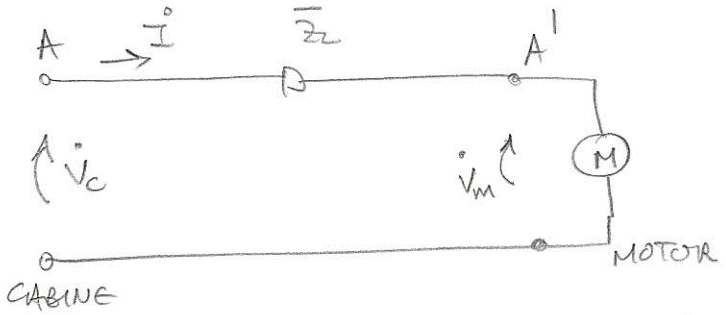
LISTA 1

EXERCÍCIO 3.16

a)



$$\begin{cases} \dot{V}_c = \dfrac{220}{\sqrt{3}} \angle\theta \ \text{V} & \text{(tensão de fase)} \\ \dot{V}_m = V_m \angle 0 & \text{(tensão de fase com ângulo adotado)} \\ \bar{Z} = (0{,}1 + j\,0{,}05)\ \Omega \\ \dot{I} = 100 \angle 0 - \arccos 0{,}7 = 100 \angle -45{,}57^\circ \ \text{A} \end{cases}$$

$$\dot{V}_c = \dot{V}_m + \bar{Z}_L \cdot \dot{I} = V_m \angle 0 + (0{,}1 + j\,0{,}05) \times 100 \angle -45{,}57^\circ$$

$$= V_m + (10{,}571 - j\,3{,}641) = (V_m + 10{,}571) - j\,3{,}641$$

$$= \frac{220}{\sqrt{3}} \angle\theta$$

$$\therefore \sqrt{(V_m + 10{,}571)^2 + 3{,}641^2} = \frac{220}{\sqrt{3}} \Rightarrow V_m = 116{,}394 \ \text{V}$$

$$\therefore \boxed{\dot{V}_m = 116{,}394 \angle 0 \ \text{V}}$$

$$\text{e} \quad \theta = \arctan \frac{-3{,}641}{116{,}394 + 10{,}571} = -1{,}64^\circ$$

$$\therefore \boxed{V_c = 127{,}017 \angle -1{,}64^\circ \ \text{V}}$$

b) $W_1 = (\sqrt{3} V_m) \cdot I \cdot \cos(\varphi + 30°)$

$W_2 = (\sqrt{3} V_m) \cdot I \cdot \cos(\varphi - 30°)$

com $\varphi = 45{,}57°$ (ângulo de potência do motor)

$W_1 = \sqrt{3} \times 116{,}394 \times 100 \times \cos(45{,}57° + 30°) = 5024\ W$

$W_2 = \sqrt{3} \times 116{,}394 \times 100 \times \cos(45{,}57° - 30°) = 19420\ W$

c) $W_3 = (\sqrt{3} \times \frac{220}{\sqrt{3}}) \cdot I \cdot \cos(\varphi_c + 30°)$

$W_4 = 220 \cdot I \cdot \cos(\varphi_c - 30°)$

com $\varphi_c = -1{,}64° - (-45{,}57°) = 43{,}93°$ ângulo de potência na cabine

$W_3 = 220 \times 100 \times \cos(43{,}93° + 30°) = 6090\ W$

$W_4 = 220 \times 100 \times \cos(43{,}93° - 30°) = 21353\ W$

d) $\cos\varphi' = 0{,}9 \Rightarrow \varphi' = \text{arc cos } 0{,}9 = 25{,}84°$

Hipótese: a tensão no motor se mantém:

$\dot{V}'_m = 116{,}394 \angle 0°\ V$

$P' = P = 5024 + 19420 = 24444\ W$

$Q = P\, tg\varphi = 24444 \times tg\, 45{,}57° = 24935\ VAr$

e $Q' = Q - Q_{cap}$

$$tg\varphi' = \frac{Q'}{P'} = \frac{Q - Q_{cap}}{P} = \frac{24935 - Q_{cap}}{24444}$$

$$= tg\, 25,84° = 0,484$$

$\therefore$ $\boxed{Q_{cap} = 13097 \text{ VAr}}$

$$C_\Delta = \frac{\frac{Q_{cap}}{3}}{(\sqrt{3} \times 116,394)^2 \cdot w} \quad \leftarrow \text{1 fase!}$$

$$C_Y = \frac{\frac{Q_{cap}}{3}}{116,394^2 \cdot w}$$

onde $w = 2\pi \cdot 60 = 120\pi \ \frac{rd}{s}$

$\boxed{C_\Delta = 285\ \mu F}$ $\quad$ $\boxed{C_Y = 855\ \mu F}$

e) $\boxed{Q_{cap} = 13097 \text{ VAr}}$ (trifásica)

f) $$I' = \frac{S'_m}{\sqrt{3} \cdot \underbrace{(\sqrt{3} V_m)}_{\text{LINHA}}} = \frac{\sqrt{P'^2 + Q'^2}}{\sqrt{3}\, V_m} = \frac{\sqrt{24444^2 + (24935 - 13097)^2}}{3 \times 116,394}$$

$I' = 77,781$ A $\quad [< 100 \text{ A } !!]$

perda ativa na linha: $p_{at} = 3 \times 0,1 \times 77,781^2 = 1815$ W

perda reativa na linha: $p_{reat} = 3 \times 0,05 \times 77,781^2 = 907$ VAr

$\therefore$ novas potências na cabine:

$$P'_c = P' + p_{at} = 24444 + 1815 = 26259 \text{ W}$$

$$Q'_c = Q' + p_{reat} = (24935 - 13097) + 907 = 12745 \text{ VAr}$$

$$S'_c = \sqrt{P'^2_c + Q'^2_c} = 29189 \text{ VA}$$

Verificação

nova tensão na Cabine

$$\dot{V}_c' = \dot{V}_m' + \bar{Z}_L \cdot \dot{I}'$$

com $\begin{cases} \dot{V}_m' = 116,394 \angle 0 \text{ V} \quad \text{(inalterada)} \\ \bar{Z}_L = (0,1 + j0,05)\,\Omega \\ \dot{I}' = 77,781 \angle 0 - (\arccos 0,9) \\ \quad = 77,781 \angle -25,84^\circ \text{ A} \end{cases}$

$$\therefore \boxed{\dot{V}_c' = 125,090 \angle 0,05^\circ \text{ V}}$$

novas potências na Cabine

$$P_c' = \sqrt{3}\, V_c' I' \cos \varphi_c'$$

$$= \sqrt{3} \times (\underbrace{\sqrt{3} \times 125,090}_{\text{LINHA}}) \times 77,781 \times \cos(0,05^\circ - (-25,84^\circ))$$

$$\boxed{P_c' = 26259 \text{ W}} \quad \underline{\text{OK}}$$

$$\boxed{Q_c' = \sqrt{3} \cdot V_c' \cdot I' \cdot \operatorname{sen} \varphi_c' = 12745 \text{ VAr}} \quad \underline{\text{OK}}$$