ECE3050 Homework Set 7

1. For the CE amplifier shown, let $R_S = 1\,\text{k}\Omega$, $R_1 = 300\,\text{k}\Omega$, $R_2 = 150\,\text{k}\Omega$, $R_3 = 50\,\Omega$, $R_C = 4.3\,\text{k}\Omega$, $R_E = 5.6\,\text{k}\Omega$, $R_L = 20\,\text{k}\Omega$, $V^+ = 15\,\text{V}$, $V^- = -15\,\text{V}$, $V_{BE} = 0.65\,\text{V}$, $\beta = 99$, $r_x = 20\,\Omega$, $r_0 = 50\,\text{k}\Omega$, and $V_T = 25\,\text{mV}$.

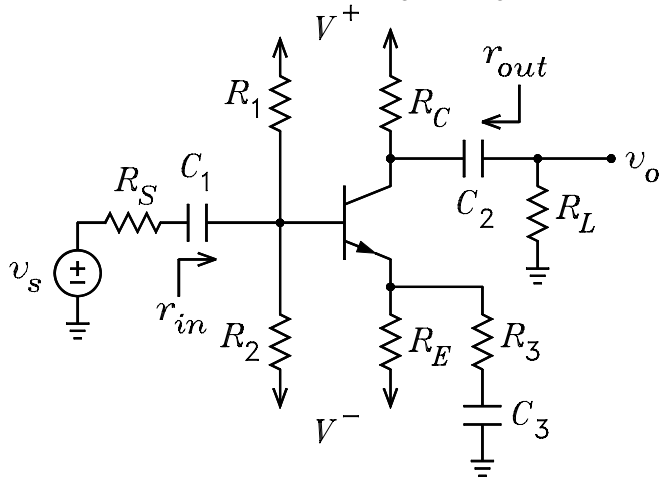
   (a) Show that $I_E = 1.417\,\text{mA}$ and $V_{CB} = 15.386\,\text{V}$.

   (b) Use the r_0 approximations to show that $v_o/v_s = -43.74$, $r_{out} = 4.169\,\text{k}\Omega$, and $r_{in} = 6.315\,\text{k}\Omega$.

   (c) Show that the clipping levels are $v_O^+ = 4.964\,\text{V}$ and $v_O^- = -15.62\,\text{V}$.

   (d) Show that the emitter current which results in symmetrical clipping is $I_E = 2.222\,\text{mA}$.

   (e) Show that the clipping levels for $I_E = 2.222\,\text{mA}$ are $v_O^+ = -v_O^- = 7.786\,\text{V}$.



2. For the CC amplifier example shown, let $R_s = 1\,\text{k}\Omega$, $R_1 = 300\,\text{k}\Omega$, $R_2 = 150\,\text{k}\Omega$, $R_E = 5.6\,\text{k}\Omega$, $R_L = 1\,\text{k}\Omega$, $V^+ = 15\,\text{V}$, $V^- = -15\,\text{V}$, $V_{BE} = 0.65\,\text{V}$, $\beta = 99$, $r_x = 20\,\Omega$, $r_0 = 50\,\text{k}\Omega$, $V_{CEsat} = 0.2\,\text{V}$, and $V_T = 25\,\text{mV}$. In the ac signal circuit, combine r_0 in parallel with R_E from the emitter to ground. This can be done because $R_{tc} = 0$, which puts r_0 in parallel with R_E.

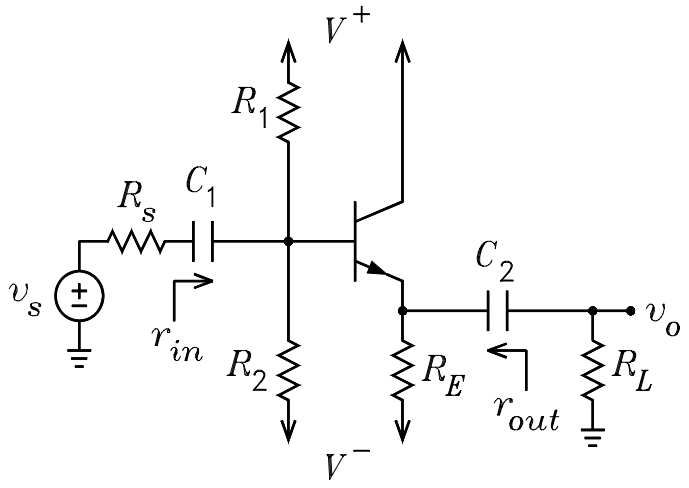
   (a) Show that $I_E = 1.417\,\text{mA}$, $V_{CB} = 21.417\,\text{V}$.

   (b) Show that $v_o/v_s = 0.958$, $r_{out} = 27.596\,\Omega$, and $r_{in} = 46.01\,\text{k}\Omega$.

   (c) Show that the clipping levels are $v_O^+ = 3.31\,\text{V}$ and $v_O^- = -1.20\,\text{V}$.

   (d) Show that the emitter current which results in symmetrical clipping is $I_E = 2.661\,\text{mA}$.

   (e) Show that the clipping levels for $I_E = 2.661\,\text{mA}$ are $v_O^+ = -v_O^- = 2.257\,\text{V}$.



3. For the CB amplifier shown, let $R_s = 50\,\Omega$, $R_1 = 300\,\text{k}\Omega$, $R_2 = 150\,\text{k}\Omega$, $R_C = 4.3\,\text{k}\Omega$, $R_E = 5.6\,\text{k}\Omega$, $R_L = 20\,\text{k}\Omega$, $V^+ = 15\,\text{V}$, $V^- = -15\,\text{V}$, $V_{BE} = 0.65\,\text{V}$, $\beta = 99$, $r_x = 20\,\Omega$, $r_0 = 50\,\text{k}\Omega$, and $V_T = 25\,\text{mV}$.

   (a) Show that $I_E = 1.417\,\text{mA}$ and $V_{CB} = 15.386\,\text{V}$.

   (b) Use the r_0 approximations to show that $v_o/v_s = 50.552$, $r_{out} = 4.202\,\text{k}\Omega$, and $r_{in} = 17.79\,\Omega$.