



SÈRIE 4

Exercici 1

Q1 a Q2 c Q3 d Q4 c Q5 b

Exercici 2

a)

$$A_3 = I_{R_5} + I_{R_6} = \frac{U_2}{R_5} + \frac{U_2}{R_6} = \frac{12}{10} + \frac{12}{20} = 1,8 \text{ A}$$

$$\begin{cases} U_1 = (R_1 + R_2) I_1 + R_3 (I_1 + I_2) \\ U_3 = R_3 (I_1 + I_2) + R_4 I_2 \end{cases} \rightarrow \begin{cases} U_1 = (R_1 + R_2 + R_3) I_1 + R_3 I_2 \\ U_3 = R_3 I_1 + (R_3 + R_4) I_2 \end{cases}$$

$$\begin{bmatrix} R_1 + R_2 + R_3 & R_3 \\ R_3 & R_3 + R_4 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} U_1 \\ U_3 \end{bmatrix}$$

$$\begin{bmatrix} 35 & 15 \\ 15 & 30 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 36 \end{bmatrix} \rightarrow \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} -0,218 \\ 1,309 \end{bmatrix} \text{ A}$$

$$A_1 = I_1 = -0,218 \text{ A} \quad A_2 = I_2 = 1,309 \text{ A}$$

b) $W_1 = U_2 (I_2 + I_{R_6}) = 12 \left(1,309 + \frac{12}{20} \right) = 22,91 \text{ W}$

c)

$$P_{U_1} = U_1 I_1 = 12 (-0,218) = -2,616 \text{ W}$$

$$P_{U_2} = U_2 I_3 = 12 (1,8) = 21,6 \text{ W}$$

$$P_{U_3} = U_3 I_2 = 36 (1,309) = 47,124 \text{ W}$$



Exercici 3

a)

$$W_1 = R_1 I_{R_1}^2 + R_2 I_{R_2}^2 = R_1 \left(\frac{U}{R_1} \right)^2 + R_2 I_{N2}^2 = \frac{U^2}{R_1} + R_2 I_{N2}^2$$

$$I_{N2}^2 = \frac{W_1 - \frac{U^2}{R_1}}{R_2} \rightarrow I_{N2} = \sqrt{\frac{889 - \frac{230^2}{100}}{15}} = 4,9 \text{ A}$$

$$S_{Ntr} = U_{N2} I_{N2} = 120 \cdot 4,9 = 588 \text{ VA}$$

b)

$$Q = Q_L - Q_C = X_L I_{N2}^2 - \frac{U^2}{X_C}$$

$$I_{N2} = \frac{U_{N2}}{\sqrt{R_2^2 + X_L^2}} \rightarrow R_2^2 + X_L^2 = \frac{U_{N2}^2}{I_{N2}^2} \rightarrow X_L = \sqrt{\frac{U_{N2}^2}{I_{N2}^2} - R_2^2}$$

$$X_L = \sqrt{\frac{120^2}{4,9^2} - 15^2} = 19,36 \, \Omega$$

$$Q = 19,36 \cdot 4,9^2 - \frac{230^2}{250} = 253,23 \text{ var}$$

c)

$$Z_{Eq} = \frac{U}{I_{inst}} = \frac{U}{\frac{S_{inst}}{U}} = \frac{U^2}{\sqrt{P^2 + Q^2}} = \frac{230^2}{\sqrt{889^2 + 253,23^2}} = 57,23 \, \Omega$$



Exercici 4

$$a) \Gamma_N = \frac{P_N}{\omega_N} = \frac{P_N}{n_N \frac{2\pi}{60}} = \frac{4000}{1200 \frac{2\pi}{60}} = 31,83 \text{ N m}$$

$$b) E_N = \frac{P_N}{I_N} = \frac{4000}{17,1} = 233,9 \text{ V} \rightarrow R_i = \frac{U_N - E_N}{I_N} = \frac{280 - 233,9}{17,1} = 2,7 \Omega$$

c) En el punt de funcionament:

$$E' = \frac{U_N}{2} - R_i \frac{I_N}{2} = \frac{280}{2} - 2,7 \frac{17,1}{2} = 116,92 \text{ V}$$

$$n' = \frac{E'}{E_N} n_N = \frac{116,92}{233,9} 1200 = 599,8 \text{ min}^{-1}$$

$$\eta (\%) = 100 \frac{P}{U I + \frac{U_{Exc}^2}{R_{Exc}}} = 100 \frac{\frac{\Gamma_N}{2} \omega'}{\frac{U_N}{2} \frac{I_N}{2} + \frac{U_{Exc}^2}{R_{Exc}}} = 100 \frac{\frac{31,83}{2} 599,8 \frac{2\pi}{60}}{\frac{280}{2} \frac{17,1}{2} + \frac{210^2}{62}} = 52,38 \%$$

d) En el punt de funcionament:

$$\eta (\%) = 100 \frac{P}{U I + \frac{U_{Exc}^2}{R_{Exc}}} = 100 \frac{\frac{\Gamma_N}{4} \omega}{U_N \frac{I_N}{2} + \frac{\left(\frac{U_{Exc}}{2}\right)^2}{R_{Exc}}} = 100 \frac{\frac{31,83}{4} 2636 \frac{2\pi}{60}}{280 \frac{17,1}{2} + \frac{\left(\frac{210}{2}\right)^2}{62}} = 85,41 \%$$

Exercici 5

$$a) R = \frac{U^2}{W_1} = \frac{400^2}{10000} = 16 \Omega$$

$$b) I_R = \frac{U}{R} = \frac{400}{16} = 25 \text{ A} \quad I_L = \frac{U}{X_L} = \frac{U}{\omega L} = \frac{400}{2\pi 50 \cdot 20 \cdot 10^{-3}} = \frac{400}{6,283} = 63,66 \text{ A}$$

$$I_C = \frac{U}{X_C} = \frac{U}{\frac{1}{\omega C}} = \frac{400}{\frac{1}{2\pi 50 \cdot 250 \cdot 10^{-6}}} = \frac{400}{12,73} = 31,42 \text{ A}$$

$$A_1 = \sqrt{3} \sqrt{I_R^2 + (I_L - I_C)^2} = \sqrt{3} \sqrt{25^2 + (63,66 - 31,42)^2} = 70,66 \text{ A}$$

$$c) S = \sqrt{3} U A_1 = \sqrt{3} \cdot 400 \cdot 70,66 = 48,95 \text{ kVA}$$

$$Q = \sqrt{S^2 - P^2} = \sqrt{S^2 - (3 W_1)^2} = \sqrt{48,95^2 - (3 \cdot 10)^2} = 38,68 \text{ kvar}$$

Alternativament,

$$Q = Q_L - Q_C = 3 X_L I_L^2 - 3 X_C I_C^2 = 3 \frac{U^2}{X_L} - 3 \frac{U^2}{X_C}$$

$$Q = 3 \cdot 6,283 \cdot 63,66^2 - 3 \cdot 12,73 \cdot 31,42^2 = 3 \frac{400^2}{6,283} - 3 \frac{400^2}{12,73} = 38,69 \text{ kvar}$$

$$d) Q_{Ca} = \frac{38,69 \text{ kvar}}{3} = 12,9 \text{ kvar} = \frac{U^2}{X_{Ca}} \rightarrow X_{Ca} = \frac{400^2}{12900} = 12,4 \Omega$$

$$X_{Ca} = \frac{1}{\omega C_a} \rightarrow C_a = \frac{1}{\omega X_{Ca}} = \frac{1}{2\pi 50 \cdot 12,4} = 256,7 \mu\text{F}$$



Exercici 6

a) $f = \frac{1}{T} = \frac{1}{5 \cdot 10^{-3}} = 100 \text{ Hz}$

b) El desfasament entre tensió i corrent és $0,6 \text{ div} \cdot 2 \frac{\text{ms}}{\text{div}} = 1,2 \text{ ms}$

$$\varphi = 1,2 \text{ ms} \frac{360^\circ}{5 \text{ div} \cdot 2 \frac{\text{ms}}{\text{div}}} = 43,2^\circ \quad \rightarrow \quad \cos \varphi = 0,729$$

c) El canal 2:

$$I_{\text{Real}} = \frac{I_{\text{Pic}}}{\sqrt{2}} (\text{Factor conversió sonda}) = \frac{3,5 \text{ div} \frac{1 \text{ V}}{1 \text{ div}}}{\sqrt{2}} \left(\frac{1 \text{ A}}{0,5 \text{ V}} \right) = 4,95 \text{ A}$$

$$P = R I_{\text{Real}}^2 = 50 \cdot 4,95^2 = 1225 \text{ W}$$