EE 40

Homework 5

Due Tuesday, April 15, 2003 at start of class (3:30 PM)

40 Total Points Possible

Problem 1: 8 Points Possible

For the NMOS transistor circuit at left, let

$V_{TH(N)} = 1 \text{ V}$,

$W/L \mu_{NCOX} = 1 \text{ mA/V}^2$,

$\lambda = 0 \text{ V}^{-1}$.

Find $V_{DS}$ and $I_D$ for the transistor.

Problem 2: 8 Points Possible

For the NMOS transistor circuit at left, let

$V_{TH(N)} = 1 \text{ V}$,

$W/L \mu_{NCOX} = 1 \text{ mA/V}^2$,

$\lambda = 0 \text{ V}^{-1}$.

Find values for $R_1$ and $R_2$ so that the circuit will supply a constant 8 mA to the resistor when the transistor is in saturation mode.
Problem 3: 8 Points Possible

Consider the unloaded CMOS inverter at right with

- $V_{DD} = 5 \text{ V}$
- $V_{TH(N)} = V_{TH(P)} = 1 \text{ V}$
- $C_{OX} = 5 \text{ fF/}\mu\text{m}^2$ for both transistors
- $L = 2.5 \mu\text{m}$ for both transistors
- $\lambda = 0$ for both transistors
- $\mu_N = 50000 \text{ mm}^2/\text{V s}$
- $\mu_P = 25000 \text{ mm}^2/\text{V s}$

Find a width $W_N$ for the NMOS transistor channel and width $W_P$ for the PMOS transistor channel that together will make $V_M = 2 \text{ V}$.

Problem 4: 8 Points Possible

Consider the unloaded CMOS inverter at right with

- $V_{DD} = 5 \text{ V}$
- $W/L \mu COX = 1 \text{ mA}$
- $V_{TH(N)} = V_{TH(P)} = 1 \text{ V}$
- $\lambda = 0$.

Find $V_{DS(N)}$, $I_{D(N)}$, $V_{DS(P)}$, and $I_{D(P)}$ corresponding to $V_{IN} = 3.5 \text{ V}$.

Problem 5: 8 Points Possible

Consider the CMOS inverter at right with

- $W/L \mu COX = 1 \text{ mA}$
- $V_{TH(N)} = V_{TH(P)} = 1 \text{ V}$
- $\lambda = 0$

and diode (large-signal model) with $V_F = 0.7 \text{ V}$.

Find the power absorbed by the transistor, resistor, and diode.