LECTURE 33 - FEEDBACK CONTINUED

Transconductance Amplifiers — Series-Series Feedback

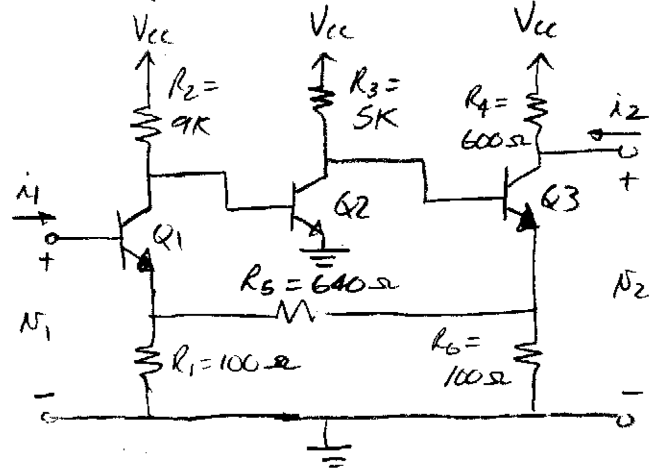
1.) Find $z_{11F} = \left.\frac{v_{1F}}{i_{1F}}\right|_{i_{2F}=0}$ (input resistance of fb. ckt. with output OC)

2.) Find $z_{22F} = \left.\frac{v_{2F}}{i_{2}}\right|_{i_{1F}=0}$ (output resistance of fb. ckt. with input OC)

3.) Find $z_{12F} = \left.\frac{v_{1F}}{i_{2F}}\right|_{i_1=0}$ (transresistance from output to input of fb. ckt. with input OC)

4.) $A = \frac{i_2}{v_1}$

Example



If $h_{fe}=100$ and $I_{C1}=0.6mA$, $I_{C2}=1mA$ and $I_{C3}=4mA$, find $\frac{v_2}{v_1}$, $\frac{v_1}{i_1}$, and $\frac{v_2}{i_2}$.

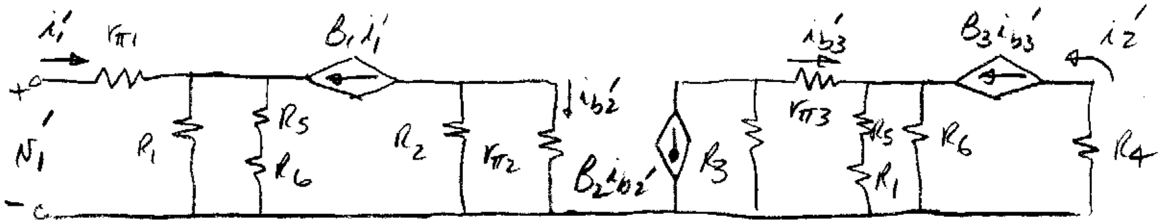
$r_{\pi1} = \frac{100 \cdot 25}{0.6} = 4.16K$, $r_{\pi2} = \frac{100 \cdot 25}{1} = 2.5K$

$r_{\pi3} = \frac{100 \cdot 25}{4} = 625\Omega$

1.) $z_{11F} = R_1 \| (R_5+R_6) = 88.1\Omega$ 2.) $z_{22F} = R_6 \| (R_1+R_5) = 88.1\Omega$

3.) $\beta = z_{12F} = \frac{R_6}{R_1+R_5+R_6} \times R_1 = 11.9\Omega$

4.)



$$A = \frac{i_2'}{v_1'} = \left(\frac{i_2'}{i_{b3}'}\right)\left(\frac{i_{b3}'}{i_{b2}'}\right)\left(\frac{i_{b2}'}{i_{b1}'}\right)\left(\frac{i_{b1}'}{v_1'}\right) = (\beta)\left(\frac{-\beta R_3}{R_3+r_{\pi3}+(1+\beta)[R_6\|(R_1+R_5)]}\right)\left(\frac{-\beta R_2}{R_2+r_{\pi2}}\right)\left(\frac{1}{r_{\pi1}+(1+\beta)[R_1\|(R_5+R_6)]}\right)$$

$$= (100)(-34.43)(-78.3)\left(\frac{1}{12.97K}\right) = 20.78 \text{ A/V}$$

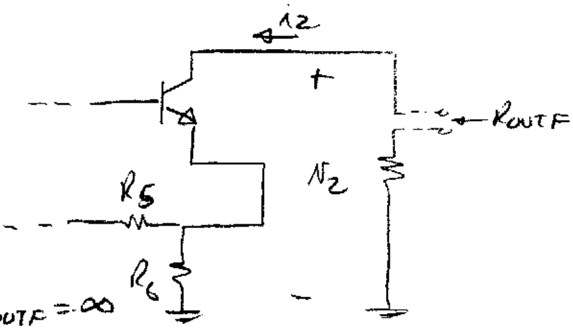
$$\therefore \frac{i_2}{v_1} = \frac{A}{1+AB} = \frac{20.78}{1+(20.78)(11.9)} = \frac{20.78}{1+247.2} = 0.0837 \text{ A/V}$$

$$\frac{v_1}{i_1} = R_{inF} = (z_{11}+R_s)(1+AB) = [r_{\pi1}+(1+\beta)(R_1\|(R_5+R_6))](248.2) = (12.97K)(248.2) = \underline{3.22M\Omega}$$

$\frac{v_2}{v_1} = \frac{i_2 R_4}{v_1} = \frac{i_2}{v_1} R_4 = \underline{50.2 \text{ V/V}}$ $\frac{v_2}{i_2} = \underline{600\Omega}$ (Not influenced by fb - outside the loop)

$$R_{OUTF} = (Z_{22T} + R_L)(1 + AB)$$

$$Z_{22T} = \left.\frac{v_2}{i_2}\right|_{i_1 = 0}$$



$i_2 = 0 \rightarrow Z_{22T} = \infty \rightarrow R_{OUTF} = \infty$

Now - $R_{out} = (R_{OUTF} - R_L) \| R_L = \infty \| R_L = R_L$