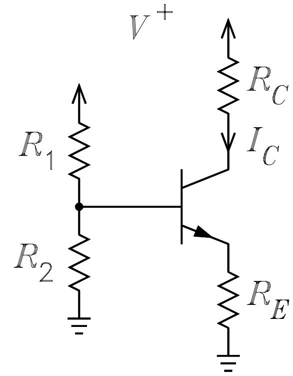
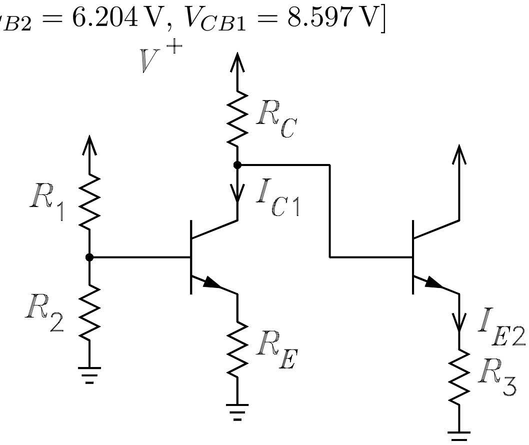
ECE3050 Homework Set 3

1. (a)Write the bias equation and solve for I_C and V_{CB} for the values $V^+ = 18\,\text{V}$, $R_E = 1\,\text{k}\Omega$, $R_1 = 130\,\text{k}\Omega$, $R_2 = 36\,\text{k}\Omega$, $R_C = 2.4\,\text{k}\Omega$, $V_{BE} = 0.7\,\text{V}$, and $\beta = 99$. (b) Is the BJT biased in the active mode? [$I_C = 2.474\,\text{mA}$, $V_{CB} = 8.863\,\text{V}$]



2. Add a second npn transistor to the circuit of problem 1 as shown below. (a) Show that I_{C1} does not change. (b) Show that $V_{BB2} = V^+ - I_{C1}R_C$ and $R_{BB2} = R_C$. (c) For $R_3 = 1\,\text{k}\Omega$, and the same V_{BE} and β as in problem 1, write the bias equation for the second transistor and solve for I_{E2}. (c) Solve for V_{CB} for both transistors and verify they are in the active mode. [$I_{E2} = 11.10\,\text{mA}$, $V_{CB2} = 6.204\,\text{V}$, $V_{CB1} = 8.597\,\text{V}$]

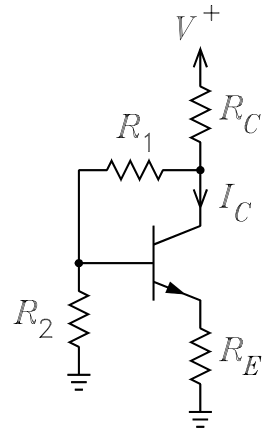


3. (a) Show that

$$V_{BB} = V^+ \frac{R_2}{R_1 + R_2 + R_C} - I_C \frac{R_C}{R_C + R_1 + R_2} \times R_2 \qquad R_{BB} = (R_1 + R_C) \| R_2$$

$$V_{CC} = V^+ \frac{R_1 + R_2}{R_C + R_1 + R_2} - I_B \frac{R_2}{R_C + R_1 + R_2} \times R_C \qquad R_{CC} = R_C \| (R_1 + R_2)$$

(b) For $\beta = 99$ and $\beta = \infty$ and $R_1 = 10\,\text{k}\Omega$, $R_2 = 47\,\text{k}\Omega$, $R_C = 1.5\,\text{k}\Omega$, $R_E = 2\,\text{k}\Omega$, $V_{BE} = 0.7\,\text{V}$, and $V^+ = 9\,\text{V}$, write the bias equation and solve for I_C and V_{CB}. Verify that the BJT is biased in the active mode. [$\beta = 99$: $I_C = 1.968\,\text{mA}$ and $V_{CB} = 1.194\,\text{V}$, $\beta = \infty$: $I_C = 2.025\,\text{mA}$, $V_{CB} = 1.019\,\text{V}$]


V^+
R_C
R_1
I_C
R_2
R_E