



## SÈRIE 1

### Primera part

#### Exercici 1

Q1 a      Q2 c      Q3 a      Q4 b      Q5 b

#### Exercici 2

$$a) A_1 = \frac{V_{an}}{R} = \frac{U}{R} = \frac{400}{100} = 2,31 \text{ A}$$

b)

$$A_2 = \frac{V_{bn}}{X_L} = \frac{400}{50} = 4,62 \text{ A}$$

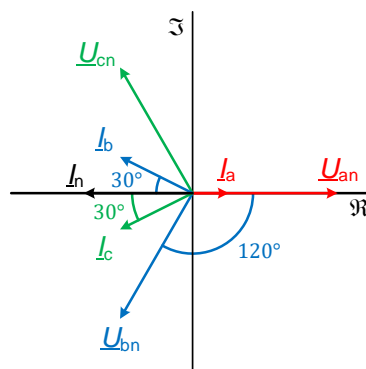
$$A_3 = \frac{V_{cn}}{X_C} = \frac{400}{50} = 4,62 \text{ A}$$

c)

$$P = R A_1^2 = 100 \cdot 2,31^2 = 533,6 \text{ W}$$

$$Q = X_L A_2^2 - X_C A_3^2 = 50 \cdot 4,62^2 - 50 \cdot 4,62^2 = 0 \text{ var}$$

d)



$$A_4 = I_n = \left| I_a - I_b \cos 30^\circ - I_c \cos 30^\circ \right| = \left| 2,31 - 4,62 \frac{\sqrt{3}}{2} - 4,62 \frac{\sqrt{3}}{2} \right| = 5,69 \text{ A}$$



## Segona part

### OPCIÓ A

#### Exercici 3

$$a) \eta_N = \frac{P_N}{\sqrt{3} U_N I_N \cos \varphi_N} = \frac{7500}{\sqrt{3} \cdot 208 \cdot 28 \cdot 0,86} = 86,45 \%$$

Alternativament,

$$\eta_N = \frac{P_N}{\sqrt{3} U_N I_N \cos \varphi_N} = \frac{7500}{\sqrt{3} \cdot 120 \cdot 48,5 \cdot 0,86} = 86,51 \%$$

$$b) \frac{60f}{n_N} = \frac{60 \cdot 400}{5850} = 4,1 \rightarrow p = 4$$

$$c) \Gamma = \frac{P}{\omega} = \frac{7500}{5850 \frac{2\pi}{60}} = 12,24 \text{ N m}$$

$$d) s = \frac{n_s - n_m}{n_s} = \frac{\frac{60f}{p} - n_m}{\frac{60f}{p}} = \frac{\frac{60 \cdot 400}{4} - 5850}{\frac{60 \cdot 400}{4}} = 0,025$$

$$e) Q = \sqrt{3} \cdot 208 \cdot 28 \cdot \sqrt{1 - 0,86^2} = 5147,6 \text{ var}$$

Alternativament,

$$Q = \sqrt{3} \cdot 120 \cdot 48,5 \cdot \sqrt{1 - 0,86^2} = 5144 \text{ var}$$

#### Exercici 4

$$a) \begin{cases} U_1 = (R_1 + R_3) I_1 + R_4 (I_1 + I_2) \\ U_2 = R_2 I_2 + R_4 (I_1 + I_2) \end{cases} \rightarrow \begin{cases} 48 = (6 + 6) I_1 + 15 (I_1 + I_2) \\ 12 = 6 I_2 + 15 (I_1 + I_2) \end{cases}$$

$$\begin{cases} 48 = 27 I_1 + 15 I_2 \\ 12 = 15 I_1 + 21 I_2 \end{cases} \rightarrow \begin{bmatrix} 27 & 15 \\ 15 & 21 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 48 \\ 12 \end{bmatrix} \rightarrow \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 2,42 \text{ A} \\ -1,16 \text{ A} \end{bmatrix}$$

b)

$$P_{R_1} = P_{R_3} = R_1 I_1^2 = R_3 I_1^2 = 6 \cdot 2,42^2 = 35,14 \text{ W}$$

$$P_{R_2} = R_2 I_2^2 = 6 \cdot (-1,16)^2 = 8,07 \text{ W}$$

$$P_{R_4} = R_4 (I_1 + I_2)^2 = 15 \cdot (2,42 - 1,16)^2 = 23,81 \text{ W}$$

$$P_{R_{1a4}} = P_{R_1} + P_{R_2} + P_{R_3} + P_{R_4} = 35,14 + 8,07 + 35,14 + 23,81 = 102,16 \text{ W}$$



c)

$$P_{U_2} = U_2 I_{U_2} = 12 \text{ W} \quad \rightarrow \quad I_{U_2} = \frac{P_{U_2}}{U_2} = \frac{12}{12} = 1 \text{ A}$$

$$I_2 + I_{U_2} + I_{R_5} = 0 \quad \rightarrow \quad I_{R_5} = -I_2 - I_{U_2} = 1,16 - 1 = 0,16 \text{ A}$$

$$R_5 = \frac{U_2}{I_{R_5}} = \frac{12}{0,16} = 75 \Omega$$

d)

$$P_{U_1} = U_1 I_1 = 48 \cdot 2,42 = 116,16 \text{ W}$$

Alternativament,

$$P_{U_1} = P_{R_{1a4}} + P_{R_5} + P_{U_2} = P_{R_{1a4}} + U_2 I_{R_5} + P_{U_2}$$

$$P_{U_1} = 102,16 + 12 \cdot 0,16 + 12 = 116,08 \text{ W}$$

Alternativament,

$$P_{U_1} = P_{R_{1a4}} - U_2 I_2$$

$$P_{U_1} = 102,16 - 12 \cdot (-1,16) = 116,08 \text{ W}$$



OPCIÓ B

Exercici 3

$$a) W_2 = W_1 - P_{R_1} = W_1 - R_1 A_1^2 = 860 - 50 \cdot 3,7^2 = 175,5 \text{ W}$$

$$b) W_2 = R_2 I_C^2 \rightarrow I_C^2 = \frac{W_2}{R_2} \quad I_C = \frac{V_1}{\sqrt{R_2^2 + X_C^2}} \rightarrow I_C^2 = \frac{V_1^2}{R_2^2 + X_C^2}$$

$$\frac{W_2}{R_2} = \frac{V_1^2}{R_2^2 + X_C^2} \rightarrow R_2^2 + X_C^2 = \frac{V_1^2}{W_2} R_2 \rightarrow R_2^2 - \frac{V_1^2}{W_2} R_2 + X_C^2 = 0$$

$$R_2^2 - \frac{73,4^2}{175,5} R_2 + \left( \frac{1}{2 \pi \cdot 50 \cdot 320 \cdot 10^{-6}} \right)^2 = 0 \rightarrow R_2^2 - 30,7 R_2 + 98,95 = 0$$

$$R_2 = \frac{30,7 \pm \sqrt{30,7^2 - 4 \cdot 98,95}}{2} = \begin{cases} 27,04 \Omega & \text{solució buscada} \\ 3,66 \Omega < 15 \Omega, & \text{per tant, descartada} \end{cases}$$

$$c) Q = Q_L - Q_C = \frac{V_1^2}{X_L} - X_C I_C^2 \rightarrow Q + X_C I_C^2 = \frac{V_1^2}{X_L} \rightarrow X_L = \frac{V_1^2}{Q + X_C I_C^2}$$

$$X_L = \frac{V_1^2}{Q + X_C I_C^2} = \frac{73,4^2}{195 + \frac{1}{2 \pi \cdot 50 \cdot 320 \cdot 10^{-6}} \cdot \frac{175,5}{27,04}} = 20,76 \Omega \rightarrow L = \frac{X_L}{\omega} = \frac{20,76}{2 \pi \cdot 50} = 66,08 \text{ mH}$$

Exercici 4

a)

$$R_{\text{estufa}} = \frac{U^2}{P} = \frac{230^2}{1500} = 35,27 \Omega$$

$$R_{\text{Línia}} = \rho \frac{l}{S} = 0,01786 \cdot 10^{-6} \frac{70}{2,5 \cdot 10^{-6}} = 0,5 \Omega$$

$$I_{\text{estufa}} = \frac{U}{2 R_{\text{Línia}} + 2 R_{\text{Contacte Endoll}} + R_{\text{estufa}}} = \frac{230}{2 \cdot 0,5 + 2 \cdot 0,1 + 35,27} = 6,31 \text{ A}$$

$$P = R_{\text{estufa}} I_{\text{estufa}}^2 = 35,27 \cdot 6,31^2 = 1404 \text{ W}$$

b)

$$\Delta U_L(\%) = 100 \frac{U - U_{\text{Final Línia}}}{U} = 100 \frac{U - (U - 2 R_{\text{Línia}} I_{\text{estufa}})}{U} = 100 \frac{2 R_{\text{Línia}} I_{\text{estufa}}}{U}$$

$$\Delta U_L(\%) = 100 \frac{2 \cdot 0,5 \cdot 6,31}{230} = 2,74 \%$$



c)

$$\begin{aligned}\Delta U_E(\%) &= 100 \frac{U_{\text{Final Línia}} - U_{\text{després contactes}}}{U} = \\ &= 100 \frac{U_{\text{Final Línia}} - (U_{\text{Final Línia}} - 2 R_{\text{Contacte Endoll}} I_{\text{estufa}})}{U} = 100 \frac{2 R_{\text{Contacte Endoll}} I_{\text{estufa}}}{U} \\ \Delta U_E(\%) &= 100 \frac{2 \cdot 0,1 \cdot 6,31}{230} = 0,55 \%\end{aligned}$$

d)

$$\begin{aligned}\eta_L(\%) &= 100 \frac{P_{\text{Final Línia}}}{P_{\text{Inici Línia}}} = 100 \frac{U I_{\text{estufa}} - 2 R_{\text{Línia}} I_{\text{estufa}}^2}{P_{\text{Inici Línia}}} \\ \eta_L(\%) &= 100 \frac{230 \cdot 6,31 - 2 \cdot 0,5 \cdot 6,31^2}{230 \cdot 6,31} = 97,26 \%\end{aligned}$$

e)

$$\begin{aligned}\eta_E(\%) &= 100 \frac{P}{P_{\text{Final Línia}}} = 100 \frac{P}{U I_{\text{estufa}} - 2 R_{\text{Línia}} I_{\text{estufa}}^2} \\ \eta_E(\%) &= 100 \frac{1404}{230 \cdot 6,31 - 2 \cdot 0,5 \cdot 6,31^2} = 99,47 \%\end{aligned}$$