SÈRIE 1

Primera part

Exercici 1

Q1 d **Q2** d **Q3** b **Q4** c **Q5** b

Exercici 2

a) $V_1 = \frac{U}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 230{,}9\ \text{V}$

b) $A_1 = \frac{V_1}{R_1} = \frac{230{,}9}{20} = 11{,}55\ \text{A}$

c) $A_2 = \frac{V_1}{\sqrt{R_2^2 + X_{\text{L2}}^2}} = \frac{230{,}9}{\sqrt{10^2+10^2}} = 16{,}33\ \text{A}$

d) $V_2 = R_2\ A_2 = 10 \cdot 16{,}33 = 163{,}3\ \text{V}$

e) $V_2 = X_{\text{L2}}\ A_2 = 10 \cdot 16{,}33 = 163{,}3\ \text{V}$

Segona part

OPCIÓ A

Exercici 3

a) $p = 3$

b) $\Gamma = \frac{P}{\omega} = \frac{90000}{948\frac{2\pi}{60}} = 906{,}6\ \text{N m}$

c) $\eta_{\text{N}} = 0{,}9425 = \frac{P_{\text{N}}}{\sqrt{3}\ U_{\text{N}}\ I_{\text{N}} \cos\varphi_{\text{N}}} = \frac{90000}{\sqrt{3}\cdot 400 \cdot I_{\text{N}} \cdot 0{,}85} \rightarrow I_{\text{N}} = \frac{90000}{\sqrt{3}\cdot 400 \cdot 0{,}9425 \cdot 0{,}85} = 162{,}2\ \text{A}$

d) $P = \sqrt{3}\ U_{\text{N}}\ I_{\text{N}} \cos\varphi_{\text{N}} = \sqrt{3} \cdot 400 \cdot 162{,}2 \cdot 0{,}85 = 95{,}52\ \text{kW}$

$Q = \sqrt{3}\ U_{\text{N}}\ I_{\text{N}} \sin\varphi = \sqrt{3} \cdot 400 \cdot 162{,}2 \cdot \sqrt{1 - 0{,}85^2} = 59{,}2\ \text{kvar}$

$S = \sqrt{3}\ U_{\text{N}}\ I_{\text{N}} = \sqrt{3} \cdot 400 \cdot 162{,}2 = 112{,}38\ \text{kVA}$

Exercici 4

a) $R_{34} = \frac{R_3\,R_4}{R_3+R_4} = \frac{10\cdot 15}{10+15} = 6\ \Omega$

$U_1 = R_1\,I_1 + R_{34}\,(I_1 + I_2) = (R_1 + R_{34})\,I_1 + R_{34}\,I_2$

$I_1 = \frac{U_1 - R_{34}\,I_2}{R_1+R_{34}} = \frac{48-6\cdot 0{,}96}{10+6} = 2{,}64\ \text{A}$

b) $U_1 - R_1\,I_1 = U_2 - R_2\,I_2 \quad \rightarrow \quad R_2 = \frac{U_2 - U_1 + R_1\,I_1}{I_2} = \frac{36-48+10\cdot 2{,}64}{0{,}96} = 15\ \Omega$

c) $P_{\text{Total}} = R_1\,I_1^2 + R_2\,I_2^2 + R_{34}\,(I_1 + I_2)^2$

$P_{\text{Total}} = 10\cdot 2{,}64^2 + 15\cdot 0{,}96^2 + 6\cdot(2{,}64+0{,}96)^2 = 161{,}28\ \text{W}$

Alternativament,

$P_{\text{Total}} = U_1\,I_1 + U_2\,I_2 = 48\cdot 2{,}64 + 36\cdot 0{,}96 = 161{,}28\ \text{W}$

OPCIÓ B

Exercici 3

a) $W_1 = R\,A_1^2 = 500\ \text{W} = 10\,A_1^2 \quad \rightarrow \quad A_1 = \sqrt{\frac{500}{10}} = 7{,}071\ \text{A}$

b) $U = Z\,I = I\,\sqrt{R^2 + (X_\text{L} - X_\text{C})^2} = 7{,}071\,\sqrt{10^2 + (10-20)^2} = 100\ \text{V}$

c) $Q_{\text{Consumida}} = X\,I^2 = (X_\text{L} - X_\text{C})\,I^2 = (10-20)\,7{,}071^2 = -500\ \text{var}$

d) En resonància, $X_\text{L} = X_\text{C}$ i, per tant,

$W_1 = R\,A_1^2 = R\,\left(\frac{U}{Z}\right)^2 = \frac{U^2}{R} = \frac{100^2}{10} = 1000\ \text{W}$

e) $X_\text{C} = \frac{1}{\omega\,C} \quad \rightarrow \quad C = \frac{1}{2\,\pi\,f\,X_\text{C}} = \frac{1}{2\,\pi\,50\cdot 20} = 159{,}15\ \mu\text{F}$

$X_\text{L} = \omega\,L \quad \rightarrow \quad L = \frac{X_\text{L}}{2\,\pi\,f} = \frac{10}{2\,\pi\,50} = 31{,}83\ \text{mH}$

$f_\text{r} = \frac{1}{2\,\pi\,\sqrt{L\,C}} = \frac{1}{2\,\pi\,\sqrt{31{,}83\cdot 10^{-3}\cdot 151{,}15\cdot 10^{-6}}} = 70{,}71\ \text{Hz}$

Exercici 4

a)

$$R_{\text{cond.}} = 2\ \frac{\Omega}{\text{km}}\ 0{,}2\ \text{km} = 0{,}4\ \Omega$$

$$L_{\text{cond.}} = 5\ \frac{\text{mH}}{\text{km}}\ 0{,}2\ \text{km} = 1\ \text{mH}$$

$$X_{\text{L cond.}} = \omega\ L = 2\ \pi\ f\ L_{\text{cond.}} = 2\ \pi\ 50 \cdot 1 \cdot 10^{-3} = 0{,}314\ \Omega$$

$$U_{\text{X}} = Z_{\text{Eq.}}\ I_{\text{N}} = \sqrt{(2\ R_{\text{cond.}} + R_{\text{M}})^2 + (2\ X_{\text{L cond.}} + X_{\text{M}})^2}\ \ I_{\text{N}}$$

$$U_{\text{X}} = \sqrt{(2 \cdot 0{,}4 + 44)^2 + (2 \cdot 0{,}314 + 13)^2} \cdot\ 5 = 234{,}1\ \text{V}$$

b)

$$\Delta U(\%) = \frac{U_{\text{X}} - U_{\text{N}}}{U_{\text{N}}}\ 100 = \frac{234{,}1 - 230}{230}\ 100 = 1{,}78\ \%$$

c)

$$\eta(\%) = 100\ \frac{P_{\text{Consumida Motor}}}{P_{\text{Inici Linia}}} = 100\ \frac{P_{\text{Consumida Motor}}}{P_{\text{Consumida Motor}} + 2\ R\ I_{\text{N}}^2}$$

$$\eta(\%) = 100\ \frac{U_{\text{N}}\ I_{\text{N}}\ \cos\varphi_{\text{N}}}{U_{\text{N}}\ I_{\text{N}}\ \cos\varphi_{\text{N}} + 2\ R\ I_{\text{N}}^2} = 100\ \frac{230 \cdot 5 \cdot 0{,}96}{230 \cdot 5 \cdot 0{,}96 + 2 \cdot 0{,}4 \cdot 5^2} = 98{,}22\ \%$$

SÈRIE 5

Primera part

Exercici 1

Q1 a **Q2** b **Q3** c **Q4** c **Q5** b

Exercici 2

a) $V_1 = \left(\sqrt{R_1^2 + X_C^2} \right) A_1 = 1{,}75 \sqrt{25^2 + 100^2} = 180{,}4 \text{ V}$

b) $W = R_1 A_1^2 + R_2 A_2^2 = 25 \cdot 1{,}75^2 + R_2 A_2^2 = 76{,}56 + R_2 A_2^2 = 205 \text{ W}$

$$A_2 = \frac{V_1}{\sqrt{R_2^2 + X_L^2}} = \frac{180{,}4}{\sqrt{R_2^2 + 75^2}} \quad \rightarrow \quad A_2^2 = \frac{180{,}4^2}{R_2^2 + 75^2} \quad \rightarrow \quad 76{,}56 + R_2 \frac{180{,}4^2}{R_2^2 + 75^2} = 205$$

$$\frac{180{,}4^2 R_2}{R_2^2 + 75^2} = 128{,}44 \quad \rightarrow \quad 128{,}44 R_2^2 - 32544 R_2 + 722475 = 0$$

$$R_2 = \frac{32544 \pm \sqrt{(-32544)^2 - 4 \cdot 128{,}44 \cdot 722475}}{2 \cdot 128{,}44} = \begin{cases} 228{,}8 \ \Omega \text{ (No vàlida)} \\ 24{,}6 \ \Omega \text{ (Solució buscada)} \end{cases}$$

OPCIÓ A

Exercici 3

a) $W = R A_1^2 = 100 \cdot 1{,}5^2 = 225 \text{ W}$

b) $X_L = \omega L = 2 \pi f L = 2 \pi 50 \cdot 100 \cdot 10^{-3} = 31{,}42 \ \Omega$

$$U = Z A_1 = \left(\sqrt{R^2 + X_L^2} \right) A_1 = 1{,}5 \sqrt{100^2 + 31{,}42^2} = 157{,}2 \text{ V}$$

c) $W = 225 \text{ W}$

d) $U = 157{,}2 \text{ V}$

Exercici 4

b) $R_{\text{Conductor}} = \rho \frac{L}{S} = 0{,}01786 \cdot 10^{-6} \cdot \frac{27}{1{,}5 \cdot 10^{-6}} = 321{,}48\ \text{m}\Omega$

$$I = \frac{P}{U\ \cos\varphi} = \frac{5000}{230 \cdot 1} = 21{,}74\ \text{A}$$

$$cdt_{\text{Cable}}(\%) = 100\ \frac{U_{\text{Cable}}}{U} = 100\ \frac{2\ R_{\text{Conductor}}\ I}{U} = 100\ \frac{2 \cdot 0{,}32148 \cdot 21{,}74}{230} = 6{,}08\ \%$$

c) El cable d'1,5 mm^2 no és adient. Es prova, doncs, el conductor de 2,5 mm^2:

$$R_{\text{Conductor}} = \rho \frac{L}{S} = 0{,}01786 \cdot 10^{-6} \cdot \frac{27}{2{,}5 \cdot 10^{-6}} = 192{,}9\ \text{m}\Omega$$

$$cdt_{\text{Cable}}(\%) = 100\ \frac{U_{\text{Cable}}}{U} = 100\ \frac{2\ R_{\text{Conductor}}\ I}{U} = 100\ \frac{2 \cdot 0{,}1929 \cdot 21{,}74}{230} = 3{,}65\ \%$$

El cable de 2,5 mm^2 és correcte.

c) $I_{\text{CC}} = \frac{U}{2\ R_{\text{Conductor}}} = \frac{230}{2 \cdot 0{,}1929} = 596\ \text{A}$

OPCIÓ B

Exercici 3

a) $\eta(\%) = 100\ \frac{P}{U_{\text{N}}\ I_{\text{N}} + \frac{U_{\text{ExcN}}^2}{R_{\text{Exc}}}} = 100\ \frac{147000}{750 \cdot 216 + \frac{450^2}{52}} = 88{,}61\ \%$

b) $\Gamma = \frac{P}{\omega} = \frac{147000}{1161\frac{2\pi}{60}} = 1209\ \text{Nm}$

c) $E = \frac{P}{I} = \frac{147000}{216} = 680{,}56\ \text{V}$ $\qquad R_{\text{i}}\ I = U - E = 750 - 680{,}56 = 69{,}44\ \text{V}$

$E' = U' - R_{\text{i}}\ I = 600 - 69{,}44 = 530{,}56\ \text{V}$

$n' = n\frac{E'}{E} = 1161\frac{530{,}56}{680{,}56} = 905{,}1\ \text{min}^{-1}$

Exercici 4

a) $I_6 = 0 \quad \rightarrow \quad U_3 = U_2 + R_3\, I_3 = 5 + 5 \cdot 1 = 10\ \text{V}$

b) $I_2 = I_3 + I_6 = I_3 = 1\ \text{A} \qquad I_5 = I_4 + I_6 = I_4$

$R_2\, I_2 = R_4\, I_4 \quad \rightarrow \quad I_5 = I_4 = \dfrac{R_2\, I_2}{R_4} = \dfrac{5 \cdot 1}{10} = 0{,}5\ \text{A}$

$I_1 = I_2 + I_4 = 1 + 0{,}5 = 1{,}5\ \text{A}$

d) $R_1 = \dfrac{U_1 - U_2 - R_3\, I_3 - R_2\, I_2}{I_1} = \dfrac{24 - 5 - 5 \cdot 1 - 5 \cdot 1}{1{,}5} = 6\ \Omega$

e) $P_{\text{U1}} = U_1\, I_1 = 24 \cdot 1{,}5 = 36\ \text{W} \qquad P_{\text{U2}} = -U_2\, I_3 = -5 \cdot 1 = -5\ \text{W}$

$P_{\text{U3}} = -U_3\, I_5 = -10 \cdot 0{,}5 = -5\ \text{W}$