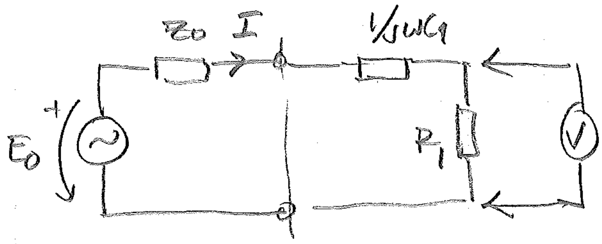
9.29



serie-krets.

$E_0 = 50 \cdot e^{j\omega t}$ V ; $\omega = 25$ krad/s

$Z_0 = (100 + j200)\,\Omega$; $R_1 = 400\,\Omega$

(V) visar max spänning $\Leftrightarrow$ $\underbrace{I = I_{MAX}}_{= \text{resonans!}}$

Då gäller att $Z = Z_{min} = R$.

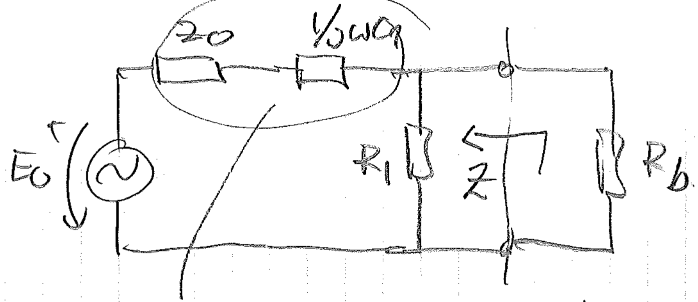
a) Bestäm C_1 vid resonans.

$$Z = Z_0 + R_1 + \frac{1}{j\omega C_1} = 100 + R_1 + j\underbrace{\left(200 - \frac{1}{\omega C_1}\right)}_{=0}$$

DVS $\frac{1}{\omega C_1} = 200 \Rightarrow C_1 = \frac{1}{\omega \cdot 200}$

$$= \frac{1}{25 \cdot 10^3 \cdot 200} = 0{,}2\,\mu F = 200\,nF$$

b)



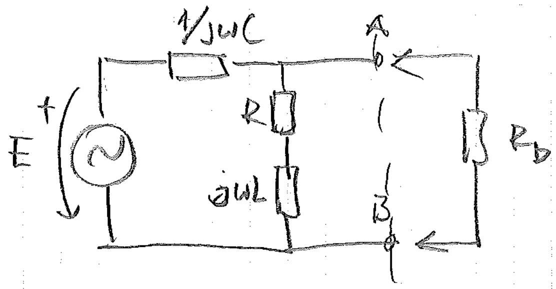
resonans $\rightarrow$ $Z_0 + \frac{1}{j\omega C_1}$ = resistiv $= 100\,\Omega$

Max effektutveckling i R_b då $R_b = |Z|$

$$|Z| = 100\,\Omega \,//\, R_1 = \frac{100 \cdot 400}{100 + 400} = 80\,\Omega$$

Således $R_b = 80\,\Omega$

(9.30)



$E = 50{,}0\, e^{j\omega t}$; $\omega = 1000$ rad/s

$R = 500\ \Omega$
$L = 0{,}5\ H$

C är vald så att seriekretsen CRL är i resonans.

a) Beräkna kapacitansen C.

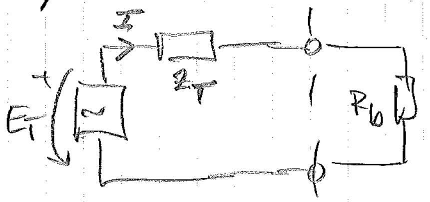
$$Z_{CRL} = R + j\omega L + \frac{1}{j\omega C} = R + j\underbrace{\left(\omega L - \frac{1}{\omega C}\right)}_{=0 \text{ vid resonans}}$$

Vid resonans är $Z = R$

$$\Rightarrow \omega L = \frac{1}{\omega C} \quad \text{dvs} \quad C = \frac{1}{\omega^2 \cdot L} = \frac{1}{10^6 \cdot 0{,}5} = 2 \cdot 10^{-6} = 2\,\mu F$$

b) R_b kopplas till tvåpolen AB.
Max effekt till R_b?

Gör om till ekvivalent tvåpol:



$R_b = |Z_T|$ för max effekt

$$E_T = \frac{R + j\omega L}{R + j\omega L + \frac{1}{j\omega C}} \cdot E = \frac{R + j\omega L}{R + j\underbrace{\left(\omega L - \frac{1}{\omega C}\right)}_{=0}} \cdot E = \frac{R + j\omega L}{R} \cdot E$$

$$= \frac{500 + j500}{500} \cdot E = (1+j)E = \sqrt{2} \cdot e^{j45°}\, 50{,}0 e^{j\omega t} = 50 \cdot \sqrt{2}\, e^{j(\omega t + 45°)}\ V$$

$$Z_T = (R + j\omega L) // \frac{1}{j\omega C} = \frac{(R + j\omega L)\frac{1}{j\omega C} \cdot j\omega C}{R + j\omega L + \frac{1}{j\omega C} \cdot j\omega C} = \frac{R + j\omega L}{R + j\underbrace{\left(\omega L - \frac{1}{\omega C}\right)}_{=0}}$$

$$= \frac{R + j\omega L}{j\omega RC} = \frac{500 + j500}{j} = \frac{500(1+j)}{j} = \frac{500 \cdot \sqrt{2}\, e^{j45°}}{1 \cdot e^{j90°}}$$

$$= 500 \cdot \sqrt{2}\, e^{-j45°} = (500 - j500)\ \Omega.$$

$$R_b = |Z_T| = 500 \cdot \sqrt{2} = 707\ \Omega$$

och $P_b = R_b \cdot I_e^2$

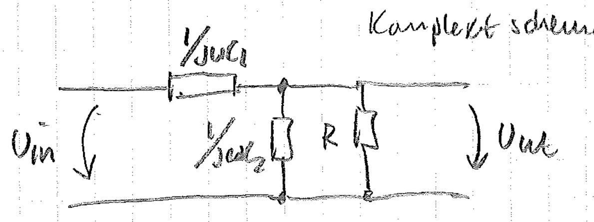
$$\text{där } I = \frac{E_T}{Z_T + R_b} = \frac{50 \cdot \sqrt{2}\, e^{j(\omega t + 45°)}}{(500 - j500) + 707} = \frac{50 \cdot \sqrt{2}\, e^{j(\omega t + 45°)}}{1306{,}5\, e^{-j22{,}5°}}\ A$$

$$\Rightarrow I_e = \frac{50}{1306{,}5}\ A$$

$$P_b = R_b \cdot I_e^2 = 707 \left(\frac{50}{1306{,}5}\right)^2 \approx 1{,}04\ W$$

(9.31)

Komplext schema



$$\begin{cases} C_1 = 1\,\mu F \\ C_2 = 9\,\mu F \\ R = 1\,k\Omega \end{cases}$$

a) Bestäm $\begin{cases}\text{överföringsfunktionen } H(\omega) \\ \text{Frekvensfunktionen } F(\omega)\end{cases}$

$$F(\omega) = \frac{U_{ut}}{U_{in}}$$

$$U_{ut} = \frac{\frac{1}{j\omega C_2} /\!/ R}{\frac{1}{j\omega C_2} /\!/ R + \frac{1}{j\omega C_1}} \cdot U_{in} \; ; \qquad \frac{1}{j\omega C_2} /\!/ R = \frac{\frac{1}{j\omega C_2} \cdot R}{\frac{1}{j\omega C_2} + R} \begin{matrix} \times j\omega C_2 \\ \times j\omega C_2 \end{matrix}$$

sp. delning

$$= \frac{R}{1 + j\omega R C_2}$$

$$\frac{U_{ut}}{U_{in}} = \frac{\frac{R}{1+j\omega RC_2}}{\frac{R}{1+j\omega RC_2} + \frac{1}{j\omega C_1}} \begin{matrix} \times j\omega C_1 \\ \times j\omega C_1 \end{matrix} = \frac{\frac{j\omega RC_1}{1+j\omega RC_2}}{\frac{j\omega RC_1}{1+j\omega RC_2} + 1} \begin{matrix} \times (1+j\omega RC_2) \\ \times (1+j\omega RC_2) \end{matrix}$$

$$= \frac{j\omega RC_1}{j\omega RC_1 + (1 + j\omega RC_2)} = \frac{j\omega RC_1}{1 + j\omega R(C_1 + C_2)}$$

Med värden:

$$\frac{U_{ut}}{U_{in}} = \frac{j\omega\, 10^3 \cdot 10^{-6}}{1 + j\omega\, 10^3 \cdot 10 \cdot 10^{-6}} = \frac{j\omega\, 10^{-3}}{1 + j\omega \cdot 10^{-2}}$$

$|F(0)| \to 0$
$|F(\infty)| \to 10^{-1}$

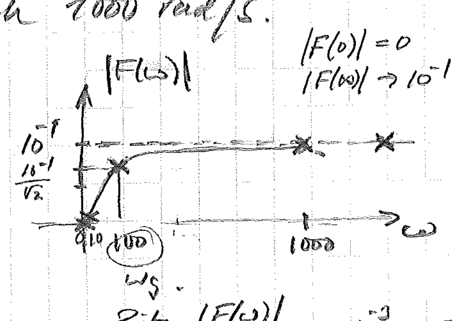
b) $F(\omega) = ?$ vid $\omega = 10, 100$ och 1000 rad/s.

$$F(10) = \frac{j\,10^{-2}}{1 + j\,10^{-1}} \approx 9{,}95 \cdot 10^{-3}\, e^{j84{,}3^\circ}$$

$$F(100) = \frac{j \cdot 10^{-1}}{1 + j} \approx 70{,}7 \cdot 10^{-3}\, e^{j45^\circ}$$

$$F(1000) = \frac{j}{1 + j10} \approx 99{,}5 \cdot 10^{-3}\, e^{j5{,}7^\circ}$$

$|F(0)| = 0$
$|F(\infty)| \to 10^{-1}$



Rita $|F(\omega)|$

stora ω: $F(\omega) \approx \frac{j\omega 10^{-3}}{j\omega 10^{-2}} = 10^{-1}$

HP-filter

c) Gränsfrekvensen $\omega_g = ?$ / HP-filter

$$\frac{|F(\omega_g)|}{|F(\infty)|} = \frac{1}{\sqrt{2}} \Rightarrow |F(\omega_g)| = \frac{|F(\infty)|}{\sqrt{2}} = \frac{10^{-1}}{\sqrt{2}}$$

$$\Rightarrow \left(\underbrace{\frac{\omega_g \cdot 10^{-3}}{\sqrt{1^2 + \omega_g^2 \cdot 10^{-4}}}}_{|F(\omega_g)|}\right)^2 = \left(\frac{10^{-1}}{\sqrt{2}}\right)^2$$

$$2 \cdot \omega_g^2 10^{-6} = \overbrace{10^{-2}(1 + \omega_g^2 \cdot 10^{-4})}^{10^{-2} + \omega_g^2 10^{-6}}$$

$$\omega_g^2 = \frac{10^{-2}}{10^{-6}} = 10^4 \Rightarrow \omega_g = 100 \text{ rad/s}$$

$$f_g = 15{,}9 \text{ Hz}$$