University of New Mexico

Department of Electrical and Computer Engineering

ECE 520 - VLSI Design (spring 2026) Homework #8

Due in class on Thursday April 2, 2026

1. The circuit in Figure 1 is a *level shift* circuit. It achieves a DC level shift between the input and the output. The value of this shift is determined by the current I_0. Assume Xd=0, γ=0.4, 2|φf|=0.6V, VT0=0.43V, kn'=115μA/V^2 and λ=0.

a. Suppose we want the nominal level shift between V_i and V_o to be 0.6V in the circuit in Figure 1-a. Neglecting the body effect, calculate the width of M2 to provide this level shift (Hint: first relate V_i to V_o in terms of I_o).

b. Now assume that an ideal current source replaces M2 (Figure 1-b). The NMOS transistor M1 experiences a shift in VT due to the body effect. Find VT as a function of V_o for V_o ranging from 0 to 2.5V with 0.5V intervals. Plot V_T vs. V_o

c. Plot V_o vs. V_i as V_o varies from 0 to 2.5V with 0.5 V intervals. Plot two curves: one neglecting the body effect and one accounting for it. How does the body effect influence the operation of the level converter?

d. At V_o (with body effect) = 2.5V, find V_o(ideal) and thus determine the maximum error introduced by the body effect.

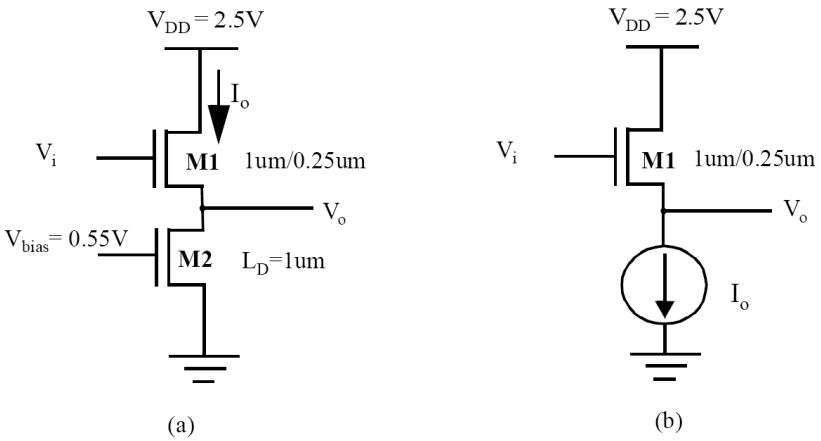

Figure 1 – NMOS Level Shifter