_{?} \cos\varphi_1 = \frac{P_{u1}}{\eta_1} = \frac{2}{0,8}$

$\boxed{P_1 = 2,5 kW}$

2°/ P_2 ? $P_2 = U \underbrace{I_2}_{?} \cos\varphi_2 = \frac{P_{u2}}{\eta_2} = \frac{4}{0,75}$

$\boxed{P_2 = 5,33 kW}$

3°/ Q_1 ? $Q_1 = P_1 \times \tan\varphi_1$ $\quad \varphi_1 = \cos^{-1}(0,707)$

$Q_1 = 2,5 \times \tan(\cos^{-1}(0,707)) = 2,5 kVar$

$\boxed{Q_1 = 2,5 kVar}$

4°/ Q_2 ? $Q_2 = P_2 \times \tan\varphi_2 =$ $\quad \varphi_2 = \cos^{-1}(0,8)$

$Q_2 = 5,33 \times \tan(\underbrace{\cos^{-1}(0,8)}_{\varphi_2}) = 4 kVar$

$\boxed{Q_2 = 4 kVar}$

5°/ P_t ? Q_t ?

$Q_t = 3 P_1 + P_2 + P_F = 3 \times 2,5 + 5,33 + 8$

$\boxed{P_t = 20,83 kW}$

$Q_t = 3 Q_1 + Q_2 + \underbrace{Q_F}_{0} = 3 \times 2,5 + 4 + 0$

$\boxed{Q_t = 11,5 kVar}$

6°) Moteur 1: (2)

$$I_1 = \frac{P_1}{U \times \cos\varphi_1} = \frac{2500}{240 \times 0{,}707} = 14{,}73\ A$$

$$\boxed{I_1 = 14{,}73\ A}$$

Moteur 2:

$$I_2 = \frac{P_2}{U \times \cos\varphi_2} = \frac{5333}{240 \times 0{,}8} = 27{,}8\ A$$

$$\boxed{I_2 = 27{,}8\ A}$$

Four:

$$I_3 = \frac{P_3}{U \underbrace{\cos\varphi_3}_{1}} = \frac{8000}{240 \times 1} = 33{,}33\ A$$

$$\boxed{I_3 = 33{,}33\ A}$$

7°) I_t ?

a) méthode Boucherot

$$I_t = \frac{S}{U} \quad , \quad S = \sqrt{P_t^2 + Q_t^2}$$

$$S = \sqrt{20{,}83^2 + 11{,}5^2} = 23{,}8\ kVA$$

$$I_t = \frac{23{,}8 \times 10^3}{240} = 99{,}1\ A$$

$$\boxed{I_t = 99{,}1\ A}$$

b) Methode de nombres complexes

$$\underline{I}_t = 3\underline{I}_1 + \underline{I}_2 + \underline{I}_3$$

$\varphi_1 = \cos^{-1}(0{,}707) = \pi/4$

avec $\underline{I}_1 = [14{,}73 ; -\frac{\pi}{4}]$

$$\underline{I}_1 = 14{,}73 \cos(-\pi/4) + j\, 14{,}73 . \sin(-\pi/4)$$

3

$\underline{I_1} = 10{,}4 - j\,10{,}4$

$\underline{I_2} = [27{,}8\,;\,-0{,}646]$ $\quad \varphi_2 = \cos^{-1}(0{,}8) = 0{,}646\,\text{rad}$

les moteurs sont de nature inductive donc le courant i est en retard par rapport à la tension d'où le signe (−)

$\underline{I_3} = [33{,}33\,;\,0]$ $\quad \varphi_3 = \cos^{-1}(1) = 0$

$\underline{I_2} = 27{,}8\cos(-0{,}646) + j\,27{,}8\sin(-0{,}646)$

$$\underline{I_t} = 3\underline{I_1} + \underline{I_2} + \underline{I_3} = 3\times(10{,}4 - 10{,}4j) + \underbrace{22{,}24 - j\,16{,}7}_{I_2} + 33{,}33$$

$\underline{I_t} = 86{,}77 - j\,47{,}9$

valeur efficace de toute l'installation

$I_t = \sqrt{86{,}77^2 + (-47{,}9)^2} = 99{,}11$

$\boxed{I_t = 99{,}11\,A}$

8°/ facteur de puissance

$k = \dfrac{P_t}{S} = \dfrac{20{,}83}{23{,}8} = 0{,}875$

autre méthode

$\left(\begin{array}{l} \text{si } \underline{z} = a + jb = [\rho, \theta] \\ \cos\theta = \dfrac{a}{\rho},\ \sin\theta = \dfrac{b}{\rho} \end{array}\right)$

$\underline{I_t} = 8\cancel{6}{,}77 - j\,47{,}9$

facteur de puissance $k = \dfrac{87{,}77}{I_t} = \dfrac{8\cancel{6}{,}77}{99{,}11} = 0{,}875$

11°/ $k = 0,875$

nouveau facteur de puissance $k' = 0,96$

Q_c ? $\varphi' = \cos^{-1}(0,96) = 0,284$ rad

on calcule la nouvelle puissance réactive Q':

$$Q' = Q_c + Q_t \Rightarrow Q_c = Q' - Q_t$$

$$Q' = P_t \times \tan\varphi' = 20,83 \times \tan(0,284)$$

$$\boxed{Q' = 6 \text{ kvar}}$$

donc $Q_c = Q' - Q_t = 6 - 11,5 = -5,5$ kvar

$$\boxed{Q_c = -5,5 \text{ kvar}}$$

- comme $Q_c = -U^2 . C . \omega \Rightarrow \boxed{C = \dfrac{-Q_c}{U^2 \times \omega}}$

AN: $C = \dfrac{-(-5500)}{240^2 \times 314} = 0,000304$ F

$$\boxed{C = 304\ \mu F}$$

11°/ $I' = \dfrac{P_t}{U \times \cos\varphi'} = \dfrac{20,83 \times 10^3}{240 \times 0,96}$

$$\boxed{I' = 90,4 A}$$