(9.6) Bergström & Nordlund: eller Kets-con-fetten

$$I_x = \frac{E}{Z_1 + Z_2} = \frac{120}{5 + 3{,}86 \cdot e^{j72{,}8^\circ}} \simeq$$

$$\simeq \frac{120}{5 + 1{,}1414 + j3{,}6824} \simeq \underline{16{,}5 \cdot e^{-j31^\circ}} \text{ ampere}$$

(9.7)

$$Z = \frac{Z_1 Z_2}{Z_1 + Z_2} = \frac{100 \cdot (50 + j200)}{100 + 50 + j200} =$$

$$= \frac{100 \cdot (50 + j200)}{150^2 + 200^2} \cdot (150 - j200) = 16 \cdot (4{,}25 + 2j)$$

$$\simeq 82{,}5 \cdot e^{j22{,}8^\circ} \ \Omega$$

(9.9)

$$I = 40{,}0 \cdot e^{j35^\circ} \cdot 10^{-3} \ A$$

$$E = 50{,}0 e^{j0^\circ} \ V$$

$$\omega = 5000 \text{ rad/s}$$

a)
$$\begin{cases} Z = R + \frac{1}{j\omega C} = R - j\frac{1}{\omega C} \\ Z = \frac{E}{I} = 1{,}25 \cdot 10^3 \cdot e^{-j35^\circ} \simeq 1024 - j717 \ \Omega \end{cases}$$

Jämför realdelar resp. imaginärdelar $\Rightarrow$

$$R = 1024 \ \Omega$$
$$C \simeq 2{,}8 \cdot 10^{-7} \ F$$

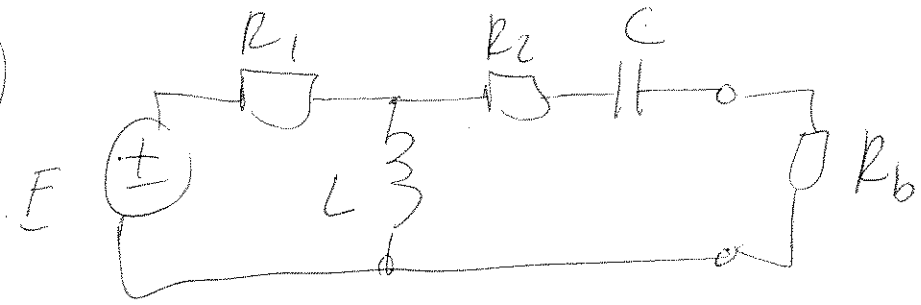
9.11 $Y = \frac{1}{R} + j\omega C + \frac{1}{j\omega L} = \frac{1}{380} + j\,3000 \cdot 2{,}5 \cdot 10^{-6} - \frac{j}{3 \cdot 10^3 \cdot 250 \cdot 10^{-3}} \approx 2{,}6316 \cdot 10^{-3} + j\,6{,}6667 \cdot 10^{-3}\ S$

$= 6{,}705 \cdot 10^{-3}\, e^{j 66{,}9^\circ}$ Siemens

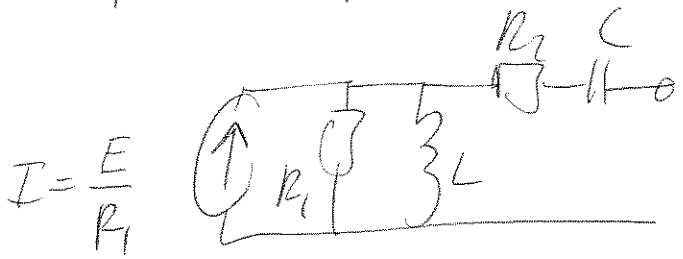
$I = 50 \cdot Y = 0{,}335 \cdot e^{j 66{,}9^\circ}\ A$

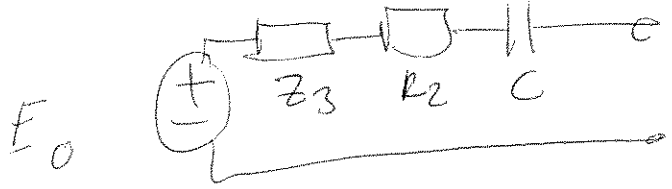
$i(t) = Im(I \cdot e^{j\omega t}) = 0{,}335 \sin(3000t + 66{,}9^\circ)\ A$

9.21



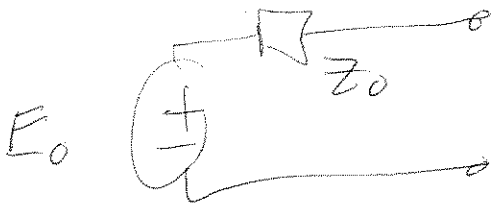
Tvåpols ersättningar:





$E_0 = \frac{E}{R_1} \cdot \frac{R_1 \cdot j\omega L}{R_1 + j\omega L}$

$Z_3 = \frac{R_1 \cdot j\omega L}{R_1 + j\omega L}$



$Z_0 = Z_3 + R_2 + \frac{1}{j\omega C}$

$$\Rightarrow \quad Z_3 \simeq 22{,}36 \cdot e^{j63{,}43^\circ} \ \Omega$$

$$Z_0 \simeq 17 - j12 \ \Omega = 20{,}81 \cdot e^{-j35{,}2^\circ}$$

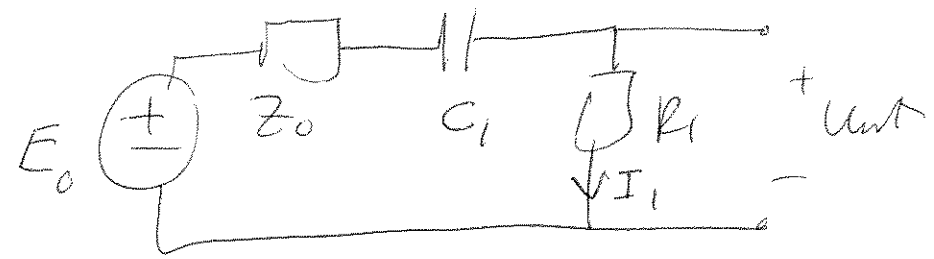
$$E_0 \simeq 8{,}944 \cdot e^{j63{,}43^\circ}$$

Effektivanpassung: $R_b = |Z_0| \simeq 20{,}8 \ \Omega$

$$\Rightarrow \quad P_{b,max} = \frac{1}{2} R_b \cdot |I_b|^2 = \frac{1}{2} R_b \left| \frac{E_0}{Z_0 + R_b} \right|^2$$

$$\simeq 0{,}529 \, W \simeq \underline{0{,}53 \, W}$$

9.29



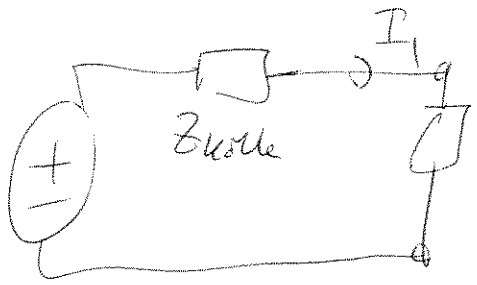
$E_0 = 50V$, $\omega = 25 \cdot 10^3 \, rad/s$, $Z_0 = 100 + j200 \ \Omega$

$R_1 = 400 \ \Omega$

$U_{out\,max}$ de $I_1 R_1$ max dui de I_1 maximal

Resistive last: $I_{1\,max}$ [illegible]

Tank C_1 som del av källans impedans



$$Z_{källa} = Z_0 + \frac{1}{j\omega C_1}$$

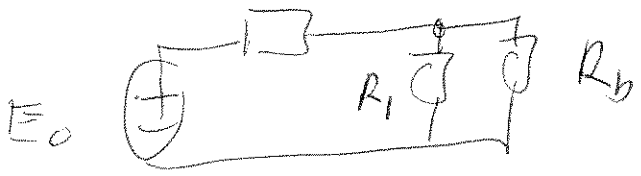
I_1 max om $|Z_{källa} + R_{last}|$ minimal

$\Rightarrow$ $\frac{1}{j\omega C_1}$ eliminerar $\mathrm{Im}\, Z_0$

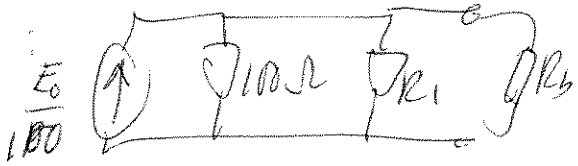
$\Rightarrow$ $\frac{1}{j\omega C_1} = -j2\Omega \Rightarrow C_1 = \underline{2 \cdot 10^{-7}\ F}$

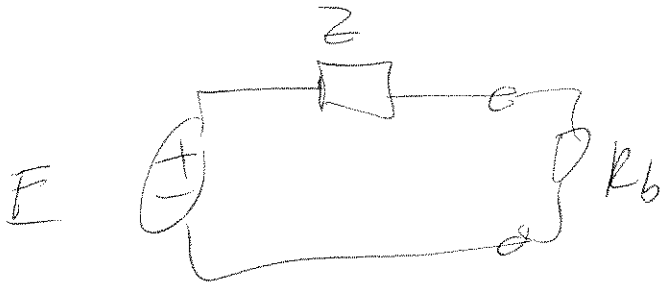
R_b ansluts // R_1 för P_b max:

100 Ω ty imdel elimineras med C_1



Tvåpolsersättn.

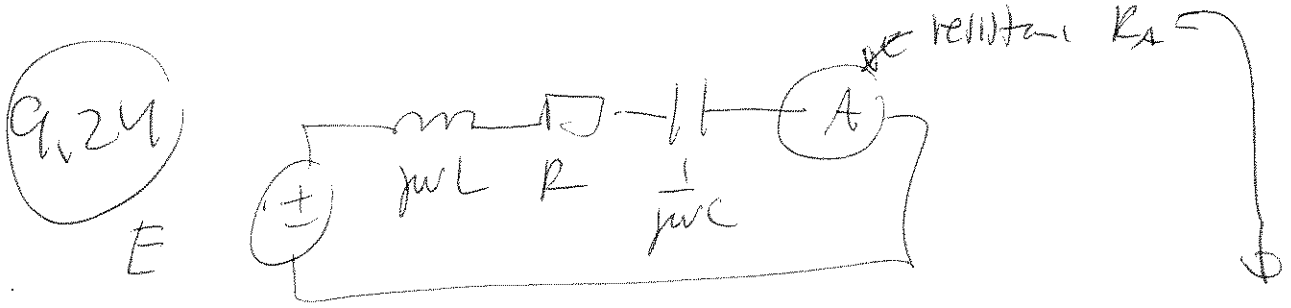




$$E = \frac{E_0}{100} \cdot (100 \,/\!/\, R_1)$$

$$Z = 100 \,/\!/\, R = \frac{100 \cdot 400}{100 + 400} = 80\ \Omega$$

effektiv gilt $R_b = |Z| = 80\ \Omega$



$E = 10\,V$, $\omega = 10^4\,rad/s$ $L = 20 \cdot 10^{-3}\,H$, $R = 20\,\Omega$, $R_A = 5{,}2\,\Omega$

a) Serienresonanz: $\omega = \frac{1}{\sqrt{LC}} \Rightarrow C = 5 \cdot 10^{-7}\,F$

b) $|U_c| = \left| \frac{1}{j\omega C} I \right| = \frac{|E|}{|Z|} \cdot \frac{1}{\omega C} = \frac{E}{R + R_A} \cdot \frac{1}{\omega C}$

$\approx 79{,}4\,V$

(9.25) Kretsen ovan 9.24 med $|E| = 2\ V$

$R_1 = 0\ \Omega$

$C = 100\ nF$

$|I|_{max} = 0{,}1\ A$ vid $f = 10^4\ Hz$

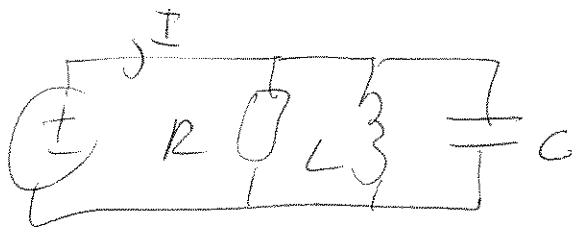
a) $L = \dfrac{1}{\omega^2 C} \approx 2{,}533 \cdot 10^{-2}\ H \approx \underline{25\ mH}$

$R = Z_{vid\ resonans} = \dfrac{|E|}{|I|_{max}} = \dfrac{1}{0{,}1} = \underline{10\ \Omega}$

b) $Q_{spole} = \dfrac{\omega L}{R_{spole}} \approx 15{,}916 \approx \underline{16}$

c) $B = \dfrac{f_0}{Q_0} = \dfrac{10^4}{15{,}916} \approx \underline{630\ Hz}$

(9.26)



$L = 9{,}42\ H$

$|I|_{min}$ då $\omega = 1{,}2 \cdot 10^3\ rad/s$

$|E| = 28\ V$

$|I|_{min} = \dfrac{50{,}6 \cdot 10^{-3} \cdot \sqrt{2}}{\uparrow}$

effektivvärde

a) $\omega_0 = \frac{1}{\sqrt{LC}} \Rightarrow C \simeq 1{,}165\ \mu F$

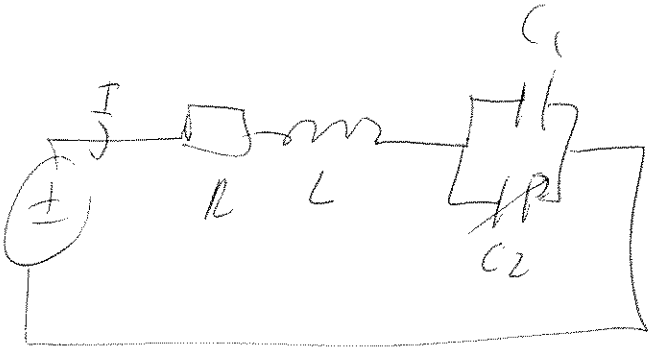
$R = Z_{\text{risonanza}} = \frac{|E|}{|I|_{min}} \simeq 350\ \Omega$

b) $|I| = \frac{|E|}{\left|\frac{R \cdot j\omega L}{R + j\omega L}\right|} \simeq 9{,}744 \cdot 10^{-2}\ A$

(effettivamente $6{,}89 \cdot 10^{-2}$ A)

↑ C tra i bont

9.27



$f = 50\ Hz$, $R = 10\ \Omega$, $L = 2 \cdot 10^{-3}\ H$

$|I|_{max} = 0{,}145\sqrt{2}\ A$ anzi di $C_2 = 20 \cdot 10^{-6}\ F$

a) $C_1 + C_2 \overset{\text{risonanza}}{=} \frac{1}{\omega_0^2 L} \Rightarrow C_1 \simeq 3{,}066 \cdot 10^{-5}\ F = 31\ \mu F$

b) C_2 tra i bont: $|I| = \frac{|E|}{\left|R + j\omega L + \frac{1}{j\omega C_1}\right|} = \frac{|I|_{max} \cdot R}{\left|R + j\omega L + \frac{1}{j\omega C_1}\right|}$

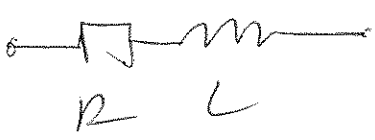
↑ Tutta risonanza facilmente da $|E| = |I|_{max} R$ da $Z = R$ da

$$\Rightarrow |\underline{I}| = \frac{4{,}47\sqrt{2}\cdot 10}{\sqrt{10^2 + \left(500\,2\pi\cdot 2\cdot 10^{-3} - \frac{1}{2\pi 500\cdot 3{,}066\cdot 10^{-5}}\right)^2}}$$

$$\approx 0{,}1897\ \text{A} \quad \text{(Rundung)}$$

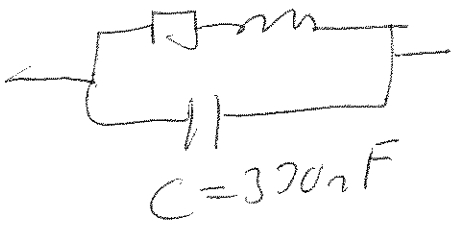
$$\Rightarrow \underline{0{,}134\ \text{A}} \quad \text{effektiv}$$

(9.28)



$Q = 2{,}8$, $L = 20\cdot 10^{-3}\,H$

$$Q_{Spule} = \frac{\omega L}{R} \Rightarrow R = \frac{\omega L}{Q_{Spule}}$$

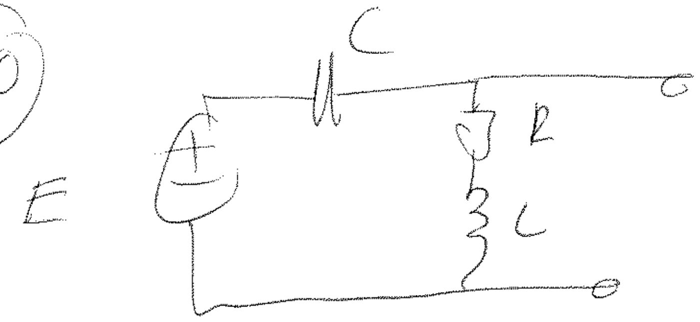


$$\omega_r = \frac{1}{\sqrt{LC}}\sqrt{1 - \frac{CR^2}{L}} = \frac{1}{\sqrt{LC}}\sqrt{1 - \frac{C\omega^2 L^2}{LQ^2}}$$

$$\approx \frac{1}{\sqrt{LC}}\cdot\sqrt{1 - \frac{1}{Q_0^2}} \approx 1{,}15\cdot 10^4\ \text{rad/s}$$

$\uparrow$ approx $\omega^2 \approx \omega_0^2 = \frac{1}{LC}$ und rechnen $\Rightarrow \frac{C\omega^2 L^2}{LQ^2} = \frac{1}{Q_0^2}$ ihne i rotem

(9.30)

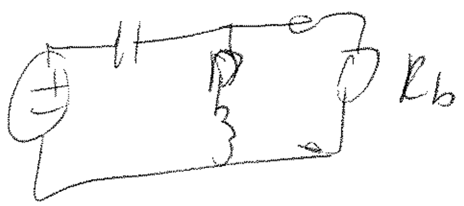


$E = 50\,V \qquad R = 500\,\Omega \;, \quad L = 0{,}5\,H$

$\omega = \omega_0 = 1000$ rad/s

a) resonans $\Rightarrow$ $C = \dfrac{1}{\omega_0^2 L} = \underline{\underline{2 \cdot 10^{-6}\,F}}$

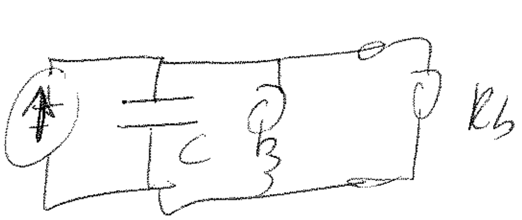
b) Anslut R_b som last:



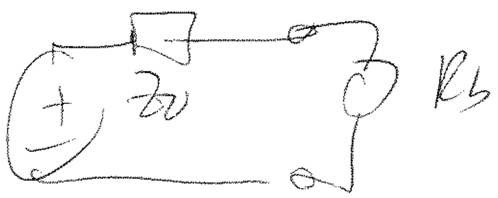
(Effektanpassa)

Först: Tvåpolsomvandlingar:

$I_0 = \dfrac{E}{\frac{1}{j\omega C}}$



$E_0 = I_0 Z_0$



$Z_0 = \dfrac{\frac{1}{j\omega C}\cdot(R + j\omega L)}{\frac{1}{j\omega C} + R + j\omega L}$

Effektanpassning: $R_b = |Z_0| = \ldots = \left\{ \begin{array}{l} \text{eller} \\ \text{alt } \omega^2 LC = 1 \\ \text{för delta} \\ \text{komponent-} \\ \text{värden} \end{array} \right\} =$

$$= \frac{R + j\omega L}{1 \cdot j\omega CR} \Big| \simeq 707{,}1\ \Omega$$

$$P_{max} = \frac{1}{2} |I|^2 R_b = \frac{1}{2} \frac{|E|^2}{|Z_0 + R_b|^2} \cdot R_b$$

där $|Z_0 + R_b| = \left| \frac{R + j\omega L}{j\omega CR} + R_b \right| \simeq 1306{,}56\ \Omega$

$$\Rightarrow P_{max} \simeq 9{,}518\ W \simeq \underline{\underline{9{,}52\ W}}$$

↑
medeleffekt

Maximumeffekt $= 2 \cdot$ medeleff $\simeq 19{,}04\ W$.