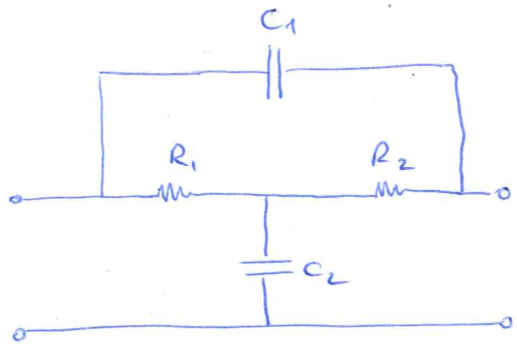
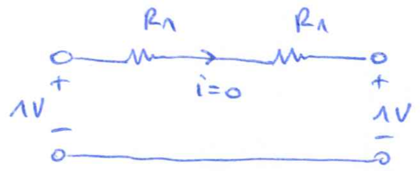
OVERBRUGD - T

① SCHEMA

a. limietanalyse

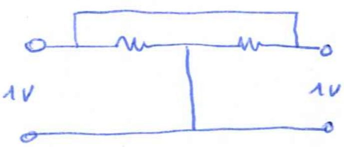


LF ($f = 0$)



$H(0) = 1$

HF ($f = \infty$)

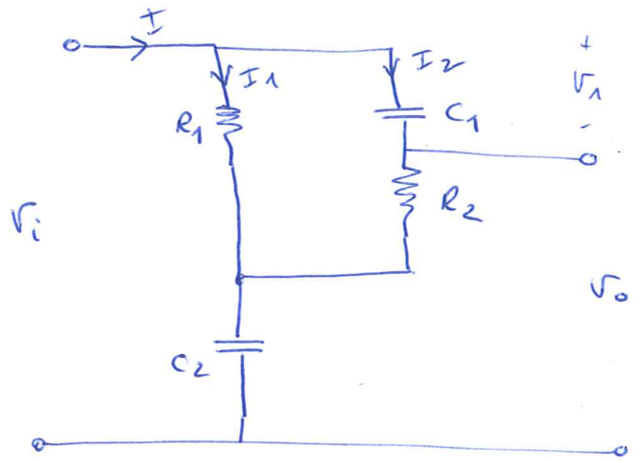


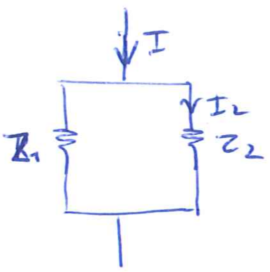
$H(\infty) = 1$

b. pole-zero analyse

kapacitieve koppeling tussen in en uit $\rightarrow$ zero(1)

② OVERBRUGD-T : berekening $H(s)$





$$Z_1 I_1 = Z_2 \cdot I_2 \qquad I_1 + I_2 = I$$

$$I_2 = \frac{Z_1 I_1}{Z_2} = \frac{Z_1 (I - I_2)}{Z_2} \qquad \frac{Z_1}{Z_2} = \frac{I_2}{I_1} = \frac{I_2}{I - I_2}$$

$$I_2 + I_2 \left(\frac{Z_1}{Z_2} \right) = \frac{Z_1}{Z_2} I$$

$$I_2 \left(\frac{Z_2 + Z_1}{Z_2} \right) = \frac{Z_1}{Z_2} I$$

$$\boxed{I_2 = I \cdot \frac{Z_1}{Z_1 + Z_2}}$$

$$\boxed{I = \frac{V_i}{Z}}$$

$$Z = \frac{1}{sC_2} + \frac{1}{\frac{1}{R_1} + \frac{sC_1}{1 + sC_1 R_2}}$$

$$Z_s = R_2 + \frac{1}{sC_1} = \frac{1 + sC_1 R_2}{sC_1}$$

$$Z = \frac{1}{sC_2} + \frac{R_1 (1 + sC_1 R_2)}{1 + sC_1 R_2 + sC_1 R_1}$$

$$\frac{a}{b} + \frac{c}{d} = \frac{ad + cb}{b.d}$$

$$Z = \frac{1 + sC_1(R_1+R_2) + (R_1 + sC_1R_1R_2) \cdot sC_2}{sC_2 \cdot (1 + sC_1R_2 + sC_1R_1)}$$

$$= \frac{1 + s(C_1R_1 + C_1R_2 + C_2R_1) + s^2 C_1C_2R_1R_2}{sC_2 \cdot (1 + sC_1R_2 + sC_1R_1)}.$$

Stroomdeling

$$I_2 = I \cdot \frac{R_1}{R_1 + Z_s} = I \cdot \frac{R_1}{R_1 + \frac{1+sC_1R_2}{sC_1}}$$

$$= I \cdot \frac{sC_1R_1}{sC_1R_1 + sC_1R_2 + 1}$$

$$v_o = v_i - v_1$$

$$= v_i - I_2 \cdot \frac{1}{sC_1}$$

$$= v_i - I \cdot \frac{\cancel{sC_1}R_1}{sC_1R_1 + sC_1R_2 + 1} \cdot \frac{1}{\cancel{sC_1}} \qquad \text{en } I = \frac{v_i}{Z}$$

$$= v_i - v_i \cdot \frac{sC_2\,\cancel{(1 + sC_1R_2 + sC_1R_1)}}{1 + s(C_1R_1 + C_1R_2 + C_2R_1) + s^2C_1C_2R_1R_2} \cdot \frac{R_1}{\cancel{(sC_1R_1 + sC_1R_2 + 1)}}$$

$$= v_i \left[\frac{1 + s(C_1R_1 + C_1R_2 + \cancel{C_2R_1}) + s^2C_1C_2R_1R_2 - \cancel{sC_2R_1}}{1 + s(C_1R_1 + C_1R_2 + C_2R_1) + s^2C_1C_2R_1R_2} \right]$$

$$H = \frac{v_o}{v_i} = \frac{1 + s\,(C_1(R_1+R_2)) + s^2C_1C_2R_1R_2}{1 + s(C_1R_1 + C_1R_2 + C_2R_1) + s^2C_1C_2R_1R_2} \overset{R=R_1=R_2}{=} \frac{1 + 2RC_1s + C_1C_2R^2s^2}{1 + sR(2C_1+C_2) + C_1C_2R^2s^2}$$

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$$H(s) = \frac{C_1 C_2 R^2 s^2 + 2 C_1 R s + 1}{C_1 C_2 R^2 s^2 + (2C_1 + C_2) R s + 1} = \frac{\left(\frac{s}{\omega_{nz}}\right)^2 + \frac{1}{Q_z}\left(\frac{s}{\omega_{nz}}\right) + 1}{\left(\frac{s}{\omega_{np}}\right)^2 + \frac{1}{Q_p}\left(\frac{s}{\omega_{np}}\right) + 1}$$

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(3) KARAKTERISATIE

ZERO

$$\omega_{nz} = \frac{1}{R\sqrt{C_1 C_2}} = 2\pi \cdot 1000\,\text{Hz}$$

$$Q_z = \frac{1}{2}\sqrt{\frac{C_2}{C_1}} = 3$$

$$\zeta_z = \frac{1}{2 \cdot Q_z} = \frac{1}{6} < 1$$

complex toegevoegd

POLE

$$\omega_{np} = \omega_{nz} = 2\pi \cdot 1000\,\text{Hz}$$

$$Q_p = \frac{1}{2\zeta_p} = 0{,}15$$

$$\zeta_p = \zeta_z + \frac{1}{2\zeta_z} = 3{,}2 > 1$$

reëel

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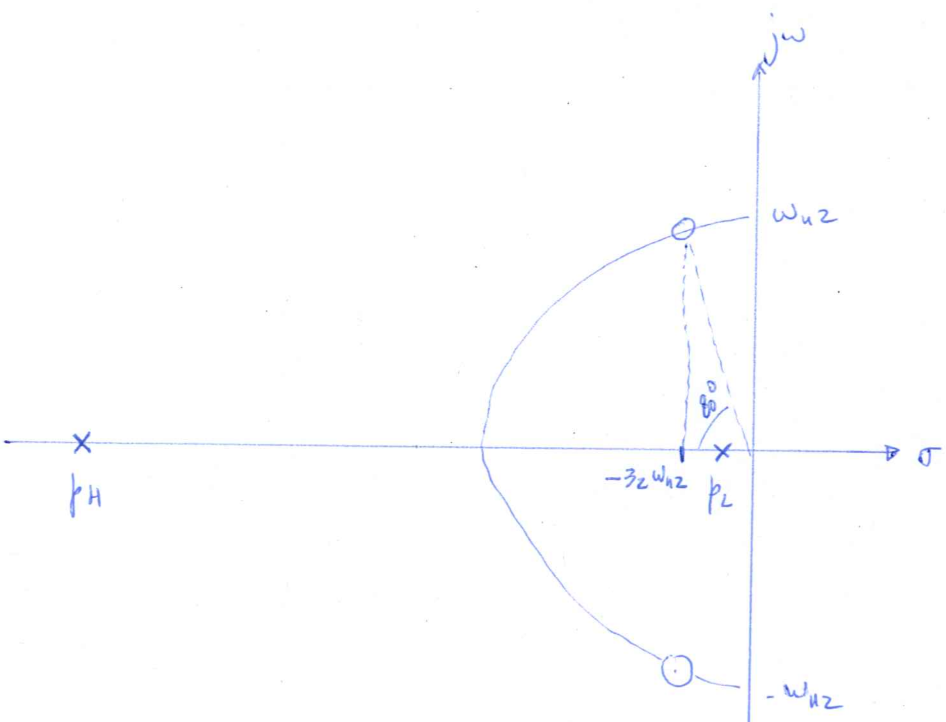
(4) POLE – ZERO PLOT



$$p_L = -\zeta_p \omega_{np} + \omega_{np}\sqrt{\zeta_p^2 - 1} = -0{,}16 \times \omega_{np} = -992\ r/s$$

$$p_H = -\zeta_p \omega_{np} - \omega_{np}\sqrt{\zeta_p^2 - 1} = -6{,}3 \times \omega_{np} = -39800\ r/s$$

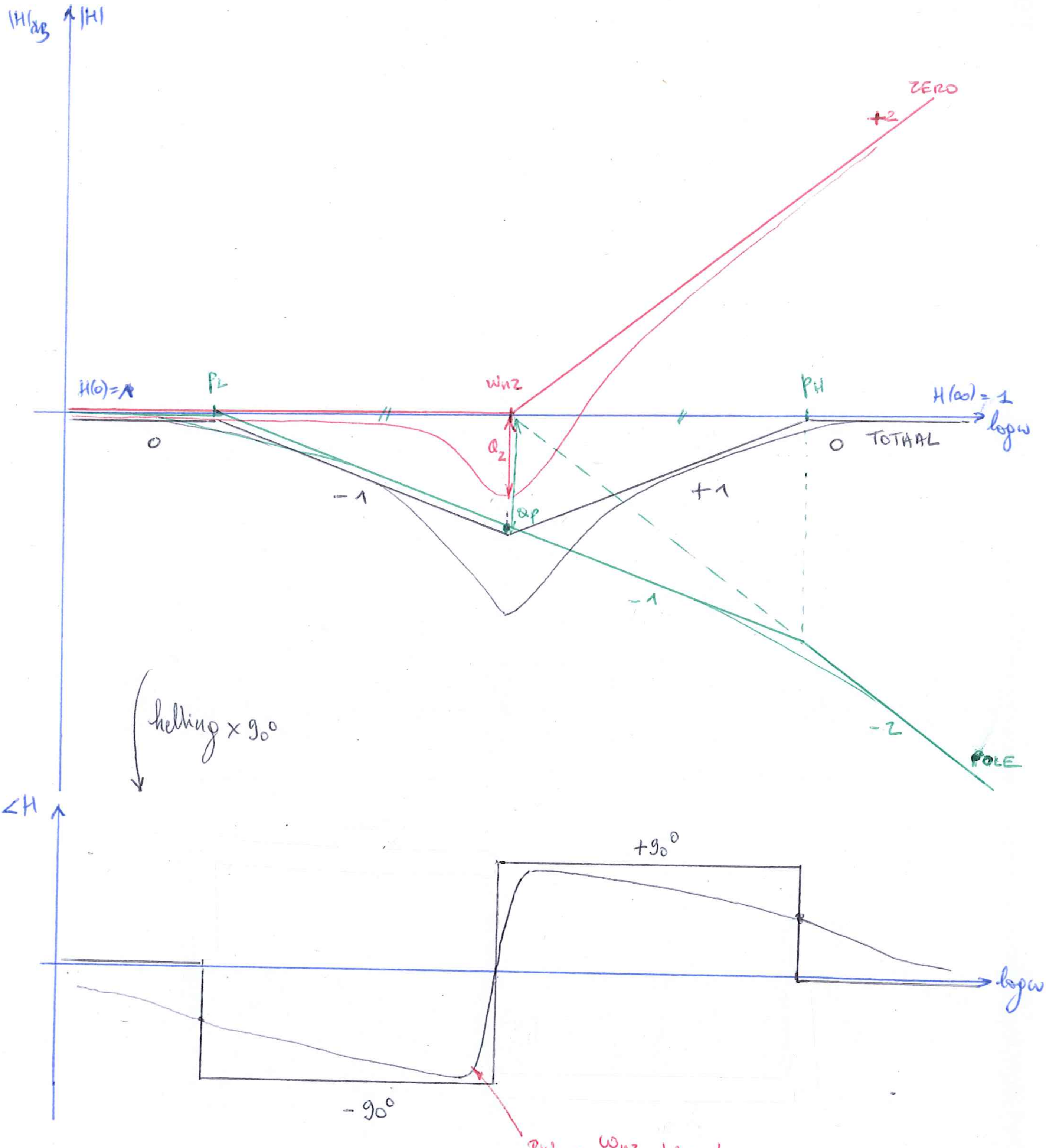
2 reële pole

$$\omega_{nz} = (\omega_{np}) = 6{,}2800\ r/s$$

$$\theta_z = \cos^{-1}(\zeta_z) = 80°$$

complex toegevoegde zero's

⑤ OVERBRUGD – T : BODE DIAGRAM



$BW_z = \dfrac{\omega_{nz}}{Q_z}$ klein !

⑥ OVERBRUGD-T : STAPRESPONSIE