ASSIGNMENT 1

EEE241 ANALOG I, 2010/2011

(1)

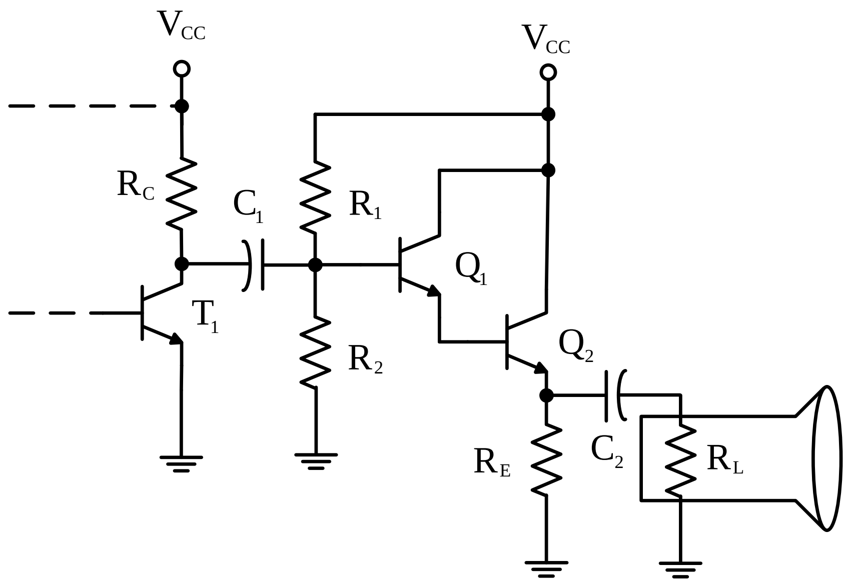

Figure 1

The emitter follower is often used as an interface between a circuit with a high output resistance and a low resistance load. In such an application, the emitter follower is called a buffer.

For example, suppose a common-emitter amplifier with a 1kΩ collector resistance (output resistance) must drive a low resistance load such as an 8Ω low power speaker. The circuit is shown in Figure 1. C1 and C2 are coupling capacitors. V_{CC} = 12 V, V_T = 26 mV and V_{BE} = 0.7 V . Assume that g_m=0.2S and $r_o >> R_C$ for the CE circuit. For the Darlington emitter-follower, R_1 = 10 kΩ, R_2 = 22 kΩ, R_E = 22 Ω, R_L = 8 Ω, and $\beta_{DC} = \beta_{ac} =$ 100 for each transistor.

Problem:

a. Calculate the open-circuit voltage gain of the CE circuit.
b. Calculate the voltage gain of the CE circuit if it is directly connected to the 8Ω speaker (no Darlington emitter-follower included).
c. Give comments based on the results of 1 and 2.
d. Calculate the voltage gain of the Darlington emitter-follower circuit.
e. Calculate the voltage gain of the whole circuit in Figure 1.

(2) (a) A cascode circuit is shown in Figure 2. What is the minimum value of V_{BIAS} required for a cascode amplifier operating at I=100µA? Let $\mu_n C_{ox} = 300\ \mu A/V^2$, $\frac{W}{L} = 10$ and $V_t = 0.6\,V$.

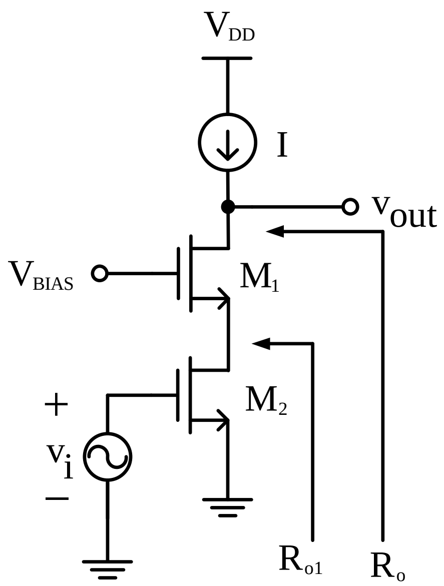

Figure 2

(b) Consider the same cascode amplifier shown in Figure 2.

I = 100μA and for each transistor, $\frac{W}{L}=\frac{5\mu m}{0.5\mu m}=10$, V_A = 10V, and $\mu_n C_{ox}=190\mu A/V^2$.
Find R_{O1} and R_O.

(3) Determine the small-signal voltage gain of the multistage cascade circuit shown in Figure 3. The transistor parameters are $K_1 = 0.5$ mA/V^2, $K_2 = 0.2$ mA/V^2, $V_{t1} = V_{t2} = 1.2$ V and $\lambda_1 = \lambda_2 = 0$. $K_n = \frac{\mu_n C_{ox}}{2}\frac{W}{L}$.

Neglect r_o. The quiescent drain currents are $I_{D1} = 0.2$ mA and $I_{D2} = 0.5$ mA.

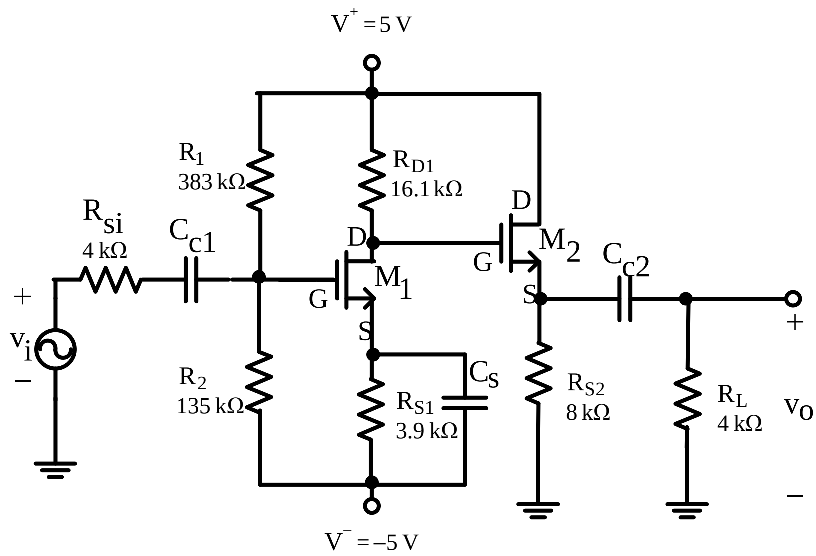

Figure 3