

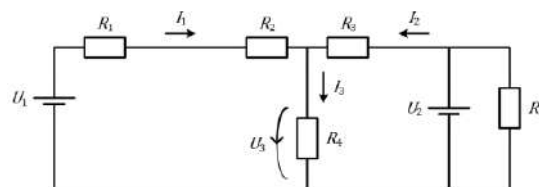


SÈRIE 1

Exercici 1

Q1: b - Q2:a - Q3:c - Q4:b - Q5:d

Exercici 2



a)

$$W = U_{R2} I_1 = R_2 I_1^2 \quad \rightarrow \quad I_1 = \sqrt{\frac{W}{R_2}} = \sqrt{\frac{0,2}{5}} = 0,2 \text{ A}$$

$$P_{U1} = U_1 I_1 = 12 \cdot 0,2 = 2,4 \text{ W}$$

b)

$$U_3 = U_1 - (R_1 + R_2) I_1 = 12 - (5 + 5) 0,2 = 10 \text{ V}$$

$$I_3 = \frac{U_3}{R_4} = \frac{10}{10} = 1 \text{ A}$$

$$I_1 + I_2 = I_3 \quad \rightarrow \quad I_2 = I_3 - I_1 = 1 - 0,2 = 0,8 \text{ A}$$

$$U_2 = U_3 + R_3 I_2 = 10 + 10 \cdot 0,8 = 18 \text{ V}$$

c)

$$P_{U2} = U_2 I_{U2} = U_2 (I_2 + I_{R5}) = U_2 \left(I_2 + \frac{U_2}{R_5} \right) = 18 \left(0,8 + \frac{18}{15} \right) = 36 \text{ W}$$

d)

Si $W = 0 \text{ W}$, llavors $I_1 = 0 \text{ A}$ i, per tant, $U_3 = U_1 = 12 \text{ V}$

$$U_3 = 12 \text{ V} = R_4 I_3 \quad \rightarrow \quad I_3 = \frac{U_3}{R_4} = \frac{12}{10} = 1,2 \text{ A}$$

$$U_2 = (R_3 + R_4) I_3 = (10 + 10) 1,2 = 24 \text{ V}$$



Exercici 3

a)

$$r_t = \frac{U_{1N}}{U_{2N}} = \frac{100}{50} = 2$$
$$V_2 = \frac{V_1}{r_t} = \frac{84}{2} = 42 \text{ V}$$

b)

$$A_2 = \frac{V_2}{R_3} = \frac{42}{5} = 8,4 \text{ A}$$

c)

$$I_{R1} = I_{R2} + I_{\text{Primari TR}} = \frac{V_1}{R_2} + \frac{A_2}{r_t} = \frac{84}{75} + \frac{8,4}{2} = 5,32 \text{ A}$$

$$U = R_1 I_{R1} + V_1 = 25 \cdot 5,32 + 84 = 217 \text{ V}$$

d)

$$Q = \frac{U^2}{X_L} = \frac{U^2}{2 \pi f L} = \frac{217^2}{2 \pi \cdot 50 \cdot 0,15} = 999,26 \text{ var}$$

e)

$$W = R_1 I_{R1}^2 + \frac{V_1^2}{R_2} + R_3 A_2^2 = 25 \cdot 5,32^2 + \frac{84^2}{75} + 5 \cdot 8,4^2 = 1154,44 \text{ W}$$



Exercici 4

a)

$$\eta_N(\%) = 100 \frac{P_N}{U_N I_N} \rightarrow P_N = \frac{U_N I_N \eta_N(\%)}{100} = \frac{300 \cdot 16 \cdot 83,34}{100} = 4 \text{ kW}$$

$$\Gamma_N = \frac{P_N}{\omega_N} = \frac{4000}{1250 \frac{2\pi}{60}} = 30,56 \text{ N m}$$

$$P_N = E_N I_N \rightarrow E_N = \frac{P_N}{I_N} = \frac{4000}{16} = 250 \text{ V}$$

$$U_N = R_i I_N + E_N \rightarrow R_i = \frac{U_N - E_N}{I_N} = \frac{300 - 250}{16} = 3,125 \Omega$$

c)

$$U = R_i I + E$$

$$E = U - R_i I = 0,8 U_N - R_i 0,5 I_N = 0,8 \cdot 300 - 3,125 \cdot 0,5 \cdot 16 = 215 \text{ V}$$

$$n = \frac{E}{E_N} n_N = \frac{215}{250} 1250 = 1075 \text{ min}^{-1}$$

d)

$$\eta(\%) = 100 \frac{\Gamma \omega}{U I} = 100 \frac{0,5 \Gamma_N \omega}{0,8 U_N 0,5 I_N} = 100 \frac{0,5 \cdot 30,56 \cdot 1075 \frac{2\pi}{60}}{0,8 \cdot 300 \cdot 0,5 \cdot 16} = 89,59 \%$$



Exercici 5

a)

$$A_1 = \frac{U}{Z} = \frac{U}{|Z|} = \frac{U}{\sqrt{R^2 + X^2}} = \frac{400}{\sqrt{84^2 + 27^2}} = 4,5335 \text{ A}$$

b)

$$A_2 = \sqrt{3} A_1 = \sqrt{3} \cdot 4,5335 = 7,8523 \text{ A}$$

c)

$$W_1 = R A_1^2 = 84 \cdot 4,5335^2 = 1726,4 \text{ W}$$

d)

$$Q = 3 X A_1^2 = 3 \cdot 27 \cdot 4,5335^2 = 1664,8 \text{ var}$$

Alternativament,

$$\varphi = \tan^{-1}\left(\frac{X}{R}\right) = \tan^{-1}\left(\frac{27}{84}\right) = 17,819^\circ$$

$$Q = \sqrt{3} U A_2 \sin \varphi = \sqrt{3} \cdot 400 \cdot 7,8523 \cdot \sin(17,819^\circ) = 1,665 \text{ kvar}$$

Alternativament, en cas que se sàpiga operar amb números complexos,

$$\underline{S} = P + j Q = 3 \frac{U^2}{Z^*} = 3 \frac{400^2}{84 - j 27} = \underbrace{5,179}_{5,179 \text{ kW}} + j \underbrace{1,665}_{1,665 \text{ kvar}} \text{ kVA}$$



Exercici 6

a)

$$f = \frac{1}{T} = \frac{1}{5 \cdot 5 \cdot 10^{-3}} = 40 \text{ Hz}$$

b)

El canal 1 (U):

$$U_{\text{Real}} = \frac{U_{\text{Pic}}}{\sqrt{2}} (\text{Factor conversió sonda}) = \frac{3 \text{ div} \frac{10 \text{ V}}{1 \text{ div}}}{\sqrt{2}} \left(\frac{10 \text{ V}}{1 \text{ V}} \right) = 212,13 \text{ V}$$

c)

El canal 2 (I):

$$I_{\text{Real}} = \frac{I_{\text{Pic}}}{\sqrt{2}} (\text{Factor conversió sonda}) = \frac{4 \text{ div} \frac{2 \text{ V}}{1 \text{ div}}}{\sqrt{2}} \left(\frac{1 \text{ A}}{0,5 \text{ V}} \right) = 11,31 \text{ A}$$

d)

El desfasament entre corrent i tensió és $0,6 \text{ div} \cdot 5 \frac{\text{ms}}{\text{div}} = 3 \text{ ms}$. El factor de potència serà capacitiu ja que el corrent s'avança a la tensió.

$$\varphi = 3 \text{ ms} \frac{360^\circ}{5 \text{ div} \cdot 5 \frac{\text{ms}}{\text{div}}} = 43,2^\circ \quad \rightarrow \quad \cos \varphi = 0,729 \text{ (c)}$$

e)

$$Z = \frac{U_{\text{Real}}}{I_{\text{Real}}} = \frac{212,13}{11,31} = 18,76 \Omega$$

$$R = Z \cos \varphi = 18,76 \cdot 0,729 = 13,68 \Omega$$

La reactància (capacitiva) val:

$$X_c = Z \sin \varphi = 18,76 \sin(43,2^\circ) = 12,84 \Omega$$

Tot i que no es demana a l'exercici, podem escriure el valor de \underline{Z} :

$$\underline{Z} = R - j X_c = 13,68 - j 12,84 \Omega$$