ECE 3050 Analog Electronics Quiz 2

May 27, 2009

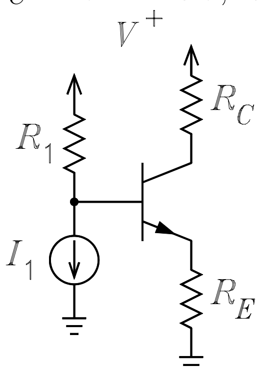
Professor Leach Last Name:________________ First Name:________________

Instructions. Print your name in the spaces above. Place a box around any answer. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials ________

$$i'_c = g_m v_\pi = \beta i_b = \alpha i'_e \qquad g_m = \frac{I_C}{V_T} \qquad \beta = g_m r_\pi \qquad a = \frac{\beta}{1+\beta}$$

$$r_\pi = \frac{V_T}{I_B} \qquad r_e = \frac{V_T}{I_E} \qquad r'_e = \frac{R_{tb} + r_x}{1+\beta} + r_e \qquad I_C = \beta I_B = \alpha I_E$$

1 of 2. Replace the circuit seen looking out of the base with a Thévenin equivalent and solve for the collector current I_C for $V^+ = 15\,\text{V}$, $R_1 = 4\,\text{k}\Omega$, $I_1 = 3\,\text{mA}$, $R_C = 1.2\,\text{k}\Omega$, $R_E = 1.1\,\text{k}\Omega$, $V_{BE} = 0.65\,\text{V}$, and $\beta = 49$.



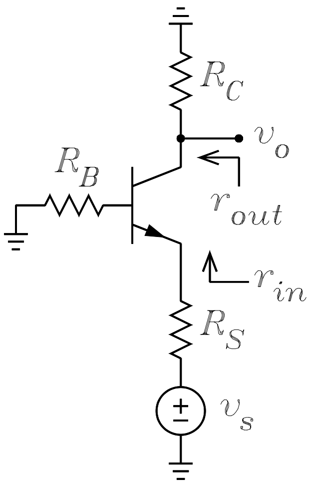
$V_p := 15 \qquad R_1 := 4000 \qquad R_E := 1100 \qquad R_C := 1200 \qquad V_{BE} := 0.65 \qquad \beta := 49$

$I_1 := 0.003 \qquad \alpha := \frac{\beta}{1+\beta} \qquad \alpha = 0.98$

$$I_C := \frac{(V_p - I_1 \cdot R_1) - V_{BE}}{\frac{R_1}{\beta} + \frac{R_E}{\alpha}} \qquad I_C = 1.952 \cdot 10^{-3}$$

$$V_{CB} := (V_p - I_C \cdot R_C) - \left(\frac{I_C}{\alpha} \cdot R_E + V_{BE}\right) \qquad V_{CB} = 9.817$$

2 of 2. For the ac signal circuit circuit shown, use the simplified T model to solve for $A_v = v_o/v_s$, r_{in}, and r_{out} for $R_S = 75\,\Omega$, $R_B = 100\,\Omega$, $R_C = 12\,\mathrm{k}\Omega$, $I_E = 1\,\mathrm{mA}$, $r_x = 50\,\Omega$, $\alpha = 0.99$, $r_0 = \infty$, and $V_T = 0.025\,\mathrm{V}$.



$R_S := 75$ $\quad R_B := 100$ $\quad R_C := 12000$ $\quad I_E := 0.001$ $\quad r_x := 50$ $\quad V_T := 0.025$

$\alpha := 0.99$ $\quad \beta := \dfrac{\alpha}{1-\alpha}$ $\quad \beta = 99$

$r_e := \dfrac{V_T}{I_E}$ $\quad r_e = 25$ $\quad r'_e := \dfrac{R_B + r_x}{1+\beta} + r_e$ $\quad r'_e = 26.5$

$v_s := 1$ $\quad i'_e := \dfrac{-v_s}{R_S + r'_e}$ $\quad i'_e = -9.852 \cdot 10^{-3}$ $\quad i'_c := \alpha \cdot i'_e$ $\quad i'_c = -9.754 \cdot 10^{-3}$

$v_o := -i'_c \cdot R_C$ $\quad v_o = 117.044$ This is the voltage gain $\dfrac{v_o}{v_s}$.

$r_{in} := r'_e$ $\quad r_{in} = 26.5$ $\quad r_{out} := R_C$ $\quad r_{out} = 1.2 \cdot 10^4$