



Sèrie 3

Exercici 1

Q1 b

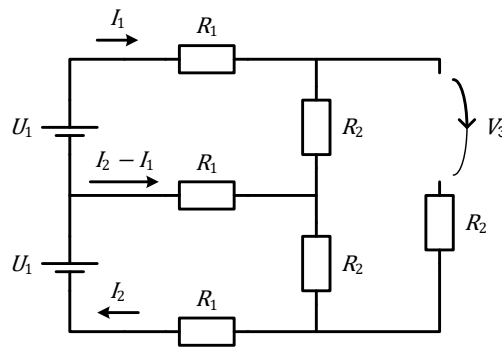
Q2 a

Q3 a

Q4 b

Q5 d

Exercici 2



a)

$$\begin{cases} U_1 = R_1 I_1 + R_2 I_1 - R_1 (I_2 - I_1) \\ U_1 = R_1 (I_2 - I_1) + R_2 I_2 + R_1 I_2 \end{cases} \rightarrow \begin{cases} U_1 = (2 R_1 + R_2) I_1 - R_1 I_2 \\ U_1 = -R_1 I_1 + (2 R_1 + R_2) I_2 \end{cases}$$

$$\begin{bmatrix} (2 R_1 + R_2) & -R_1 \\ -R_1 & (2 R_1 + R_2) \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} U_1 \\ U_1 \end{bmatrix} \rightarrow \begin{bmatrix} 9 & -2 \\ -2 & 9 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 12 \end{bmatrix}$$

$$\begin{cases} A_1 = I_1 = 1,714 \text{ A} \\ A_2 = I_2 = 1,714 \text{ A} \end{cases}$$

Alternativament, per simetria es pot veure que $A_1 = A_2$ i, per tant, no circula corrent per la R_1 , que està en la posició central. Llavors:

$$I_1 = I_2 = \frac{U_1 + U_2}{2 R_1 + 2 R_2} = \frac{12 + 12}{2 \cdot 2 + 2 \cdot 5} = 1,714 \text{ A}$$



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b)

$$V_3 = R_2 I_1 + R_2 I_2 = 2 R_2 I_1 = 2 \cdot 5 \cdot 1,714 = 17,14 \text{ V}$$

c)

$$P_{U_1 U_2} = 2 U_1 I_1 = 2 \cdot 12 \cdot 1,714 = 41,136 \text{ W}$$

d)

$$P_{R_1} = 2 R_1 I_1^2 = 2 \cdot 2 \cdot 1,714^2 = 11,751 \text{ W}$$

Exercici 3

a)

$$W_3 = \frac{P}{3} = \frac{12}{3} = 4 \text{ kW}$$

b)

$$X_C = \frac{1}{\omega C} = \frac{1}{2 \pi f C} = \frac{1}{2 \pi 50 \cdot 25 \cdot 10^{-6}} = 127,32 \Omega$$
$$Q = 3 \frac{U^2}{X_C} = 3 \frac{400^2}{127,32} = 3,77 \text{ kvar}$$

c)

$$S = \sqrt{P^2 + Q^2} = \sqrt{12^2 + 3,77^2} = 12,578 \text{ kVA}$$
$$S = \sqrt{3} U A_1 \rightarrow A_1 = \frac{S}{\sqrt{3} U} = \frac{12578}{\sqrt{3} \cdot 400} = 18,15 \text{ A}$$

d)

$$W_3 = R A_1^2 \rightarrow R = \frac{W_3}{A_1^2} = \frac{4000}{18,15^2} = 12,14 \Omega$$



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e)

$$A_1 = \frac{U}{Z} = \frac{U}{\sqrt{R^2 + X_L^2}} \rightarrow Z = \frac{U}{A_1} = \frac{400}{18,15} = 12,72 \Omega$$

$$Z^2 = R^2 + X_L^2 \rightarrow X_L = \sqrt{Z^2 - R^2} = \sqrt{12,72^2 - 12,14^2} = 3,8 \Omega$$

$$L = \frac{X_L}{\omega} = \frac{X_L}{2 \pi f} = \frac{3,8}{2 \pi 50} = 12,1 \text{ mH}$$

Alternativament:

$$Q_a = \frac{Q}{3} = \frac{3770}{3} = 1257 \text{ kvar}$$

$$X_L = \frac{Q_a}{A_1^2} = \frac{1257}{18,15^2} = 3,81 \Omega$$

$$L = \frac{X_L}{\omega} = \frac{X_L}{2 \pi f} = \frac{3,81}{2 \pi 50} = 12,1 \text{ mH}$$

Exercici 4

a)

$$f = \frac{1}{T} = \frac{1}{6 \text{ div} \cdot 2 \frac{\text{ms}}{\text{div}} \frac{1 \text{ s}}{1000 \text{ ms}}} = 83,33 \text{ Hz}$$

b)

$$U_{R2} = \frac{U_{\text{pic } R2}}{\sqrt{2}} = \frac{4 \text{ div} \frac{5 \text{ V}}{\text{div}}}{\sqrt{2}} = 14,14 \text{ V}$$

$$I = \frac{U_{R2}}{R_2} = \frac{14,14}{10} = 1,414 \text{ A}$$

$$U = U_{R1} + U_{R2} = R_1 I + U_{R2} = 47 \cdot 1,414 + 14,14 = 80,6 \text{ V}$$

c)

$$P = U I = 80,6 \cdot 1,414 = 113,97 \text{ W}$$



Exercici 5

a)

$$\Gamma_N = \frac{P_N}{\omega_N} = \frac{75000}{1480 \frac{2\pi}{60}} = 483,9 \text{ N m}$$

b)

$$\eta_N(\%) = 100 \frac{P_N}{\sqrt{3} U I \cos \varphi_N} = 100 \frac{75000}{\sqrt{3} \cdot 400 \cdot 135 \cdot 0,85} = 94,34 \%$$

Alternativament:

$$\eta_N(\%) = 100 \frac{P_N}{\sqrt{3} U I \cos \varphi_N} = 100 \frac{75000}{\sqrt{3} \cdot 230 \cdot 234 \cdot 0,85} = 94,65 \%$$

c)

$$Q_N = \sqrt{3} U I \sin \varphi_N = \sqrt{3} \cdot 400 \cdot 135 \sqrt{1 - 0,85^2} = 49,27 \text{ kvar}$$

Alternativament:

$$Q_N = \sqrt{3} U I \sin \varphi_N = \sqrt{3} \cdot 230 \cdot 234 \sqrt{1 - 0,85^2} = 49,11 \text{ kvar}$$

d)

Com que $n_N = 1480 \text{ min}^{-1}$ i $f = 50 \text{ Hz}$, llavors $p = 2$

e)

$$\Gamma_0 = \Gamma_{\text{màx.}} \frac{3}{6} = 1500 \frac{3}{6} = 750 \text{ N m}$$



Exercici 6

a)

$$A_1 = \frac{U}{R} = \frac{100}{10} = 10 \text{ A}$$

b)

$$X_L = \omega L = 2 \pi f L = 2 \pi 50 \cdot 25 \cdot 10^{-3} = 7,854 \Omega$$

$$A_2 = \frac{U}{X_L} = \frac{100}{7,854} = 12,732 \text{ A}$$

c)

$$X_C = \frac{1}{\omega C} = \frac{1}{2 \pi f C} = \frac{1}{2 \pi 50 \cdot 47 \cdot 10^{-6}} = 67,726 \Omega$$

$$A_3 = \frac{U}{X_C} = \frac{100}{67,726} = 1,477 \text{ A}$$

d)

$$A_4 = \sqrt{A_1^2 + (A_2 - A_3)^2} = \sqrt{10^2 + (12,732 - 1,477)^2} = 15,06 \text{ A}$$

e)

$$W = 0 \text{ W}$$

f)

Això es dona quan L i C estan en ressonància, i per tant:

$$f = \frac{1}{2 \pi \sqrt{LC}} = \frac{1}{2 \pi \sqrt{25 \cdot 10^{-3} \cdot 47 \cdot 10^{-6}}} = 146,83 \text{ Hz}$$