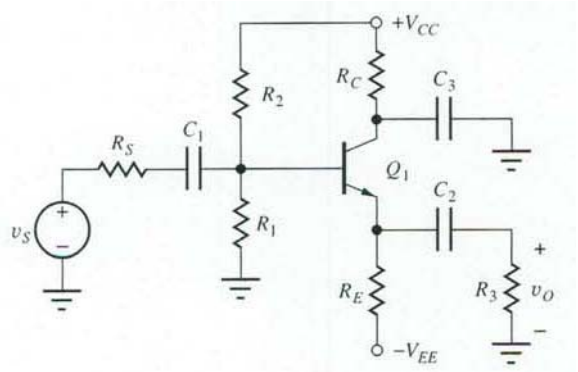
PROBLEM SET #2

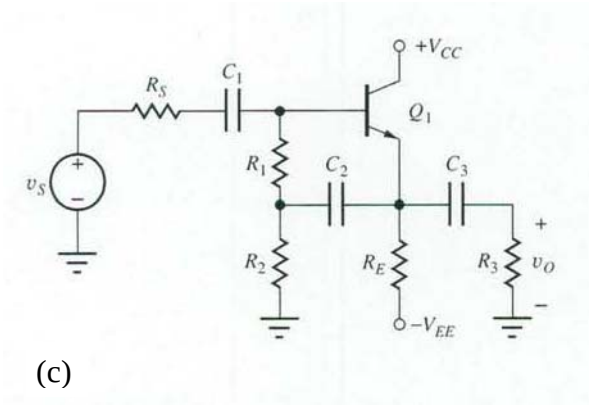
Issued: Tuesday, Feb.3, 2009

Due: Tuesday, Feb.10, 2009, 6:00 p.m. in the EE 140 homework box in 240 Cory

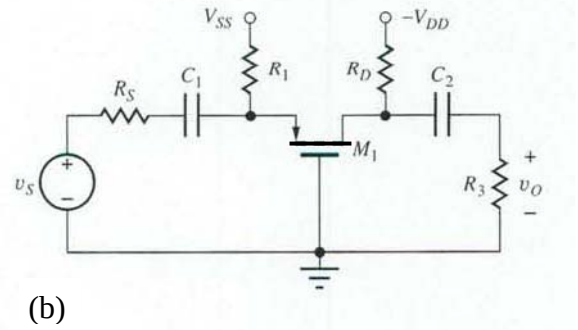
1. Use inspection analysis to write expressions for the input resistance R_i, output resistance R_o, and gain v_o/v_S for each of the amplifiers below. The expressions should be in terms of the given elements and parameters of the small-signal equivalent circuits (i.e., g_m, r_p, r_o, β, etc.) for the transistors used. For each circuit, assume that all capacitors shown have infinite values.



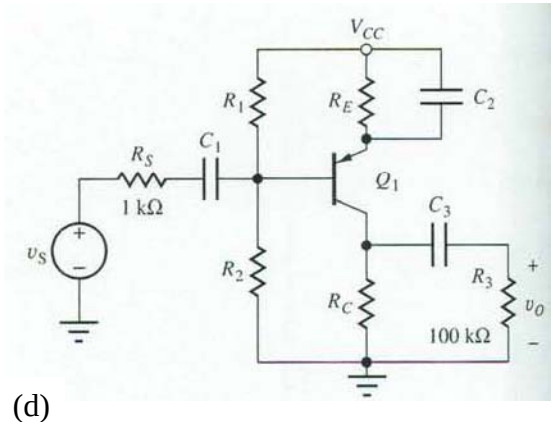
(a)



(c)



(b)



(d)

Fig. PS2.1

2. Calculate numerical values for the input resistance R_i, output resistance R_o, gain v_o/v_S, and maximum amplitude of the signal source that still provides linear operation, for the circuit in Fig. PS2.1(d) if R_1 = 20kΩ, R_2 = 62kΩ, R_E = 3.9kΩ, R_c = 8.2kΩ, and V_{CC} = 12V. Use β = 75 and an Early voltage V_A = 60V.

3. Determine expressions for the small-signal input resistance, output resistance, and gain, for each of the circuits in Razavi, Fig. 3.67, except for (b). Use inspection analysis where possible, but resort to the full small-signal model if you deem it necessary.

4. For the Darlington emitter follower of Fig. PS2.2.

(a) Determine the dc collector currents in Q_1 and Q_2, and then the small-signal input resistance and voltage gain. Neglect r_μ, r_b and r_o, and assume that $V_{BE}(on)$ = 0.7V, β=200, V_T=26mV(300k). Use inspection analysis wherever possible.

(b) Determine the -3dB corner frequency (f_H) of the gain using open circuit time-constant methods. Assume $V_{BE}(on)$ = 0.7V, β=200, V_T=26mV(300k), f_T=500MHz at I_C=1mA, C_μ=0.4pF, C_{je}=2pF, C_{CS}=1pF, and neglect r_μ, r_b and r_o. *(Note: use the DC operating point found in (a) and assume zero source impedance.)*

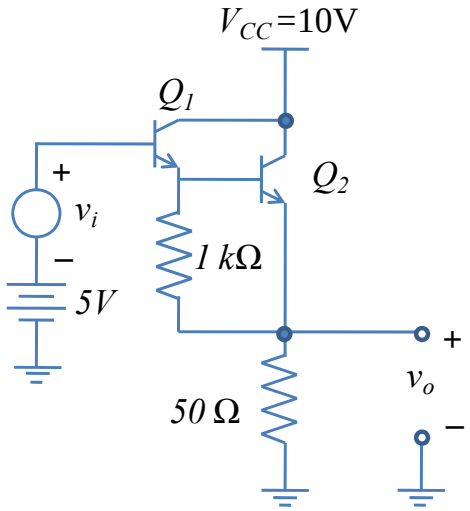


Fig. PS2.2