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ENEE 303H Final Exam – Fall 2013

150 points, 2 hours, open book, open notes. Notebooks are due at the end of the exam.

Good luck and have a good semester break

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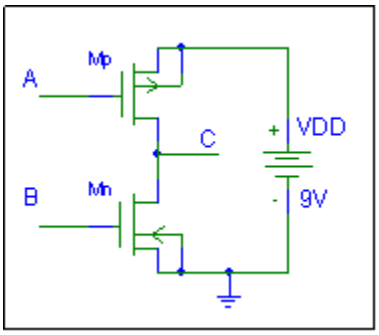
1. (40 points, 20 minutes)

The following circuit is proposed as a possible two transistor logic gate. For this consider that logic 0 is represented by 0 volts and logic 1 by VDD volts both with respect to ground.

For the CMOS transistors assume KP=3*10E-4, |VTO|=1, LAMBDA=λ=0, W=L=10E-6.

a) Calculate the voltage for C when the input logic values are A=0 with B=1.

b) Without calculating give the voltage for C when A=1 and B=0. Repeat for A=B=0 and again for A=1=B=1.



2. (40 points, 20 minutes)

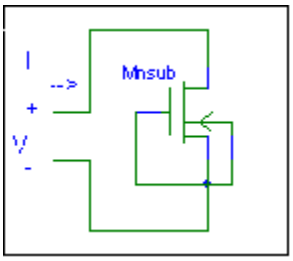
The following NMOS transistor works in sub-threshold for which the law is

$$I_D = I_S e^{V_{GS}/nV_T}(1 - e^{-V_{DS}/V_T})$$

where VT=thermal voltage=0.026V, n=2, IS=saturation current=10E-18.

a) Find the small signal conductance g=dI/dV.

b) This circuit is claimed to give very large resistance for small signals. Determine if this is the case when it is biased at 0.5V.



3. (40 points, 20 minutes)

Two identical OTA's back to back with inverted inputs and with a bridging capacitor have the 2-port admittance Y(s) given below. . Each OTA's small signal transconductance is gm and the capacitance is C.

$$Y(s) = \begin{bmatrix} Cs & -Cs + gm \\ -Cs - gm & Cs \end{bmatrix}$$

a) Load this 2-port in a resistor of conductance G=1/R Mhos Draw the resulting circuit and give the resulting voltage transfer function V2/V1(s) as a function of capacitance C and gm

b) Give the poles and zeros of your V2/V1(s).

4. (30 points, 15 minutes)

For the following circuit IB=10uA and β=200. Find the voltage at the top of the one Ohm resistor with respect to ground. The MOS transistors can be assumed to have the parameters of Problem 1 (except for W/L of Mout)..