EE 140 | **ANALOG INTEGRATED CIRCUITS** | **SPRING 2009**

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PROBLEM SET #11

Issued: Tuesday, April 28, 2009

Due: Wednesday, May 6, 2009, **5:00 p.m.** in the EE 140 homework box in 240 Cory

1. For the feedback amplifier in Figure PS11-1 calculate:

(a) The output voltage at the quiescent point.

(b) Midband loop gain.

(c) Midband closed loop gain.

(d) Midband input impedance.

(e) Midband output impedance.

$$V_{CC} = 10V,\ V_{BE} = 0.6V,\ V_{CES} = 0.2V,\ \beta_F = 100,$$
$$R_C = 10k\Omega,\ R_E = 1.4k\Omega,\ R_F = 100k\Omega,\ R_G = 1k\Omega,\ C_B = 10\mu F$$

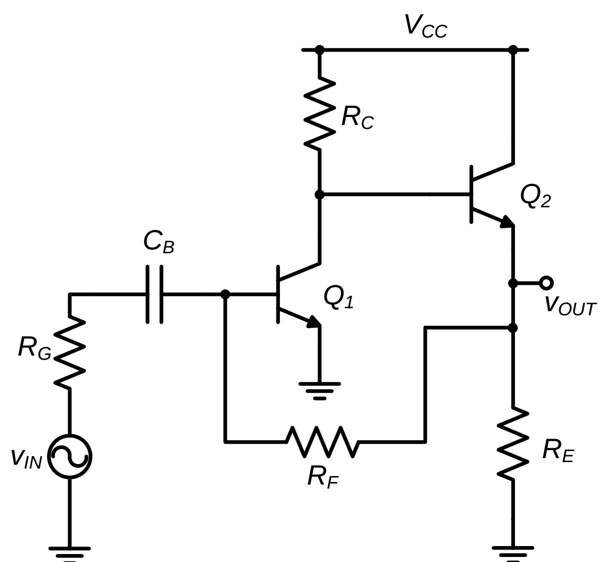

Figure PS11-1

2. A variable-gain CMOS amplifier is shown in Fig. PS11-2. Note that M_4 represents shunt feedback around M_6. Assuming that the bias value of V_i is adjusted so that V_{GD6} = 0V dc, calculate bias currents in all devices and the small-signal voltage gain and output resistance for V_c equal to 3V, and then 4V. Compare your answer with a SPICE simulation and use SPICE to plot out the complete large-signal transfer characteristic of the circuit. Use $\mu_n C_{ox}$ = 30 $\mu A/V^2$, V_{tn} = 0.8V, V_{tp} = -0.8V, $\lambda_n = \lambda_p = 0$, and $\gamma_n = 0.5V^{1/2}$.

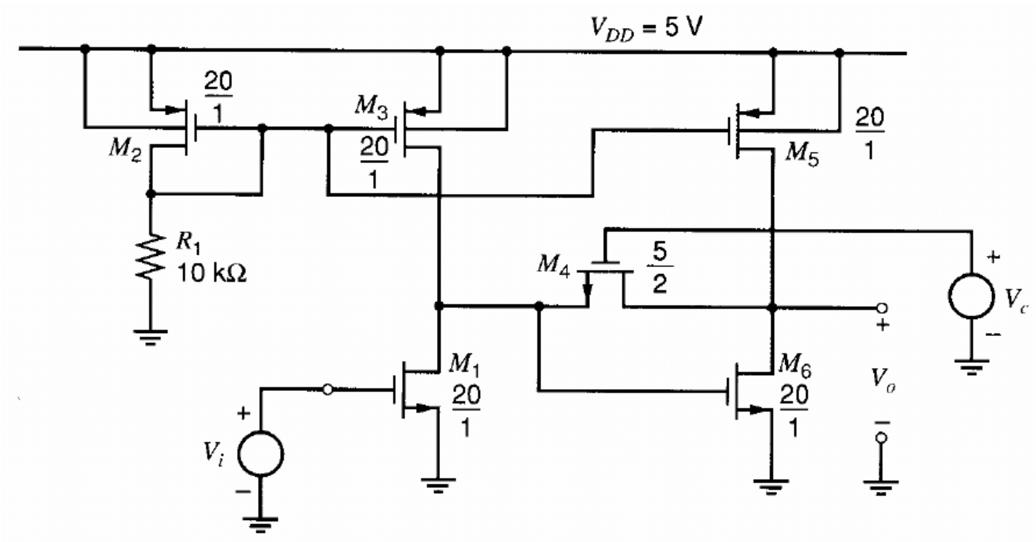

Figure PS11-2

3. A CMOS feedback amplifier is shown in Fig. PS11-3. If the dc input voltage is zero, calculate the overall gain v_o/v_i and the output resistance. Compare your answer with a SPICE simulation. Use $\mu_n C_{ox}$ = 60 × 10^{-6} A/V^2, $\mu_p C_{ox}$ = 30 × 10^{-6} A/V^2, V_{tn}, = 0.8 V, V_{tp} = -0.8 V, λ_n=|λ_p|=0.03 V^{-1}, and γ_n=. γ_p=0.

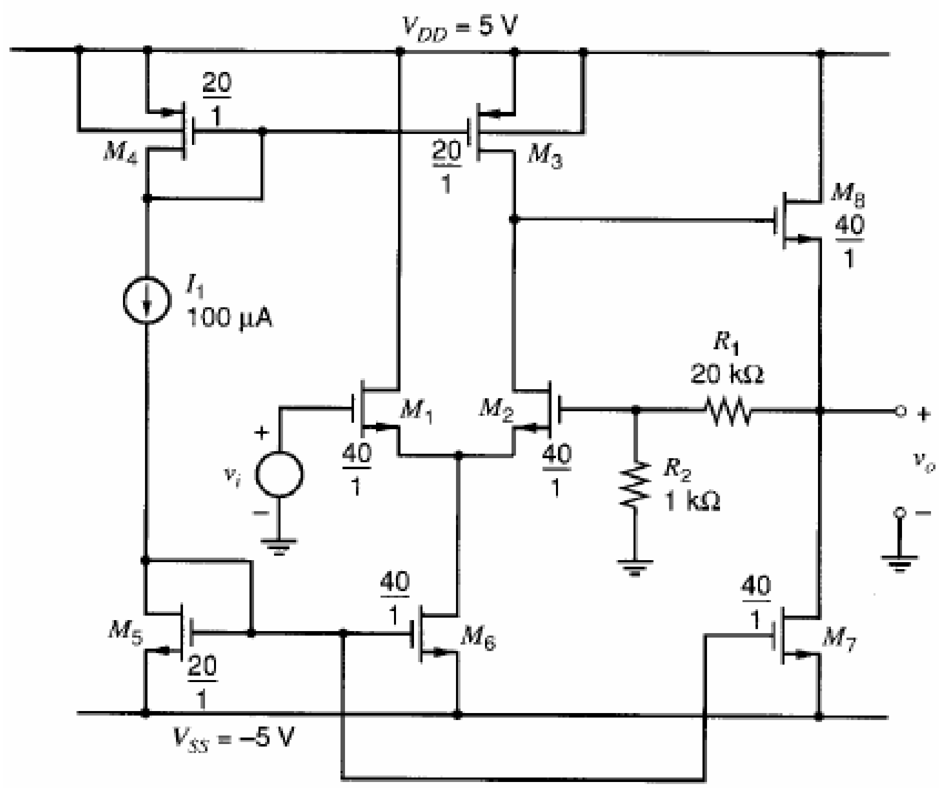

Figure PS11-3