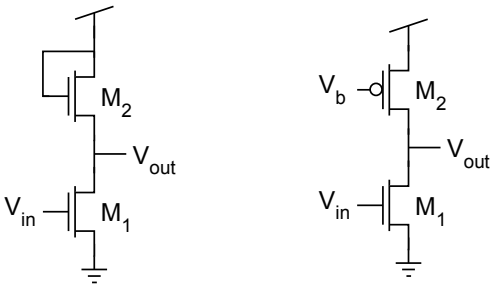
EE 551 Linear Integrated Circuits
Homework 4

Unless otherwise specified, use the following transistor parameters.

$V_{T0} = 0.7V$, $\gamma = 0.45V^{1/2}$, $2\varphi_F = 0.9V$, $\kappa_n = \kappa_p = 0.65$ (subthreshold), $\mu_n=1360cm^2/Vs$, $\mu_p=460cm^2/Vs$, $K = 100\mu A/V^2$, $I_0 = 1pA$, $I_{th} = 1\mu A$, $V_A = 50V$, $K_s=11.8$, $\varepsilon_0=8.854x10^{-12}F/m$, $T=300K$, $V_{dd} = 5V$

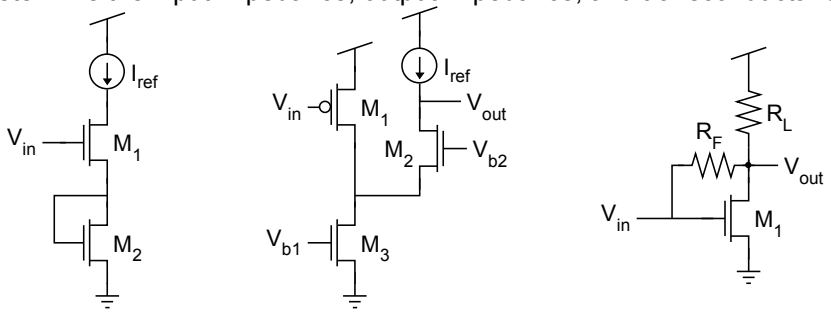
1. Determine the small-signal voltage gain of the following two amplifiers and the maximum voltage swing (assuming both transistors are saturated). Assume that $W_1/L_1 = 50\mu m/0.5\mu m$, $K_n' = 1.34x10^{-4}A/V^2$, and $K_p' = 4.0x10^{-5}A/V^2$, and VA = 50V for a transistor with length of 0.5µm.

   a. Let $W_2/L_2 = 10\mu m/0.5\mu m$ and $I_{D1} = I_{D2} = 10nA$.
   b. Let $W_2/L_2 = 50\mu m/2\mu m$ and $I_{D1} = I_{D2} = 500\mu A$.

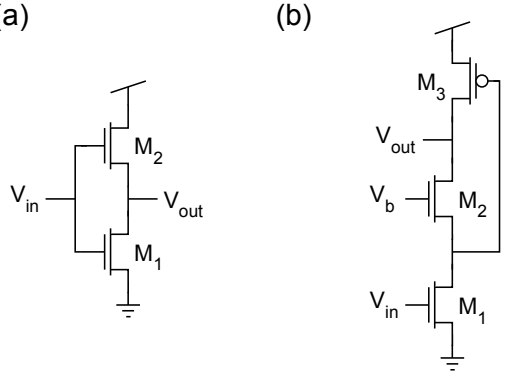


(a) (b)

2. Determine expressions for the voltage gain of each of the following amplifiers. For (a) and (b), also determine the input impedance, output impedance, and transconductance.



(a) (b) (c)



(d) (e)

3. For amplifier (c) in the previous problem, sketch V_{out} versus V_{in} as V_{in} is swept from ground to V_{dd}. Assume I0 = 0 (i.e. no subthreshold current).