MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Electrical Engineering and Computer Science

6.301 Solid State Circuits

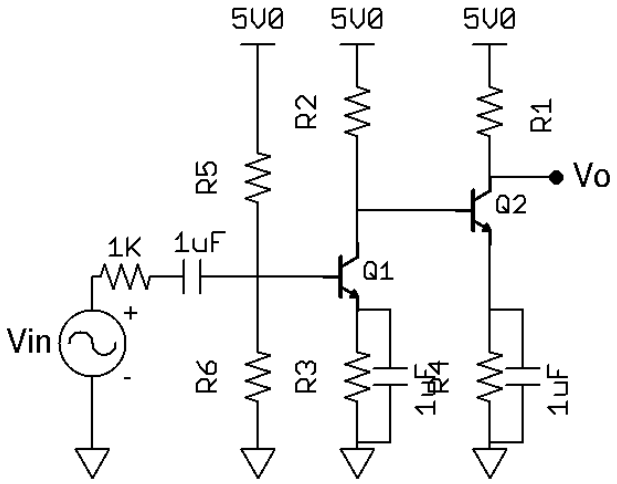
Fall 2013 — Issued : Sept 17, 2013

Problem Set 3 — Due : Sept 24, 2013

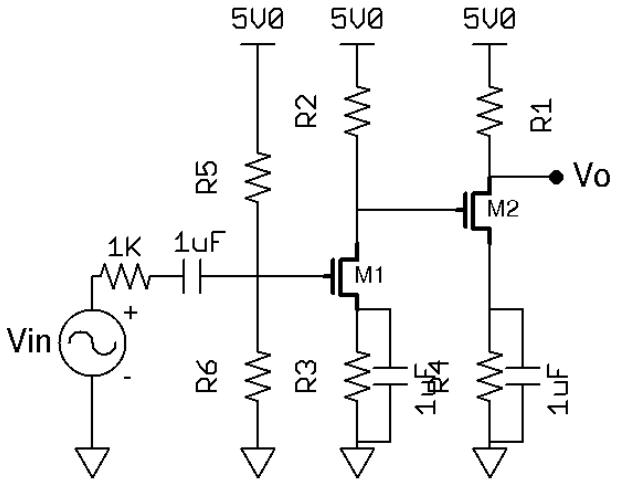
Problem 1: Cascades

For the following circuits find the midband gain, input impedance (not including R_s), output impedance, and power dissipation. Assume $\beta = 200$, $V_{be} = 0.6V$, and $r_o = \infty$.

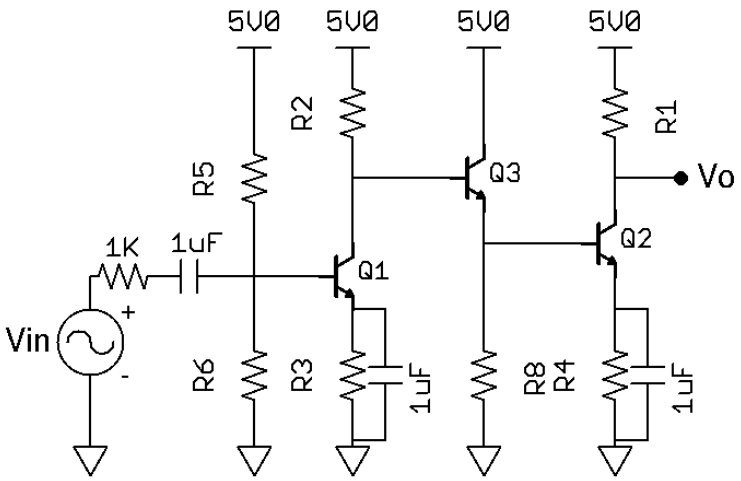
(a) Cascaded common emitter (CE-CE) amplifier:



(b) Cascaded common source (CS-CS) amplifer:



(C) Cascaded common emitter, emitter follower, common emitter (CE-EF-CE) amplifier:



Problem 4: More transfer function review

For the following transfer functions find the 3 dB bandwidth (the frequency at which the magnitude of the frequency response is .707 of the DC gain) in hertz. For A_1, A_2, and A_4 find the 10-90% risetime.

$$A_1(s) = \frac{1}{\tau s + 1} \quad A_2(s) = \frac{10}{(\tau s + 1)^2}$$

$$A_3(s) = \frac{100}{(\tau s + 1)^M} \quad A_4(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

Problem 5: Frequency Domain Jungle Gym

For the following transfer functions, sketch the pole-zero plot, the bode plot, and the step response.

$$A_1(s) = \frac{1}{s^2} \quad A_2(s) = \frac{20}{s^2 + 2s + 1} \quad A_3(s) = \frac{10}{s^2 + s + 1}$$

$$A_4(s) = \frac{s+1}{s+2} \quad A_5(s) = \frac{s+2}{s+1} \quad A_6(s) = \frac{s-1}{s+1}$$