

WS 22/23 Kurzlösung

A1

a) $I_B = 0 \rightarrow$ unbelasteter Spannungsteiler

$$U_E = \frac{R_2}{R_1 + R_2} \cdot U_B = \frac{1}{2} \cdot 2V = 1V$$

Basis - Collector - Diode sperrt $\rightarrow$ Normalbetrieb

b) $I_E = I_C$ da $I_{BE} = 0$

$$U_{BE} = U_E - U_A = 1V - U_A$$

$$f(U_A) = R_3 \cdot I_S \left(e^{\frac{(U_E - U_A)}{U_T}} - 1 \right) - U_A \stackrel{!}{=} 0$$

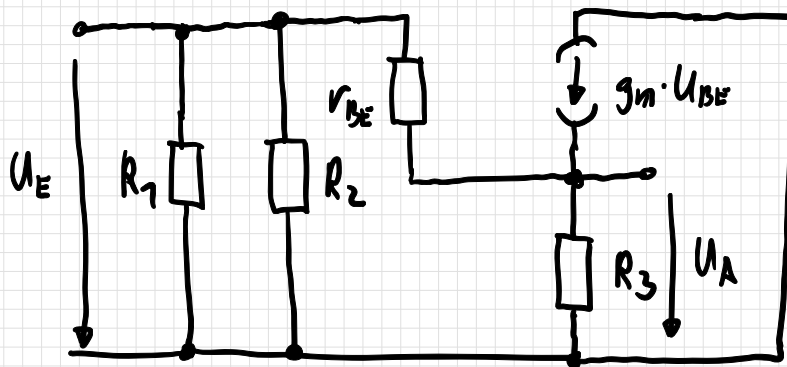
$$f'(U_A) = - \frac{R_3 I_S}{U_T} e^{\frac{(U_E - U_A)}{U_T}} - 1$$

$$U_A^{(n+1)} = U_A^{(n)} - \frac{f(U_A^{(n)})}{f'(U_A^{(n)})}$$

$$U_A^{(4)} = 0,283 V$$

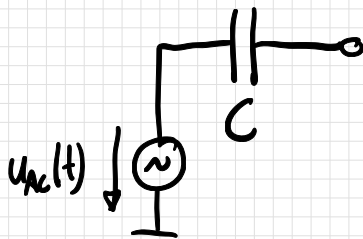
$$U_{BE} = 1V - U_A = 0,717 V$$

c) U_B kurzschließen

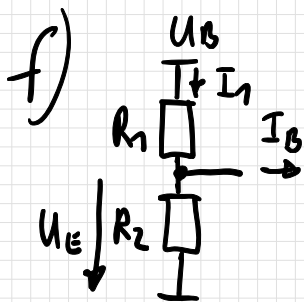


$$g_m = \frac{d I_c}{d U_{BE}} = \frac{I_s}{U_T} e^{\frac{U_{BE}}{U_T}} \approx 0,114 \frac{A}{V}$$

d) Blockkondensator notwendig



e) TR bis $n=3 \rightarrow$ Frequenzen in $u_A(t)$: $f_{AC}, 2f_{AC}, 3f_{AC}$



$$I_1 = I_B + \frac{U_B}{R} = \frac{U_B - U_E}{R}$$

$$U_E = \frac{\frac{U_B}{R_1} - \frac{I_c}{\beta}}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{U_B \cdot R_2 - I_c \cdot R_1 \cdot R_2 \cdot \frac{1}{\beta}}{R_1 + R_2}$$

$$U_A = I_E \cdot R_3 = (I_c + I_B) R_3 = I_c R_3 \left(1 + \frac{1}{\beta}\right)$$

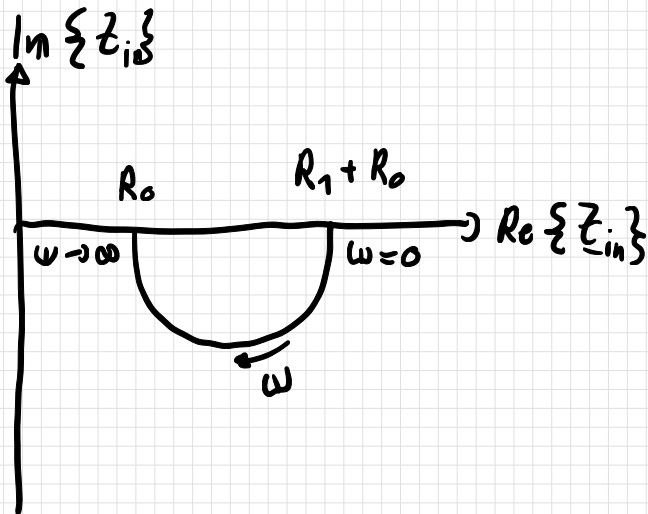
$$f(I_c) = I_s \left(e^{\left[\frac{U_B \cdot R_2 - I_c \cdot R_1 \cdot R_2 \cdot \frac{1}{\beta}}{R_1 + R_2} - I_c R_3 \left(1 + \frac{1}{\beta}\right) \right] \frac{1}{U_T}} - 1 \right) - I_c \stackrel{!}{=} 0$$

A2

$$a) [Y_a] = \begin{bmatrix} \frac{1}{R_1} + j\omega C_1 & 0 \\ g_m & \frac{1}{R_2} \end{bmatrix}$$

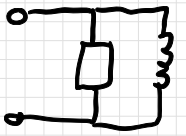
$$[A_a] = \frac{1}{g_m} \begin{bmatrix} -\frac{1}{R_2} & -1 \\ -(\frac{1}{R_1} + j\omega C_1) \frac{1}{R_2} & -\frac{1}{R_1} - j\omega C_1 \end{bmatrix}$$

$$b) Z_{in} = R_o + \frac{1}{\frac{1}{R_1} + j\omega C_1}$$



$$c) [A_b] = \frac{1}{j\omega M} \begin{bmatrix} j\omega L_1 & \overbrace{j\omega L_1 \cdot j\omega L_2 - (j\omega M)^2}^{=0 \text{ da festgekoppelt}} \\ 1 & j\omega L_2 \end{bmatrix}$$

$$d) \underline{y}_3 = \frac{\underline{A}_{b,21} \cdot R_L + \underline{A}_{b,22}}{\underline{A}_{b,11} \cdot R_L + \underline{A}_{b,12}} = \left(\frac{1}{10} - j0,159 \right) S \rightarrow$$



$$P_w = \frac{U_{eff}^2}{R} = \left(\frac{1V}{\sqrt{2}} \right)^2 \cdot \frac{1}{10} S = \frac{1}{20} W$$

$$e) [\underline{A}_{ges}] = [\underline{A}_a] \cdot [\underline{A}_i] \cdot [\underline{A}_b]$$

$$f) \underline{T} = \frac{\underline{U}_3}{\underline{U}_1} = \frac{1}{\underline{A}_{a11} \cdot \underline{A}_{a11} + \underline{A}_{a12} \cdot \underline{A}_{a21}} = \frac{1}{\underline{A}_{aa11}}$$

$$= \frac{g_m^2 \cdot R_2^2 \cdot \frac{R_1}{R_1 + R_2}}{1 + j\omega C_1 \frac{R_2 R_1}{R_1 + R_2}}$$

$$\omega = \frac{R_1 + R_2}{C_1 R_1 R_2}$$

$$f_{3dB} = \frac{R_1 + R_2}{2\pi C_1 R_1 R_2}$$

