EEE314
EXPERIMENT #3

MOSFET Inverter Voltage Transfer Characteristics

The objective of this experiment is to examine the voltage transfer characteristic of NMOS and CMOS inverters.

PRELIMINARY WORK

In this preliminary work, use the following parameters for the NMOS and PMOS transistors respectively.

NMOS	PMOS
$V_{thn} = 1.7V$	$V_{thp} = -1V$
$k_n = 0.64mA/V^2$	$k_p = 0.5mA/V^2$
$\gamma_n = 1.28\ V^{1/2}$	$\gamma_p = -0.9\ V^{1/2}$
$\lambda_n = 0.02\ V^{-1}$	$\lambda_p = -0.05\ V^{-1}$

Transistor parameters

1. Using the transistor parameters above and keeping in mind that $V_{DD} = 10$Volts,

(a) Calculate the Voltage Transfer Characteristics (VTC) for the NMOS inverter circuit shown in Figure 1.

(b) How does the VTC of the circuit change if the gate of *just one* of the inverting transistors (either Q2 or Q3) is grounded?

2. Use the transistor parameters above, to calculate the VTC for the CMOS inverter in Figure 2 considering $V_{DD} = 10V$.

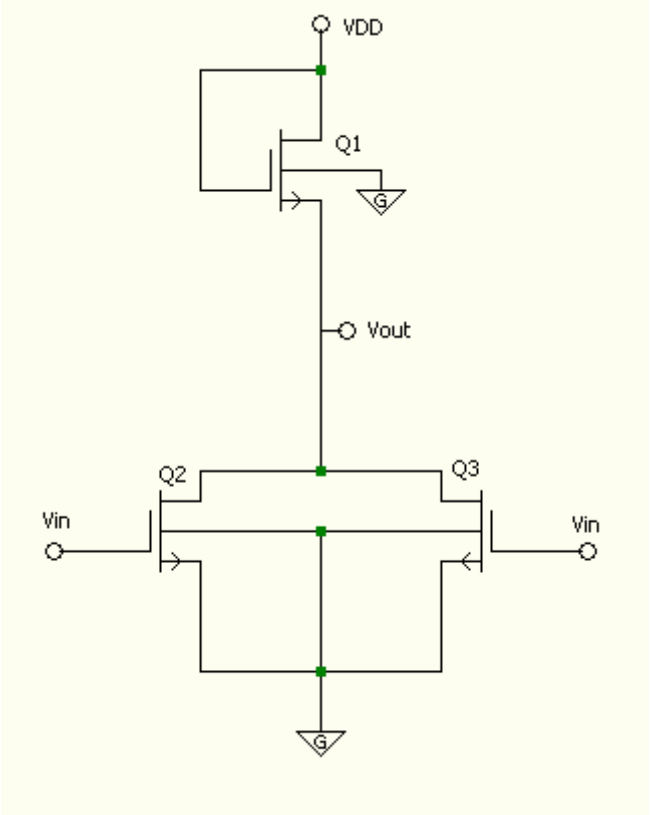

Figure 1: Note that the same signal (Vin) is applied to the gates of Q2 and Q3. Q1, Q2 and Q3 are all NMOS transistors.

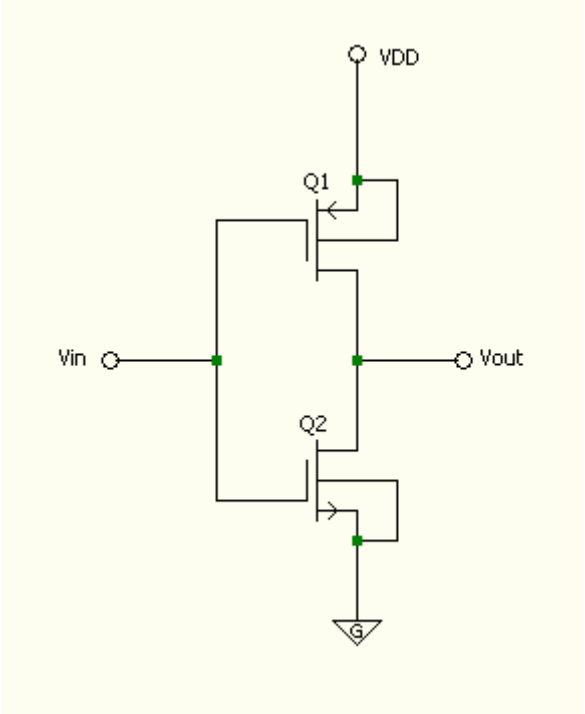

Figure 2: CMOS Inverter, Q1 is a PMOS and Q2 is an NMOS transistor.

EXPERIMENT

1. Use the 4007 IC and connect the NMOS inverter circuit shown in Figure 1.

(a) Apply a 1*KHz* triangular wave of amplitude 10*V* peak-to-peak to the input. Plot the voltage transfer characteristic (*Vout* vs. *Vin*) for *Vin* between 0 and 10V. Record V_{IL}, V_{IH}, V_{OL}, V_{OH} values and compare with your results in the preliminary work.

(b) Repeat part (a) but eliminate one of the inverter transistors by connecting its gate to ground. Compare the results to those of part (a).

2. Connect the CMOS inverter circuit shown in Figure 2.

(a) Repeat part 1(a) for this circuit as well.

(b) Compare the obtained results to those of part 1(a), and explain the possible reasons for the difference at the output and the performance of the two inverters.

EE314 EXPERIMENT #3 DATASHEET

Date:

Name:

1)

(a)

V_{IL}	V_{IH}	V_{OL}	V_{OH}

(b)

V_{IL}	V_{IH}	V_{OL}	V_{OH}

2)

(a)

V_{IL}	V_{IH}	V_{OL}	V_{OH}