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Parcial #3

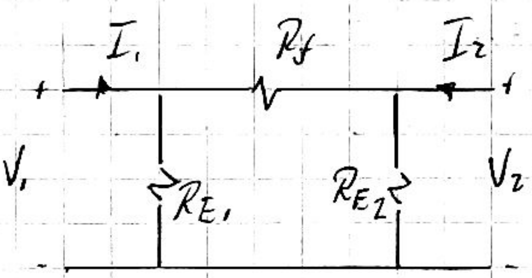
1.

- → Realimentacion de corriente (serie): i_o
- → Comparación de voltaje (serie): V_s

Amplificador serie - serie

- Parametro "z"

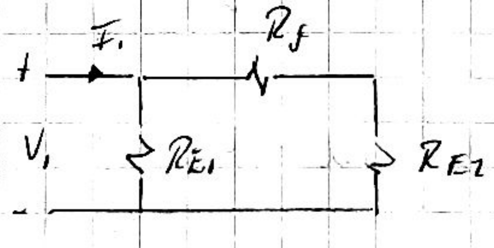
- La red de realimentacion



$$V_1 = Z_{11f} I_1 + Z_{12f} I_2$$

$$V_2 = Z_{21f} I_1 + Z_{22f} I_2$$

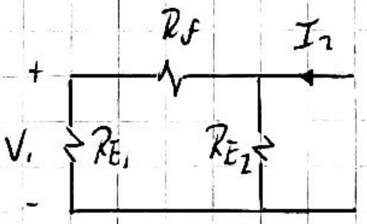
$$Z_{11f} = \frac{V_1}{I_1}\Big|_{I_2=0}$$



$$Z_{11f} = (R_f + R_{E_2}) \parallel R_{E_1}$$

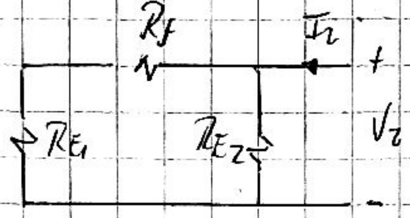
$$Z_{11f} = 42.76 \ \Omega$$

$$Z_{12f} = \frac{V_1}{I_2}\Big|_{I_1=0}$$



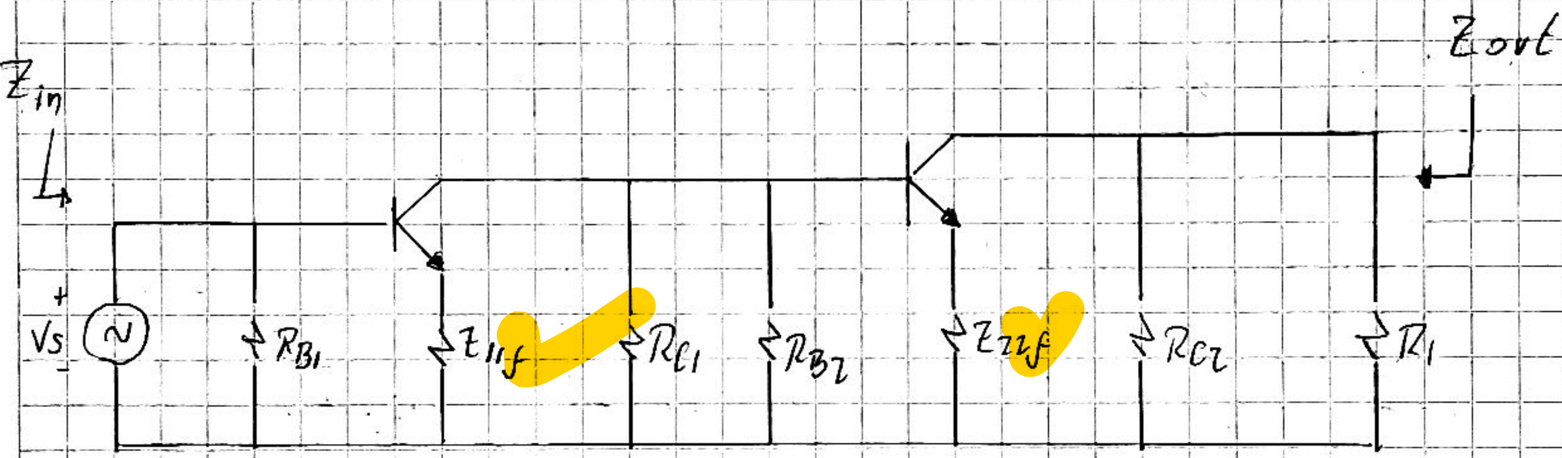
$$V_1 = \frac{I_2 R_{E_2} R_{E_1}}{R_{E_1} + R_f + R_{E_2}} \Rightarrow \frac{V_1}{I_2} = Z_{12f} = \beta = \frac{R_{E_1} \cdot R_{E_2}}{R_{E_1} + R_F + R_{E_2}} = 9.73 \ \Omega$$

$$Z_{22f} = \left.\frac{V_2}{I_2}\right|_{I_1=0}$$



$$Z_{22f} = (R_{E1} + R_f) \parallel R_{E2} = 13,8\ \Omega$$

- El amplificador sin realimentacion y efectos de carga



Nota: En DC no hay efectos de carga

- $I_{CQ_1} = \dfrac{V_{BB1} - V_{BE}}{\dfrac{R_{B1}}{\beta} + R_{E1}}$

$$V_{BB1} = \frac{V_{CC}\, R_1}{R_1 + R_2} = 1,69\ V$$

$$R_{B1} = R_1 \parallel R_2 = 16,75\ k\Omega$$

$$I_{CQ_1} = 3.30\ mA$$

- $I_{CQ_2} = \dfrac{V_{BB2} - V_{BE}}{\dfrac{R_{B2}}{\beta} + R_{E2}}$

$$V_{BB2} = \frac{V_{CC}\, R_3}{R_3 + R_4} = 0.87\ V$$

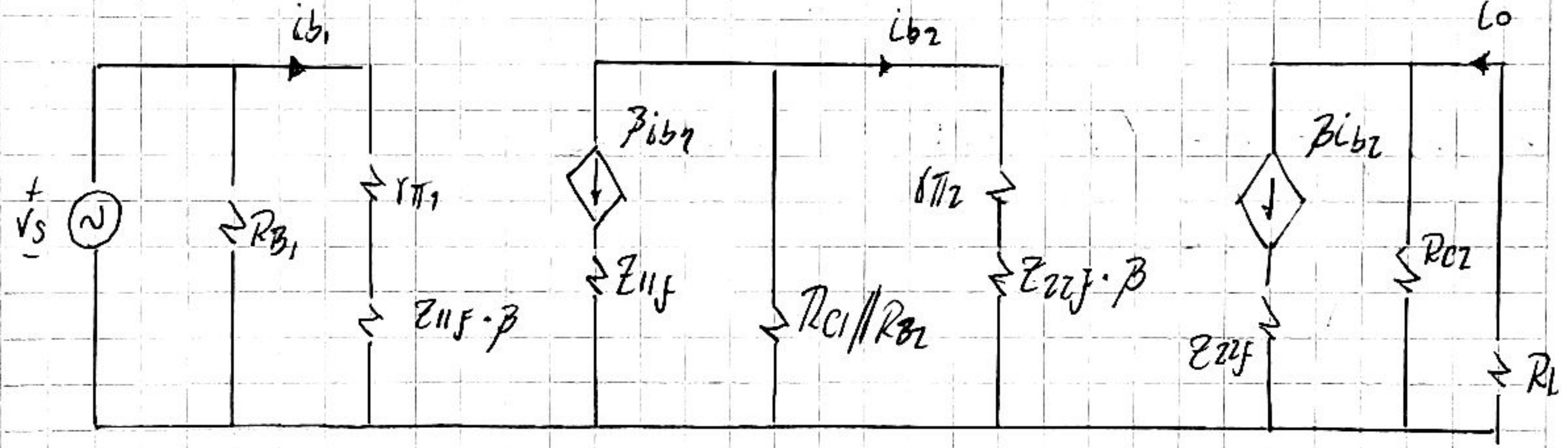
$$R_{B2} = \frac{R_4 \cdot R_3}{R_3 + R_4} = 1.87\ k\Omega$$

$$I_{CQ_2} = 5,04\ mA$$

- $r_{\pi 1} = \dfrac{\beta \, 26\,mV}{I_{CQ_1}} = 787{,}88\ \Omega$

- $r_{\pi 2} = \dfrac{\beta \, 26\,mV}{I_{CQ_2}} = 515{,}87\ \Omega$

▶ Modelo híbrido en lazo abierto



$A = \dfrac{i_o}{V_s}$

- $i_o = \dfrac{\beta \, i_{b_2} \, R_{C2}}{R_{C2} + R_L} = 50\, i_{b_2}$

- $i_{b_1} = \dfrac{i_s \, R_{B_1}}{R_{B_1} + r_{\pi_1} + (Z_{11f}\cdot\beta)} = 0.77\, i_s$

- $i_{b_2} = \dfrac{-\beta i_{b_1} \, (R_{C1} \| R_{B2})}{(R_{C1} \| R_{B2}) + r_{\pi_2} + (Z_{22f}\cdot\beta)} = -27{,}82\, i_{b_1}$

▶ $i_o = 50\,(-27{,}82\,(0.77\, i_s)) = -1071{,}07\, i_s$

▶ $V_s = i_{b_1}\,(r_{\pi_1} + (Z_{11f}\cdot\beta)) = 0.77\, i_s\,(r_{\pi_1} + (Z_{11f}\cdot\beta)) = -0.77\left(\dfrac{i_o}{1071{,}07}\right)(r_{\pi_1} + (Z_{11f}\cdot\beta))$

$A = \dfrac{i_o}{V_s} = -\dfrac{1071.07}{(0{,}77)\,(r_{\pi_1} + (Z_{11f}\,\beta))} = -0.278\ \mho$

$$A_f = \frac{A}{1+\beta A} = \frac{-0{,}278 \ \mho}{1 + (9.73\,\Omega\,(-0.278\ \mho))} = 0.162\ \mho$$

- $Z_{in} = (r_{\pi_1} + Z_{11f}\,\beta) \parallel R_{B_1} = 3852{,}87\ \Omega$
- $Z_{out} = R_{C_2} \parallel R_L = 500\ \Omega$
- $Z_{in\,f} = R_i\,(1 + \beta |A|) = 14274{,}65\ \Omega$

$R_i \to Z_{in}$, $\beta \to 9.73$

- $Z_{out\,f} = R_{out}\,(1 + \beta |A|) = 1852.47\ \Omega$

$R_{out} \to Z_{out}$, $\beta \to 9.73$

2)

a) $A(j\omega) = \dfrac{200}{\left(1 + \dfrac{j\omega}{2\times10^5}\right)^4}$

$\beta = 5$ y $\beta = 0{,}01$

$$-180 = -4\,\mathrm{Tan}^{-1}\left(\frac{\omega_{-180}}{2\cdot10^5}\right)$$

$$\mathrm{Tan}(45) = \frac{\omega_{-180}}{2\cdot10^5} \longrightarrow \omega_{-180} = 1\cdot2\cdot10^5\,\frac{rad}{s}$$

Evaluando en la función de Magnitud

$|\beta A(\omega)|$

• $\beta = 5$

$$|\beta A(\omega)| = \frac{1000}{\left(\sqrt{1+\left(\frac{2\cdot10^5}{2\cdot10^5}\right)^2}\right)^4} = \frac{1000}{\sqrt{2}^{\,4}}$$

$$= \frac{1000}{4} = 250 \;\boxed{>1 \text{ inestable}}$$

• $\beta = 0{,}01$

$$|\beta A(\omega)| = \frac{2}{4} = \frac{1}{2} \;\boxed{<1 \text{ Estable}}$$

b) β para margen de ganancia de -18 dB

$$20 \log(A) = -18$$

$$A = 10^{-18/20} = 0{,}1258$$

$$|\beta A|_{w_{180}} = 0{,}1258 \Rightarrow \frac{\beta \cdot 200}{4} = 0{,}1258$$

$$\beta = \frac{4 \cdot 0{,}1258}{200} \Rightarrow 2{,}516 \cdot 10^{-3}$$

β debe tener un valor de $2{,}516 \cdot 10^{-3}$ para tener un margen de ganancia de -18 dB