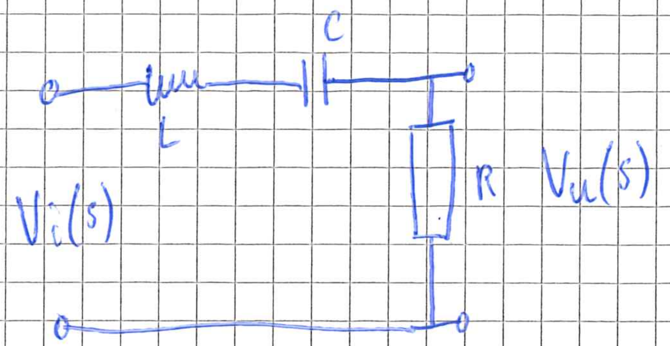
1



$$Z_L = sL \, , \quad Z_C = \frac{1}{sC} \, , \quad Z_R = R$$

Spenningsdeling

$$V_i(s) = V_L + V_C + V_R$$

$$V_i(s) = I \cdot Z_L + I \cdot Z_C + V_u(s)$$

$$I = \frac{V_i(s)}{Z_L + Z_C + Z_R}$$

$$V_i(s) = (Z_L + Z_C) \cdot \frac{V_i(s)}{Z_L + Z_C + Z_R} + V_u(s)$$

$$V_i(s) - V_i(s) \frac{Z_L + Z_C}{Z_L + Z_C + Z_R} = V_u(s)$$

$$V_i(s) \left(\frac{Z_L + Z_C + Z_R}{Z_L + Z_C + Z_R} - \frac{Z_L + Z_C}{Z_L + Z_C + Z_R} \right) = V_u(s)$$

$$V_i(s) \cdot \frac{Z_R}{Z_L + Z_C + Z_R} = V_u(s)$$

$$V_i(s) \cdot \frac{R \cdot sC}{\left(sL + \frac{1}{sC} + R\right) \cdot sC} = V_u(s)$$

$$\underline{\underline{V_i(s) \frac{sRC}{s^2LC + 1 + sRC} = V_u(s)}}$$

2) $V_u(s) = \dfrac{sR}{s^2L + sR + \frac{1}{C}} V_i(s)$

a) $V_u(s=j\omega) = \dfrac{j\omega R}{(j\omega)^2 L + j\omega R + \frac{1}{C}} V_i(j\omega) \Big|_{s=\sigma+j\omega}$

$$= \frac{j\omega R}{\frac{1}{C} + j\omega R - \omega^2 L} V_i(j\omega)$$

$V_i(\omega)$

b) $v_i(t) = \delta(t)$

$V_i(j\omega) = 1$

$V_o(j\omega) = H(j\omega) \cdot V_i(j\omega)$

$= H(j\omega)$

③ $$H(j\omega) = \frac{j\omega RC}{1 + j\omega RC - \omega^2 LC}$$

$C = L = 1, \quad R = 2$

$$\underline{H(j\omega) = \frac{2j\omega}{1 + 2j\omega - \omega^2}}$$

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

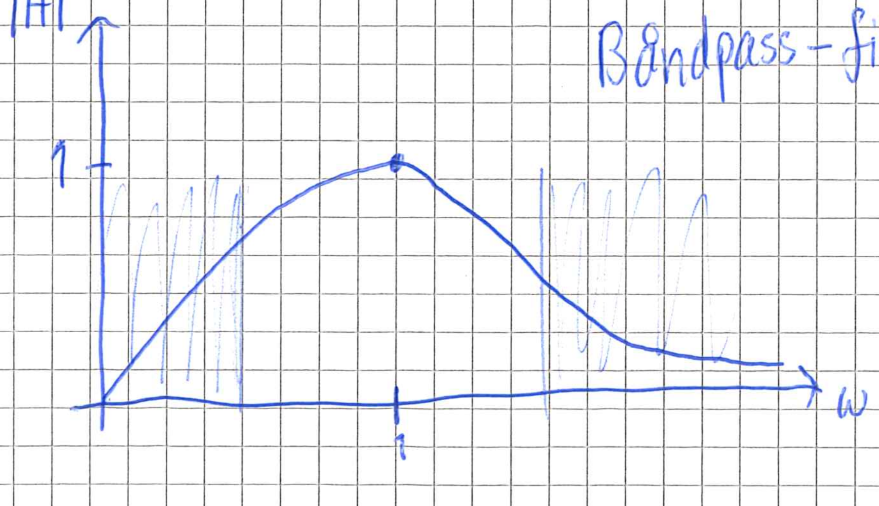
$$|2j\omega| = 2\,|j|\,|\omega| = 2|\omega|$$

$$|\underbrace{1 - \omega^2 + 2j\omega}_{(1-\omega^2 + j\cdot 2\omega)}| = \sqrt{(1-\omega^2)^2 + 2^2\omega^2}$$

$$= \sqrt{1 - 2\omega^2 + \omega^4 + 4\omega^2}$$

$$= \sqrt{1 + 2\omega^2 + \omega^4} = \sqrt{(1+\omega^2)^2} = \underline{1 + \omega^2}$$

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



Bandpass-filter

4) $H(j\omega) = H(\omega)$ $\quad s = \cancel{\sigma} + j\omega$

$$= \frac{2j\omega}{1 + 2j\omega - \omega^2} = \frac{V_o(j\omega)}{V_i(j\omega)}$$

$$V_o(j\omega) = H(j\omega) \cdot V_i(j\omega)$$

$$V_i(j\omega) = \frac{2}{\omega^2 + 1} \quad , \quad v_i(t) = e^{-|t|}$$

$$V_o(j\omega) = \left(\frac{2j\omega}{1 + 2j\omega - \omega^2}\right)\left(\frac{2}{\omega^2 + 1}\right)$$

$$v_o(t) = ?\int_{-\infty}^{\infty} \left(\frac{2j\omega}{1 + 2j\omega - \omega^2}\right)\left(\frac{2}{\omega^2 + 1}\right) e^{j\omega t}\, d\omega = ???$$