SANTA CLARA UNIVERSITY	ELEN 115 Spring 2023	Dr. S. Krishnan

Lab7: Applications of the MOSFET in analog systems

I. OBJECTIVES

- To study the MOSFET as a switch in sample and hold systems
- To study a MOS inverting amplifier

II. PRE-LAB

Part 1: MOS as a Switch

The MOS transistors in Figure 1 and 2 have the below parameters.

V_{TN}= 1 V, V_{TP} = -1 V λ = 0, k_n' = 20μA/V^2 and k_p' = 10μA/V^2.

All device dimensions are 500μm/10μm

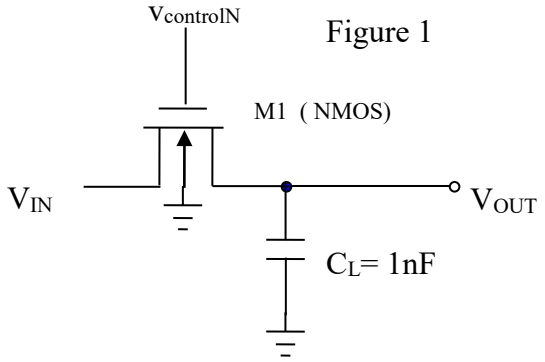

Figure 1

1. Figure 1 shows an NMOS transistor used as a switch.

(a) Initial voltage condition on capacitor C_L is 0V. V_{IN} is 5V.

The voltage $v_{controlN}$ switches from 0V to 5V and stays at 5V till the capacitor settles to its final value. Find the final value of the output voltage V_{OUT}

(b) Initial voltage condition on capacitor C_L is 5V. V_{IN} is 0V.
The voltage $v_{controlN}$ switches from 0V to 5V and stays at 5V till the capacitor settles to its final value. Find the final value of the output voltage V_{OUT}

(c) Initial voltage condition on capacitor C_L is 0V. V_{IN} is 2V.

The voltage $v_{controlN}$ switches from 0V to 5V and stays at 5V till the capacitor settles to its final value. Find the final value of the output voltage V_{OUT}

Part 2: MOS Inverting Amplifier

(a) For the amplifier circuit Figure 2, draw a rough voltage transfer curve (VTC) clearly marking the points where the transistor changes its mode of operation. Clearly mark the various regions of operation of the MOSFET on your VTC.
(b) Mark the portions of the curve that help you use the device as an inverting amplifier.
(c) Mark the portions of the curve that help you use the device as a logic inverter.
(d) Find the values at the critical points
   a. where the transistor changes its mode of operation
   b. the output high voltage and output low voltage when this circuit acts as an inverter.

For the MOSFET use the following parameters:

V_{DD} = 2.5V, V_{to}= 0.6V, k' = 30μA/V^2, λ = 0 , W/L = 100μm/1μm, R_D= 150KΩ

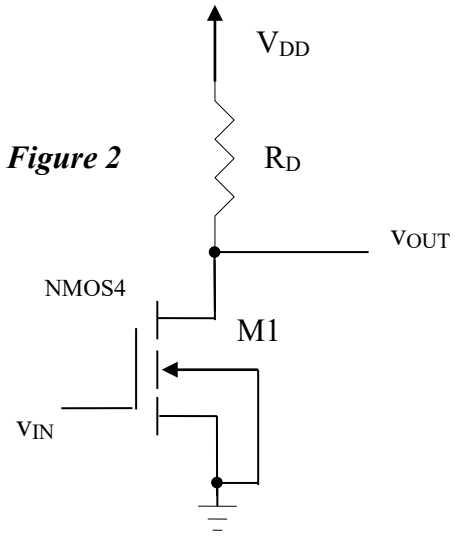

Figure 2