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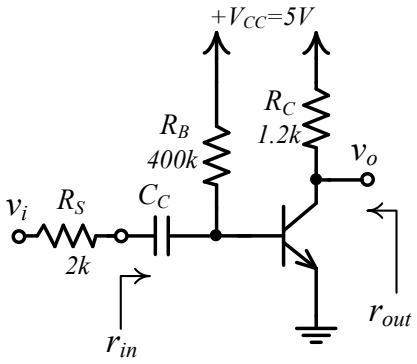
Student ID:

EHB222E Introduction to Electronics
Homework 3

Deadline: 04/05/2015 (before the lecture)



Common-emitter amplifier

1. **CALCULATION:** Consider the amplifier shown above. Use the following parameters for your calculations.
   Transistor parameters : β=200, V_{BE}=0.7V, V_T=25mV, V_A=100V

   a. Find $\boldsymbol{V_B}$ and $\boldsymbol{V_C}$ of the transistor by performing DC analysis.
   b. Find small signal resistances $\boldsymbol{r_{in}}$ and $\boldsymbol{r_{out}}$ as well as the small signal voltage gain $\boldsymbol{v_o/v_i}$ by performing small signal analysis.
   c. Construct a linear model for the amplifier by using the values obtained in 1(b). The model should consist of $\boldsymbol{R_S}$, $\boldsymbol{r_{in}}$, $\boldsymbol{r_{out}}$, and a **controlled voltage source**.
   d. Determine the minimum value of $\boldsymbol{R_L}$ (load resistance connected to the output) such that $\boldsymbol{v_o/v_i}$ does not drop below **90%** of the gain achieved without $\boldsymbol{R_L}$.

2. **SIMULATION:** Construct the above circuit using SPICE. Coupling capacitor C_C should take a high value; you can select 1mF. Use Philips 2N2222 model for the transistor.

   a. Find $\boldsymbol{V_B}$ and $\boldsymbol{V_C}$ of the transistor by performing bias point (DC operating point) analysis in SPICE. Compare the results with those calculated in part **1(a).** Do they match well? Justify your answer.
   b. Find small signal resistances $\boldsymbol{r_{in}}$ and $\boldsymbol{r_{out}}$ as well as the small signal voltage gain $\boldsymbol{v_o/v_i}$ by performing transient analysis in SPICE. Use a sine signal with 1mV peak-to-peak amplitude and 1kHz frequency as a small signal voltage source. Compare the results with those calculated in part **1(b).** Do they match well? Justify your answer.
      - Hint: calculate $\boldsymbol{r_{in}}$, $\boldsymbol{r_{out}}$, and $\boldsymbol{v_o/v_i}$ as a ratio of the corresponding sine signals' amplitudes.

Grading: 1(a)10%, 1(b)20%, 1(c)15%, 1(d)15 %, 2(a)10, 2(b)30%

Note: *Do not forget to attach SPICE* ***output file*** *prints to your homework!*