bjt_ce_amp_2.sqproj

Description

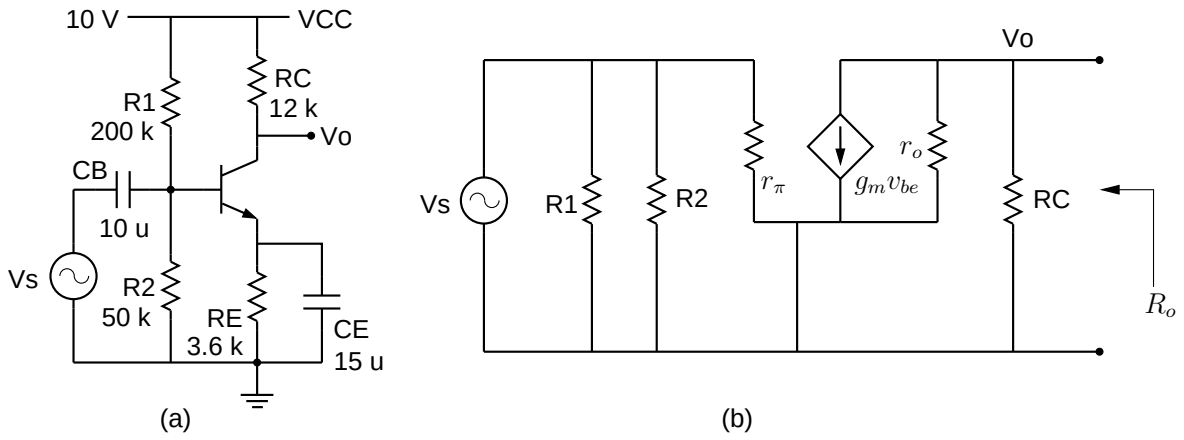

Figure 1: (a) BJT common-emitter amplifier, (b) small-signal equivalent circuit.

The purpose of this exercise it to find the output resistance of a common-emitter amplifier shown in Fig. 1 (a) in the mid-band frequency regime. The small-signal equivalent circuit of the amplifier is shown in Fig. 1 (b). If the output resistance of the BJT r_o is large, $R_o \approx R_C$. Our goal is to verify this by simulation.

The small-signal circuit of the amplifier can be represented by that shown inside the dashed rectangle in Fig. 2. Let us connect a load resistance R_L at the output. The output voltage is,

$$v_o = A_V \, v_s \, \frac{R_L}{R_o + R_L} \, . \tag{1}$$

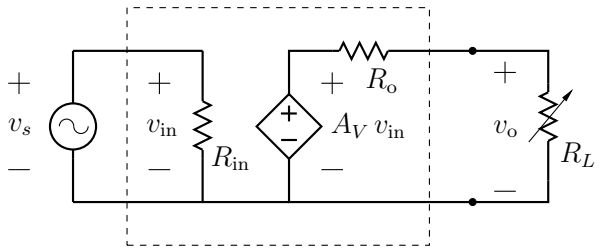

Figure 2: Equivalent representation of the circuit in Fig. 1 (b).

If $R_L \to \infty$, $v_o \to A_V \, v_s$, and if $R_L = R_o$, $v_o = A_V \, v_s/2$. This gives us the following procedure for finding R_o:

1. Vary R_L from ∞ (or a sufficiently large value) to a small value (say, 10 times smaller than the expected value of R_o), and plot $|\mathbf{V}_o|$ versus $\log R_L$.

2. Denote the maximum value of $|\mathbf{V}_o|$ by V_m. From the plot, find R_L for which $|\mathbf{V}_o|$ is $V_m/2$. The resistance thus obtained is the same as R_o.

Exercise Set

1. Perform DC simulation of the amplifier.

2. Obtain the gain versus frequency response of the amplifier, and find the midband range.

3. Set the frequency in the midband range. Obtain R_o by simulation, as described above, and compare it with its expected value.