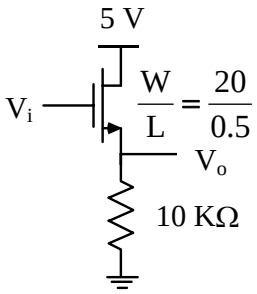
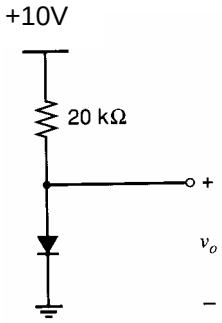
ECE 621 Winter 2008

Homework #3 (Due Jan. 31)

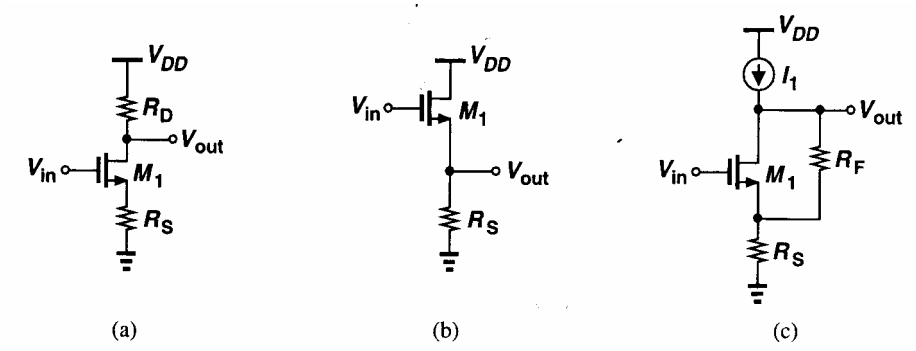
1. For the MOSFET circuit shown, using feedback ideas calculate HD2 and verify the result with SPICE. V_i is a sinusoidal input of 1V and the gate bias is chosen to have a quiescent drain current of 200 μA. V_{TO} =0.5 V, $k' = 250\,\mu A/V^2$, $\gamma = 0\,V^{1/2}$, $\lambda = 0\,V^{-1}$. Will there be any HD3 for this circuit? Explain your answer and give the value of HD3. How does this value compare with SPICE?



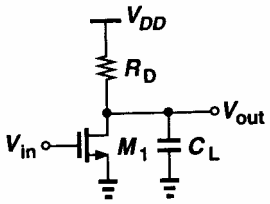
2. (a) Calculate the noise-voltage spectral density in V^2/Hz at v_o for the diode circuit. Neglect capacitive effects, flicker noise and the diode series resistance. Assume that the dc voltage drop across the diode is 0.6V.
(b) Calculate the total output noise voltage in a 100 kHz bandwidth.
(c) If a 100 pF capacitor is connected across the diode, calculate the noise bandwidth of the circuit and then calculate the total output noise at v_o.



3. Calculate the input referred thermal noise voltage for the circuits shown. Ignore the body effect. Take λ = 0 and $\overline{i_d^2} = 4KT\gamma g_m \Delta f$.



4. For the circuit shown, derive an expression for the total output thermal and 1/f noise in a bandwidth [f_L, f_H]. Assume $\lambda \neq 0$ and neglect all transistor capacitances.



5. Consider a simple MOS current mirror that has to be designed to achieve minimum output current noise. The two transistors must be identical and the gate area of the two transistors combined must not exceed A μm^2. Explain the criterion for choosing the W and L of the devices at low frequencies ($\omega << \omega_T$) when (i) 1/f noise dominates, (ii) thermal noise dominates.

6. Problem 11.10 of textbook.

7. Problem 11.8 of textbook. Assume the second-order system has two real poles.

8. Problem 11.1 of textbook.

9. Problem 11.2 of textbook

10. This problem makes use of the result from Problem 11.2 of the textbook. Consider the cascade of two amplifiers as shown. Find the noise figure of the overall system. Can the components be rearranged to give a better noise figure?