Øving 9

36) Passive Filter 9.A

36.1) Spenningsdeler

$$V_{out}(s)=V_{inn}(s)\cdot\frac{R}{R+\frac{1}{sC}}$$

$$H(s)=\frac{R}{R+\frac{1}{sC}}=\frac{s}{s+\frac{1}{RC}}$$

$$H(j\omega)=\frac{j\omega}{j\omega+\frac{1}{RC}} = \frac{j\omega}{j\omega+4000}$$

$$|H(j\omega)|=\frac{\omega}{\sqrt{\omega^2+\frac{1}{(RC)^2}}}$$

36.2)

$$|H(j\omega_c)|=\frac{\omega_c}{\sqrt{\omega_c^2+\frac{1}{(RC)^2}}}=\frac{1}{\sqrt{2}}$$

$$\sqrt{2}\,\omega_c=\sqrt{\omega_c^2+\frac{1}{(RC)^2}}$$

$$\omega_c=\frac{1}{RC} = 4000$$

Introduserer ω_c i formler:

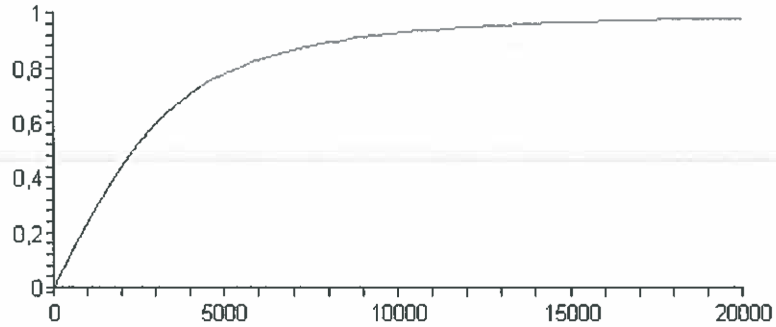
$$H(s)=\frac{s}{s+\omega_c}$$

$$H(j\omega)=\frac{j\omega}{j\omega+\omega_c}$$

$$|H(j\omega)|=\frac{\omega}{\sqrt{\omega^2+\omega_c^2}} = \frac{\omega}{\sqrt{\omega^2+16\cdot 10^6}}$$

36.3) $|H(j\omega)| = \dfrac{\omega}{\sqrt{\omega^2+\omega_c^2}}$

Amplituden:

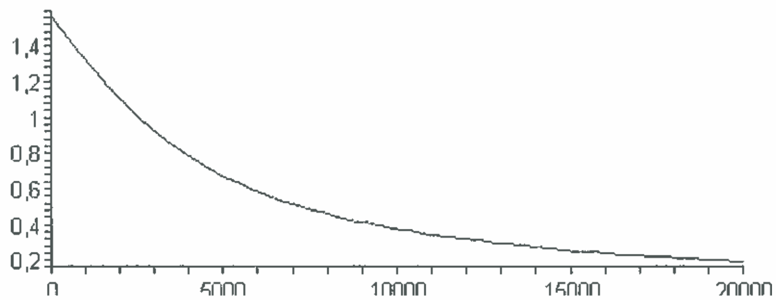


$$H(j\omega) = \frac{j\omega}{j\omega+\omega_c}$$

$$\theta(j\omega) = \theta(H(j\omega)) = \theta\left(\frac{j\omega}{j\omega+\omega_c}\right) = \theta(j\omega) - \theta(\omega_c + j\omega)$$

$$\theta(j\omega) = \frac{\pi}{2} - atan\left(\frac{\omega}{\omega_c}\right)$$

Fasen:



36.4) $\omega_c = \dfrac{1}{RC} \quad \rightarrow \quad R = \dfrac{1}{\omega_c C} = \dfrac{1}{2\pi f_c C} = 5{,}3\ k\Omega$

36.5) $R_{total} = \dfrac{1}{2\pi f_c' C} \qquad R_{total} = R_{Last} || R \qquad R_{Last} = \dfrac{1}{\dfrac{1}{R_{Total}} - \dfrac{1}{R}}$

$R_{total} = 4780\Omega \qquad R_{Last} = 48{,}66\ k\Omega$

37) Passive Filter 9.B

37.1) $$Z_{RL}=\frac{s\,R\,L}{R+s\,L}$$

$$V_2(s)=\frac{Z_{RL}}{Z_{RL}+\frac{1}{sC}}\cdot V_1(s)$$

$$H(s)=\frac{V_2(s)}{V_1(s)}=\frac{Z_{RL}}{Z_{RL}+\frac{1}{sC}}=\frac{s^2}{s^2+s\cdot\frac{1}{RC}+\frac{1}{LC}}$$

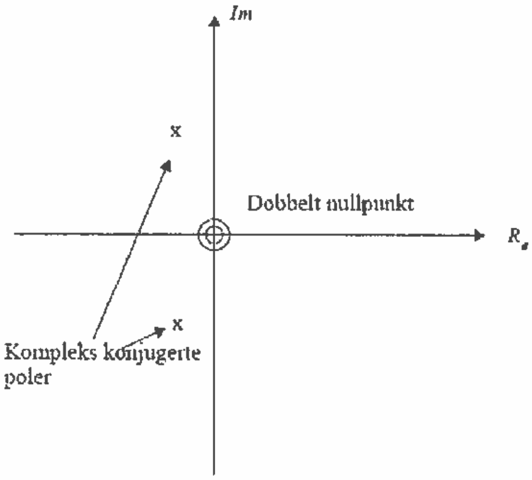
37.2) $$\omega_1=\frac{1}{\sqrt{LC}} \qquad R=\sqrt{\frac{L}{C}} \quad \rightarrow \quad underdempet$$

$$\frac{1}{RC}=\frac{1}{\sqrt{\frac{L}{C}}\cdot C}=\frac{1}{\sqrt{LC}}=\omega_1 \qquad \frac{1}{LC}=\left(\frac{1}{\sqrt{LC}}\right)^2=\omega_1^2$$

$$H(s)=\frac{s^2}{s^2+s\cdot\omega_1+\omega_1^2}$$

37.3) $$s^2=0 \quad \rightarrow \quad s_{1,2}=0$$

$$s^2+s\cdot\omega_1+\omega_1^2=0 \quad \rightarrow \quad s_{3,4}=-\frac{\omega_1}{2}\pm j\frac{\sqrt{3}}{2}\omega_1$$



TET4100 Kretsanalyse – Løsning

Institutt: Elkraftteknikk Dato: 2012.08.15

37.4) $$H(s)=\frac{s^2}{s^2+s\cdot\omega_1+\omega_1^2}$$

$$H(j\omega)=\frac{(j\omega)^2}{(j\omega)^2+j\omega\cdot\omega_1+\omega_1^2}=\frac{-\omega^2}{-\omega^2+j\omega\cdot\omega_1+\omega_1^2}=\frac{\omega^2}{\left(\omega^2-\omega_1^2\right)-j\omega\cdot\omega_1}$$

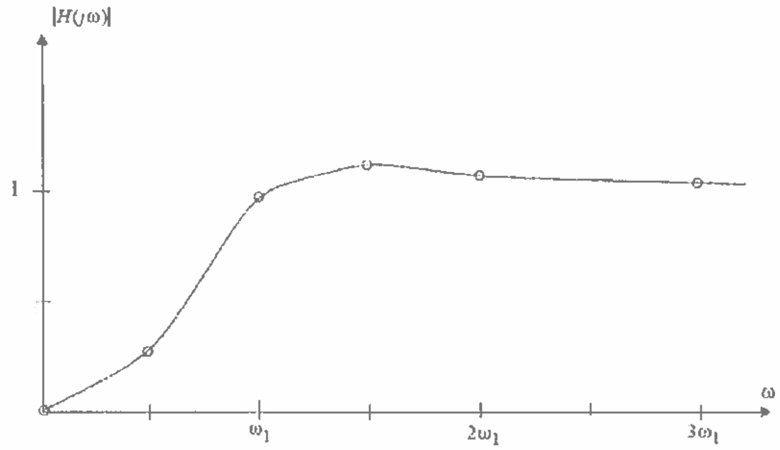
37.5) $$|H(j\omega)|=\frac{\omega^2}{\sqrt{\left(\omega^2-\omega_1^2\right)^2+\left(\omega\cdot\omega_1\right)^2}}$$

$$\omega_{rel}=\frac{\omega}{\omega_1}$$

$$|H(j\omega_{rel})|=\frac{\omega_{rel}^2}{\sqrt{\left(\omega_{rel}^2-1\right)^2+\omega_{rel}^2}}=\frac{\omega_{rel}^2}{\sqrt{\omega_{rel}^4-\omega_{rel}^2+1}}$$

$|H(j0)|=0$ $\qquad |H(j0{,}5)|=\frac{1}{\sqrt{13}}$ $\qquad |H(j1)|=1$

$|H(j1{,}5)|=\frac{9}{\sqrt{61}}$ $\qquad |H(j2)|=\frac{4}{\sqrt{13}}$ $\qquad |H(j3)|=\frac{9}{\sqrt{73}}$



37.6) Høypassfilter

38) Passive Filter 9.C

38.1) $$H(s)=\frac{\frac{1}{sC}}{sL+\frac{1}{sC}}=\frac{\frac{1}{LC}}{s^2+\frac{1}{LC}}$$

$$\omega_0=\sqrt{\frac{1}{LC}}$$

$$H(s)=\frac{\omega_0^2}{s^2+\omega_0^2}$$

$$H(j\omega)=\frac{\omega_0^2}{\omega_0^2-\omega^2}$$

38.2) $$H(j\omega_0)=\frac{1}{1-1}=\infty$$

Amplituden på utgangssignalet går mot uendelig

38.3)