

SÈRIE 1**Primera part****Exercici 1**

Q1 c Q2 a Q3 c Q4 b Q5 c

Exercici 2

$$a) A_1 = \frac{V_{an}}{\sqrt{R_1^2 + X_{C1}^2}} = \frac{\frac{400}{\sqrt{3}}}{\sqrt{25^2 + 25^2}} = 6,53 \text{ A}$$

$$b) A_2 = \frac{V_{an}}{\sqrt{R_2^2 + X_{L2}^2}} = \frac{\frac{400}{\sqrt{3}}}{\sqrt{35^2 + 15^2}} = 6,06 \text{ A}$$

$$c) V_1 = R_1 A_1 = 25 \cdot 6,53 = 163,3 \text{ V}$$

$$d) V_2 = X_{C1} A_1 = 25 \cdot 6,53 = 163,3 \text{ V}$$

$$e) V_3 = R_2 A_2 = 35 \cdot 6,06 = 212,1 \text{ V}$$

$$f) V_4 = X_{L2} A_2 = 15 \cdot 6,06 = 90,9 \text{ V}$$

Segona part**OPCIÓ A****Exercici 3**

$$a) \eta_N = \frac{P_N}{\sqrt{3} U_N I_N \cos \varphi_N} = \frac{100000}{\sqrt{3} \cdot 400 \cdot 196 \cdot 0,82} = 89,81 \%$$

Alternativament,

$$\eta_N = \frac{P_N}{\sqrt{3} U_N I_N \cos \varphi_N} = \frac{100000}{\sqrt{3} \cdot 230 \cdot 339 \cdot 0,82} = 90,3 \%$$

$$b) p = 1$$

$$c) \Gamma = \frac{P}{\omega} = \frac{100000}{2900 \frac{2\pi}{60}} = 329,3 \text{ N m}$$

$$d) U = 230 \text{ V}, I = 339 \text{ A}$$

Exercici 4

$$a) \begin{cases} U_1 = \left(R_1 + \frac{R_2 R_3}{R_2 + R_3} \right) I_1 + R_4 (I_1 + I_2) \\ U_2 = R_5 I_2 + R_4 (I_1 + I_2) \end{cases} \rightarrow \begin{cases} 48 = \left(2 + \frac{10 \cdot 15}{10 + 15} \right) I_1 + 10 (I_1 + I_2) \\ 12 = 3 I_2 + 10 (I_1 + I_2) \end{cases}$$

$$\begin{cases} 48 = 18 I_1 + 10 I_2 \\ 12 = 10 I_1 + 13 I_2 \end{cases} \rightarrow \begin{bmatrix} 18 & 10 \\ 10 & 13 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 48 \\ 12 \end{bmatrix} \rightarrow \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 3,761 \text{ A} \\ -1,97 \text{ A} \end{bmatrix}$$

b)

$$P_{U_1} = U_1 I_1 = 48 \cdot 3,761 = 180,53 \text{ W}$$

$$P_{U_2} = U_2 I_2 = 12 \cdot (-1,97) = -23,64 \text{ W}$$

c)

$$I_2 = 0 \text{ A} \rightarrow U_{R_4} = U_2 = 12 \text{ V}$$

$$U_{R_4} = \frac{R_4}{R_1 + \frac{R_2 R_3}{R_2 + R_3} + R_4} U_1 \rightarrow 12 = \frac{R_4}{2 + \frac{10 \cdot 15}{10 + 15} + R_4} 48$$

$$12 (8 + R_4) = 48 R_4 \rightarrow R_4 = \frac{12 \cdot 8}{48 - 12} = 2,67 \Omega$$

OPCIÓ B

Exercici 3

a) $X_L = \frac{V_1}{A_1} = \frac{15}{3} = 5 \Omega$

b) $X_C = \frac{V_2}{A_1} = \frac{90}{3} = 30 \Omega$

c) $W_1 = (R_1 + R_2) A_1^2 \quad \rightarrow \quad R_1 + R_2 = \frac{W_1}{A_1^2} = \frac{270}{3^2} = 30 \Omega$

d) $U = Z I = I \sqrt{(R_1 + R_2)^2 + (X_L - X_C)^2} = 3 \sqrt{30^2 + (5 - 30)^2} = 117,15 \text{ V}$

e) En ressonància, $X_L = X_C$ i, per tant,

$$U = 117,15 \text{ V} = Z I = I \sqrt{(R_1 + R_2)^2 + (X_L - X_C)^2} = I \sqrt{30^2 + 0^2}$$

$$I = \frac{117,15}{30} = 3,905 \text{ A}$$

$$W_1 = (R_1 + R_2) A_1^2 = 30 \cdot 3,905^2 = 457,47 \text{ W}$$

Alternativament,

$$W_1 = \frac{U^2}{R_1 + R_2} = \frac{117,15^2}{30} = 457,47 \text{ W}$$

Exercici 4

a)

$$I = \frac{P}{U} = \frac{2500}{230} = 10,87 \text{ A}$$

$$\Delta U_{\text{màx}} = 0,05 \cdot 230 = 11,5 \text{ V}$$

$$2 R_{\text{màx}} = \frac{\Delta U_{\text{màx}}}{I} \rightarrow R_{\text{màx}} = \frac{\Delta U_{\text{màx}}}{2 I} = \frac{11,5}{2 \cdot 10,87} = 0,529 \Omega$$

$$R_{\text{màx}} = \rho \frac{L}{S_{\text{mín}}} \rightarrow S_{\text{mín}} = \rho \frac{L}{R_{\text{màx}}} = 0,01786 \cdot 10^{-6} \frac{100}{0,529} = 3,376 \text{ mm}^2$$

Alternativament,

$$\Delta U_{\text{màx}} = 0,05 \cdot 230 = 11,5 \text{ V}$$

$$R_{\text{calefactor}} = \frac{U^2}{P} = \frac{230^2}{2500} = 21,16 \Omega$$

$$I = \frac{U - \Delta U_{\text{màx}}}{R_{\text{calefactor}}} = \frac{230 - 11,5}{21,16} = 10,33 \text{ A}$$

$$2 R_{\text{màx}} = \frac{\Delta U_{\text{màx}}}{I} \rightarrow R_{\text{màx}} = \frac{\Delta U_{\text{màx}}}{2 I} = \frac{11,5}{2 \cdot 10,33} = 0,557 \Omega$$

$$R_{\text{màx}} = \rho \frac{L}{S_{\text{mín}}} \rightarrow S_{\text{mín}} = \rho \frac{L}{R_{\text{màx}}} = 0,01786 \cdot 10^{-6} \frac{100}{0,557} = 3,21 \text{ mm}^2$$

b)

La secció escollida és 4 mm^2

c)

$$R_{\text{calefactor}} = \frac{U^2}{P} = \frac{230^2}{2500} = 21,16 \Omega$$

$$R_{\text{conductor}} = \rho \frac{L}{S} = 0,01786 \cdot 10^{-6} \frac{100}{4 \cdot 10^{-6}} = 0,4465 \Omega$$

$$I = \frac{U}{R_{\text{calefactor}} + 2 R_{\text{conductor}}} = \frac{230}{21,16 + 2 \cdot 0,4465} = 10,43 \text{ A}$$

$$U_{\text{calefactor}} = U - 2 R_{\text{conductor}} I = 230 - 2 \cdot 0,4465 \cdot 10,43 = 220,7 \text{ V}$$

d)

$$\eta(\%) = 100 \frac{P_{\text{consumida calefactor}}}{P_{\text{inici línia}}}$$

$$\eta(\%) = 100 \frac{U_{\text{calefactor}} I}{U I} = 100 \frac{220,7 \cdot 10,43}{230 \cdot 10,43} = 95,96 \%$$

SÈRIE 5**Primera part****Exercici 1**

Q1 a Q2 c Q3 b Q4 b Q5 c

Exercici 2

$$a) \begin{cases} R_1 I_1 + \frac{R_3 R_4}{R_3 + R_4} (I_1 + I_2) = U_1 \\ R_2 I_2 + \frac{R_3 R_4}{R_3 + R_4} (I_1 + I_2) = U_2 \end{cases} \rightarrow \begin{cases} 5 I_1 + \frac{12 \cdot 12}{12 + 12} (I_1 + I_2) = 48 \\ 5 I_2 + \frac{12 \cdot 12}{12 + 12} (I_1 + I_2) = 36 \end{cases}$$

$$\begin{cases} 5 I_1 + 6 (I_1 + I_2) = 48 \\ 5 I_2 + 6 (I_1 + I_2) = 36 \end{cases} \rightarrow \begin{cases} 11 I_1 + 6 I_2 = 48 \\ 6 I_1 + 11 I_2 = 36 \end{cases} \rightarrow \begin{bmatrix} 11 & 6 \\ 6 & 11 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 48 \\ 36 \end{bmatrix}$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 3,67 \\ 1,27 \end{bmatrix} \text{ A}$$

$$b) P_{U_1} = U_1 I_1 = 48 \cdot 3,67 = 176,2 \text{ W}$$

$$P_{U_2} = U_2 I_2 = 36 \cdot 1,27 = 45,72 \text{ W}$$

$$c) P_{R_3} = R_3 \left(\frac{I_1 + I_2}{2} \right)^2 = 12 \left(\frac{3,67 + 1,27}{2} \right)^2 = 73,21 \text{ W}$$

OPCIÓ A**Exercici 3**

$$a) A_1 = \frac{\frac{U}{\sqrt{3}}}{\sqrt{R^2 + X_L^2}} = \frac{\frac{400}{\sqrt{3}}}{\sqrt{75^2 + 25^2}} = 2,92 \text{ A}$$

$$b) A_2 = 0 \text{ A}$$

$$c) V_1 = R A_1 = 75 \cdot 2,92 = 219 \text{ V}$$

$$d) V_2 = X_L A_1 = 25 \cdot 2,92 = 73 \text{ V}$$

$$e) P = 3 R A_1^2 = 3 \cdot 75 \cdot 2,92^2 = 1918,4 \text{ W}$$

$$Q = 3 X_L A_1^2 = 3 \cdot 25 \cdot 2,92^2 = 639,5 \text{ var}$$

Exercici 4

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

b) Quan condueix D_1 :

$$I_{R_1} = I_{R_3} = \frac{2 \text{ div} \cdot 5 \frac{\text{V}}{\text{div}}}{R_3} = \frac{10}{25} = 0,4 \text{ A}$$

$$I_{R_1} = \frac{U_{G_1 \text{ Max}}}{R_1 + R_3} \rightarrow R_1 = \frac{U_{G_1 \text{ Max}}}{I_{R_1}} - R_3 = \frac{48}{0,4} - 25 = 95 \Omega$$

c) Quan condueix D_2 :

$$I_{R_2} = I_{R_3} = \frac{3 \text{ div} \cdot 5 \frac{\text{V}}{\text{div}}}{R_3} = \frac{15}{25} = 0,6 \text{ A}$$

$$I_{R_2} = \frac{U_{G_1 \text{ Max}}}{R_2 + R_3} \rightarrow R_2 = \frac{U_{G_1 \text{ Max}}}{I_{R_2}} - R_3 = \frac{48}{0,6} - 25 = 55 \Omega$$

OPCIÓ B**Exercici 3**

$$a) P = \sqrt{3} U_N I_N \cos \varphi_N = \sqrt{3} \cdot 690 \cdot 48 \cdot 0,84 = 48,19 \text{ kW}$$

$$Q = \sqrt{3} U_N I_N \sin \varphi_N = \sqrt{3} \cdot 690 \cdot 48 \cdot \sqrt{1 - 0,84^2} = 31,13 \text{ kvar}$$

Alternativament,

$$P = \sqrt{3} U_N I_N \cos \varphi_N = \sqrt{3} \cdot 400 \cdot 83 \cdot 0,84 = 48,3 \text{ kW}$$

$$Q = \sqrt{3} U_N I_N \sin \varphi_N = \sqrt{3} \cdot 400 \cdot 83 \cdot \sqrt{1 - 0,84^2} = 31,2 \text{ kvar}$$

$$b) \Gamma = \frac{P_N}{\omega_N} = \frac{45000}{989 \frac{2\pi}{60}} = 434,5 \text{ N m}$$

$$c) \eta(\%) = 100 \frac{P_N}{P} = 100 \frac{45000}{48190} = 93,38 \%$$

$$\text{Alternativament, } \eta(\%) = 100 \frac{P_N}{P} = 100 \frac{45000}{48300} = 93,17 \%$$

$$d) p = 3$$

$$e) s = \frac{n_s - n_N}{n_s} = \frac{1000 - 989}{1000} = 0,011$$

Exercici 4

$$a) W = R_2 I_2^2 \rightarrow I_2 = \sqrt{\frac{W}{R_2}} = \sqrt{\frac{200}{5}} = 6,32 \text{ A}$$

$$U_{R_2} = R_2 I_2 = 5 \cdot 6,32 = 31,6 \text{ V}$$

$$I_C = \frac{U_{R_2}}{X_C} = \frac{31,6}{20} = 1,58 \text{ A}$$

$$b) A_1 = \sqrt{I_C^2 + I_2^2} = \sqrt{1,58^2 + 6,32^2} = 6,51 \text{ A}$$

$$c) P = R_1 A_1^2 + W = 10 \cdot 6,51^2 + 200 = 623,8 \text{ W}$$