University of New Mexico

Department of Electrical and Computer Engineering

ECE 520 - VLSI Design (spring 2026) Homework #6

Due in class: Thursday March 12, 2026

1. Consider the low swing driver of Figure 1, and assume that Vtn0=0.4V, Vtp0=-0.5V.

a. What is the voltage swing on the output node (V_{out})? Assume γ=0.

b. Estimate (i) the energy drawn from the supply and (ii) energy dissipated for a 0V to 2.5V transition at the input. Assume that the rise and fall times at the input are 0. Repeat the analysis for a 2.5V to 0V transition at the input.

c. Compute t_{pLH} (i.e. the time to transition from V_{OL} to (V_{OH} + V_{OL}) /2). Assume the input rise time to be 0. V_{OL} is the output voltage with the input at 0V and V_{OH} is the output voltage with the input at 2.5V. Assume that K'_n=100uA/V^2.

d. Compute V_{OH} taking into account body effect. Assume γ = 0.4V$^{1/2}$ and $2\varphi_F$=0.6V for both NMOS and PMOS.

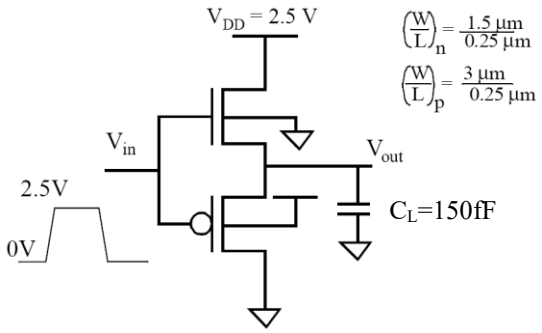

Figure 1 – Low Swing Driver

2. The inverter below operates with VDD=0.4V and is composed of $|V_t|$ = 0.6V devices. The devices have identical I_0 and n. Assume n=1.5.

a. Calculate the switching threshold (V_M) of this inverter.

b. Calculate V_{IL} and V_{IH} of the inverter.

c. Calculate noise margin (NM_L and NM_H) of this inverter.

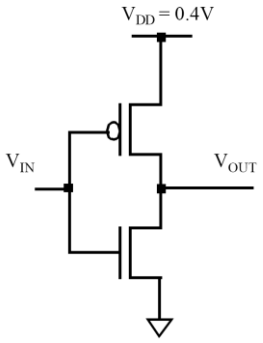

Figure 2 – Inverter in Weak Inversion Regime