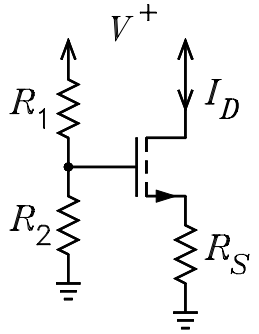
ECE 3050 Analog Electronics Quiz 3

September 9, 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 _____

1 of 2. For $V^+ = +24\,\text{V}$, $R_1 = 1\,\text{M}\Omega$, $R_2 = 1.5\,\text{M}\Omega$, $K = 4\times10^{-4}\,\text{S}$, and $V_{TO} = 1.5\,\text{V}$, solve for R_S for $I_D = 2.5\,\text{mA}$. Reference equation: $i_D = K\left(v_{GS} - V_{TO}\right)^2$.



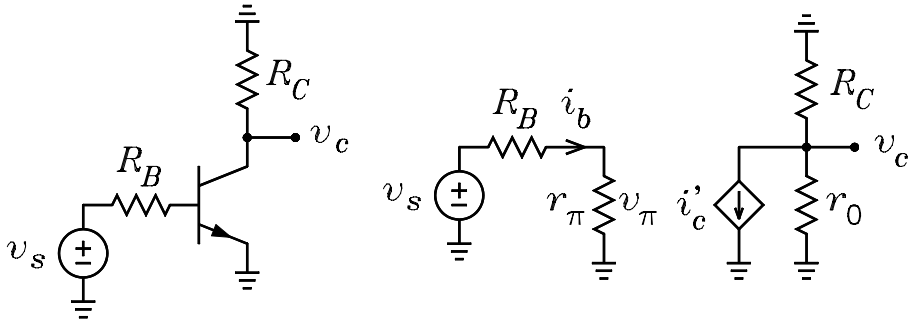
$V_p := 24$ $R_1 := 1000000$ $R_2 := 1500000$ $K := 4\cdot10^{-4}$ $V_{TO} := 1.5$ $I_D := 0.0025$

$V_{GG} := V_p\cdot\frac{R_2}{R_1+R_2}$ $R_{GG} := R_{p2}\left(R_1, R_2\right)$ $V_{GG} = 14.4$ $R_{GG} = 6\cdot10^5$

$V_{GS} := \sqrt{\frac{I_D}{K}} + V_{TO}$ $V_{GS} = 4$

$V_{GG} = V_{GS} + I_D\cdot R_S$ $R_S := \frac{V_{GG} - V_{GS}}{I_D}$ $R_S = 4.16\cdot10^3$

2 of 2. The circuit on the left is the signal circuit for a CE amplifier. The two circuits on the right show the hybrid-π model for the circuit. For $R_B = 2.2\,\text{k}\Omega$, $R_C = 10\,\text{k}\Omega$, $I_C = 1.5\,\text{mA}$, and $V_{CE} = 10\,\text{V}$, solve for the voltage gain $A_v = v_c/v_s$. For the transistor, assume $\beta = 100$, $V_A = 75$, and $V_T = 25\,\text{mV}$. Reference equations: $i_c' = g_m v_\pi = \beta i_b = \alpha i_e'$, $r_\pi = V_T/I_B$, $g_m = I_C/V_T$, $I_C = \beta I_B$, $r_0 = \left(V_A + V_{CE}\right)/I_C$.



$R_B := 2200 \qquad R_C := 10000 \qquad I_C := 0.0015 \qquad V_{CE} := 10 \qquad \beta := 100 \qquad V_T := 0.025$

$I_B := \frac{I_C}{\beta} \qquad I_B = 1.5 \cdot 10^{-5} \qquad g_m := \frac{I_C}{V_T} \qquad g_m = 0.06 \qquad V_A := 75$

$r_\pi := \frac{V_T}{I_B} \qquad r_\pi = 1.667 \cdot 10^{3} \qquad r_0 := \frac{V_A + V_{CE}}{I_C} \qquad r_0 = 5.667 \cdot 10^{4} \qquad v_s := 1$

$i'_c := v_s \cdot \frac{r_\pi}{R_B + r_\pi} \cdot g_m \qquad i'_c = 0.026 \qquad v_{o1} := -i'_c \cdot R_{p2}\left(R_C, r_0\right) \qquad v_{o1} = -219.828$

$i_b := \frac{i'_c}{\beta} \qquad i_b = 2.586 \cdot 10^{-4} \qquad v_{o2} := -\beta \cdot i_b \cdot R_{p2}\left(R_C, r_0\right) \qquad v_{o2} = -219.828$