ECE 3050 Analog Electronics Quiz 10

July 22, 2009

Professor Leach Last Name:_____ First Name:_____

Instructions. Print your name in the spaces above. Place a box around any answer. Credit will not be given for any answer without full supporting work. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____

$$r_{ib} = r_x + r_\pi + (1+\beta)\,R_{te} \quad r_\pi = \frac{V_T}{I_B} \quad r_{ie} = r'_e = \frac{R_{tb}+r_x}{1+\beta} + r_e \quad r_e = \frac{V_T}{I_E} \quad r_{ic} = \frac{r_0 + r'_e \| R_{te}}{1 - \dfrac{\alpha R_{te}}{r'_e + R_{te}}} \quad r_0 = \frac{V_A + V_{CE}}{I_C}$$

A CE amplifier is shown. It is given that $R_1 = 100\,\text{k}\Omega$, $R_2 = 120\,\text{k}\Omega$, $R_C = 5.1\,\text{k}\Omega$, $R_E = 6.8\,\text{k}\Omega$, $R_s = 3\,\text{k}\Omega$, $R_L = 15\,\text{k}\Omega$, $V^+ = 15\,\text{V}$, $V^- = -15\,\text{V}$, $V_{BE} = 0.65\,\text{V}$, $V_T = 25\,\text{mV}$, $\beta = 99$, $\alpha = 0.99$, $r_x = 50\,\Omega$, $V_A = \infty$, $R_3 = 120\,\Omega$, $C_1 = 0.15\,\mu\text{F}$, $C_2 = 2.2\,\mu\text{F}$, $C_3 = 120\,\mu\text{F}$, and $I_C = 2.53\,\text{mA}$.

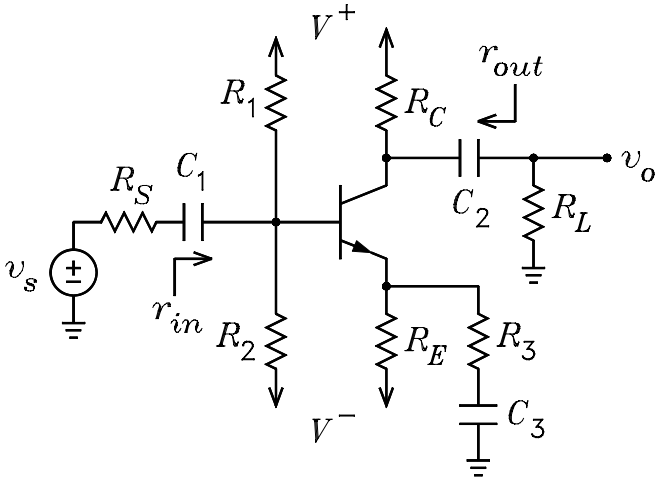
(a) Solve for the worst case pole frequency set by C_1.

(b) Solve for the worst case pole frequency set by C_2.

(c) Solve for the worst case pole and zero frequencies set by C_3.

(d) Solve for the worst case lower cutoff frequency in Hz using the equation $f_L = \sqrt{\Sigma p_{pole}^2 - 2\Sigma f_{zero}^2}$

(e) Which capacitor dominates in setting f_L?



$r_{ib} := r_x + r_\pi + (1+\beta)\cdot R_{te}$ $\quad r_{ib} = 1.301\cdot 10^4$

$r_{in} := R_{p2}\left(r_{ib}, R_{p2}\left(R_1, R_2\right)\right)$ $\quad r_{in} = 1.05\cdot 10^4$

$\tau_1 := \left(R_S + r_{in}\right)\cdot C_1$ $\quad \tau_1 = 2.026\cdot 10^{-3}$ $\quad f_1 := \dfrac{1}{2\cdot\pi\cdot\tau_1}$ $\quad f_1 = 78.567$

$\tau_2 := \left(R_C + R_L\right)\cdot C_2$ $\quad \tau_2 = 0.044$ $\quad f_2 := \dfrac{1}{2\cdot\pi\cdot\tau_2}$ $\quad f_2 = 3.599$

$\tau_{3p} := \left(R_{p2}\left(R_E, r'_e\right) + R_3\right)\cdot C_3$ $\quad \tau_{3p} = 0.019$ $\quad f_{3p} := \dfrac{1}{2\cdot\pi\cdot\tau_{3p}}$ $\quad f_{3p} = 8.27$

$\tau_{3z} := \left(R_E + R_3\right)\cdot C_3$ $\quad \tau_{3z} = 0.83$ $\quad f_{3z} := \dfrac{1}{2\cdot\pi\cdot\tau_{3z}}$ $\quad f_{3z} = 0.192$

$$f_L := \sqrt{f_1^2 + f_2^2 + f_{3p}^2 - 2 \cdot f_{3z}^2} \qquad f_L = 79.082$$