ECE 3050 Analog Electronics Quiz 2

September 2, 2009

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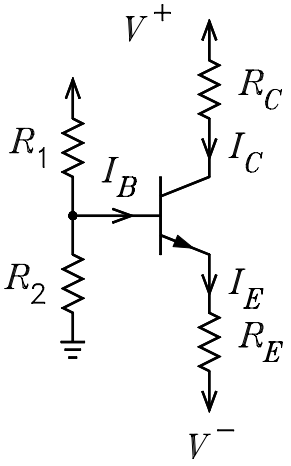
Instructions. Print your name in the spaces above. Place a box around any answer. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____

1 of 2. Given $V^+ = 22\,\text{V}$, $V^- = -15\,\text{V}$, $R_1 = 220\,\text{k}\Omega$, $R_2 = 22\,\text{k}\Omega$, $R_C = 12\,\text{k}\Omega$, $\alpha = 0.99$, $\beta = 99$, and $V_{BE} = 0.65\,\text{V}$.
(a) Solve for R_E for $I_C = 1.3\,\text{mA}$.
(b) Verify that the BJT is biased in its active mode.



$V_p := 22$ $V_n := -15$ $R_1 := 220000$ $R_2 := 22000$ $R_C := 12000$

$\alpha := 0.99$ $\beta := 99$ $V_{BE} := 0.65$ $I_C := 0.0013$

$V_{BB} := V_p \cdot \frac{R_2}{R_1 + R_2}$ $R_{BB} := R_{p2}(R_1, R_2)$ $V_{BB} = 2$ $R_{BB} = 2 \cdot 10^4$

$$V_{BB} - V_n = \frac{I_C}{\beta} \cdot R_{BB} + V_{BE} + \frac{I_E}{\alpha} \cdot R_E$$

$$R_E := \frac{V_{BB} - V_n - \frac{I_C}{\beta} \cdot R_{BB} - V_{BE}}{\frac{I_C}{\alpha}} \qquad R_E = 1.225 \cdot 10^4$$

$$V_{CB} := \left(V_p - I_C \cdot R_C\right) - \left(V_n + \frac{I_C}{\alpha} \cdot R_E\right) \qquad V_{CB} = 5.313$$

2 of 2. (a) The MOSFET drain current is given by $i_D = K\,(v_{GS} - V_{TO})^2$. If you are given i_D, there are two solutions to the equation for v_{GS}. What determines the correct one? [The solution for which $v_{GS} > V_{TO}$.]
(b) The gate-source loop bias equation for the MOSFET is $V_{GG} - V_{SS} = V_{GS} + I_D R_{SS}$. When it is used with the equation in part (a), show that this equation leads to a quadratic equation that must be solved for I_D. You do not have to solve the quadratic equation.

$$I_D R_{SS} + \frac{1}{\sqrt{K}} \sqrt{I_C} - (V_{GG} - V_{SS} - V_{TO}) = 0$$