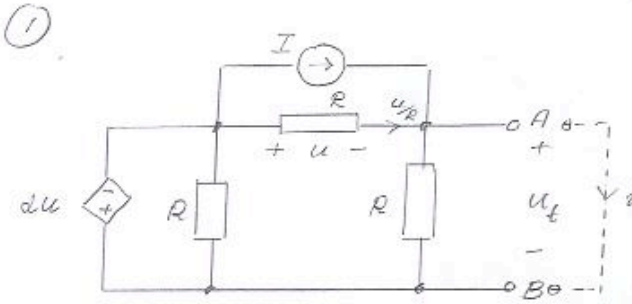
Elektriska kretsar för Z1 23/8 2005

(1)



Tomgång:

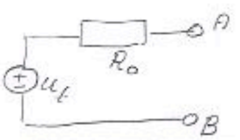
KVL →

$u + u_t + \alpha u = 0$

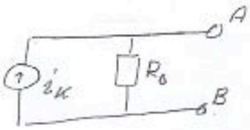
$\rightarrow u = -\frac{u_t}{\alpha+1}$

Ohms lag → $u_t = R\left(I + \frac{u}{R}\right) = RI - \frac{u_t}{\alpha+1} \Rightarrow u_t = \frac{RI(\alpha+1)}{\alpha+2}$

Kortslutning: $u + \alpha u = 0 \rightarrow u = 0$, $i_K = I + \frac{u}{R} = I$



eller



$R_0 = \frac{u_t}{i_K} = \frac{R(\alpha+1)}{\alpha+2}$

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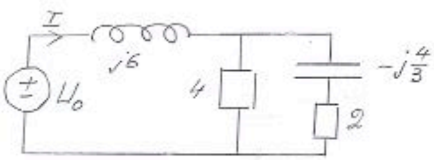
(2) $u_0(t) = 4\cos 3t \Rightarrow U_0 = 4e^{j0°}$, $\omega = 3$, $\omega(L_1+L_2) = 6$

$\frac{1}{\omega C} = \frac{4}{3}$. Ekvivalent krets:



$4 // \left(2 - j\frac{4}{3}\right) = \frac{4\left(2-j\frac{4}{3}\right)}{4+2-j\frac{4}{3}} \approx$

$\approx \cdots \approx 1.46 - j0.56$

$Z_{tot} = j6 + 1.46 - j0.56 = 1.46 + j5.44$

$I = \frac{U_0}{Z_{tot}} \approx 0.71 e^{-j75.1°}$ $\quad i(t) = Re\{Ie^{j\omega t}\} = 0.71\cos(3t - 75.1°)$ A

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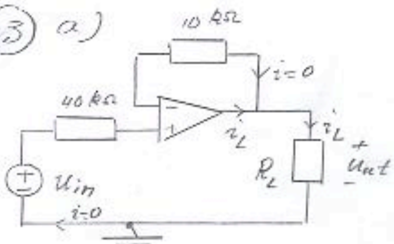
(3) a)



KVL → $u_{in} = u_{ut}$

Ohms lag → $u_{ut} = R_L i_L$

$\therefore i_L = \frac{u_{ut}}{R_L} = \frac{u_{in}}{R_L} = \frac{4}{2\cdot 10^4} =$

$= 2\cdot 10^{-4}$ A $\Rightarrow P_1 = R_L i_L^2 =$

$= \frac{u_{in}^2}{R_L} = \frac{16}{2\cdot 10^4} = 8\cdot 10^{-4}$ W

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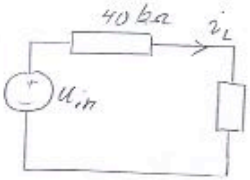
(3) b)



Ohms lag $\Rightarrow i_L = \dfrac{u_{in}}{R_L + 4 \cdot 10^4} =$

$= \dfrac{4}{6 \cdot 10^4} = \dfrac{2}{3} \cdot 10^{-4}\,A$

$\underset{\sim}{P_2} = \underset{\sim}{R_L i_L^2} = \underset{\sim}{\dfrac{8}{9} \cdot 10^{-4}\,W}; \quad \underset{\sim}{\dfrac{P_1}{P_2} = 9}$

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(4) a) $S_1 = P_1 + jQ_1 = 3 \cdot 10^3 + j4 \cdot 10^3$

$S_2 = P_2 + jQ_2 = 2.2 \cdot 10^3 (\cos\varphi_2 + j\sin\varphi_2) =$

$[\cos\varphi_2 = 0.6;\ \sin\varphi_2 = \sqrt{1 - \cos^2\varphi_2} = 0.8] = (1{,}32 + j1.76)10^3$

$S_3 = P_3 = 1.5 \cdot 10^3$

$\underset{\sim}{S_{tot}} = S_1 + S_2 + S_3 = (3 + 1.32 + 1.5)10^3 + j(4 + 1.76)10^3 = \underset{\sim}{P_{tot} + jQ_{tot}}$

där $\underset{\sim}{P_{tot} = 5.82\,kW}$, $\underset{\sim}{Q_{tot} = 5.76\,kVAr}$

b) $S_{tot} = \dfrac{1}{2} U_0 I^* = \dfrac{1}{2} U_0 \left(\dfrac{U_0}{Z_{tot}}\right)^* = \dfrac{1}{2} \dfrac{|U_0|^2}{Z_{tot}^*} \rightarrow Z_{tot}^* = \dfrac{|U_0|^2}{2S_{tot}}$

$\underset{\sim}{Z_{tot}} = \dfrac{|U_0|^2}{\underset{\sim}{2S_{tot}^*}} \approx \dfrac{(220\sqrt{2})^2}{2 \cdot 5.8 \cdot 10^3 (1-j)} = \dots = \dfrac{121}{29}(1+j) \approx \underset{\sim}{4(1+j)\,\Omega}$

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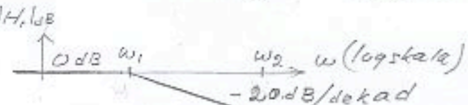
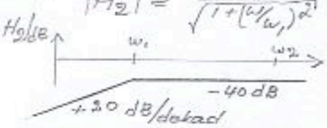
(5) a) $|H_1| = \dfrac{1}{\sqrt{1 + \left(\frac{\omega}{\omega_1}\right)^2}}$ $\quad \omega/\omega_1 \ll 1 \quad |H_1| \approx 1 \quad |H_1|_{dB} = 20\log 1 = 0$

$\omega/\omega_1 \gg 1 \quad |H_1| \approx \dfrac{1}{\omega/\omega_1} \quad |H_1|_{dB} = 20\log\left(\dfrac{1}{\omega/\omega_1}\right)$



b) $|H_2| = \dfrac{\omega/\omega_2}{\sqrt{1 + (\omega/\omega_1)^2}}$ $\quad \omega/\omega_1 \ll 1,\ |H_2| \approx \omega/\omega_2,\ |H_2|_{dB} = 20\log(\omega/\omega_2)$

$\omega/\omega_1 \gg 1,\ |H_2| \approx \dfrac{\omega/\omega_2}{\omega/\omega_1},\ |H_2|_{dB} = 20\log 10^{-2} = -40$



$|H_3| = \dfrac{\sqrt{1 + (\omega/\omega_2)^2}}{\sqrt{1 + (\omega/\omega_1)^2}}$ $\quad \omega/\omega_1 \ll 1,\ |H_3| \approx 1$

$|H_3|_{dB} = 20\log 1 = 0\,dB$

c)

$\omega_1 \ll \omega \ll \omega_2,\ |H_3|_{dB} \approx 20\log\dfrac{1}{\omega/\omega_1}$

$\omega/\omega_2 \gg 1 \quad |H_3|_{dB} \approx 20\log \omega_1/\omega_2 = -40\,dB$

A.J.