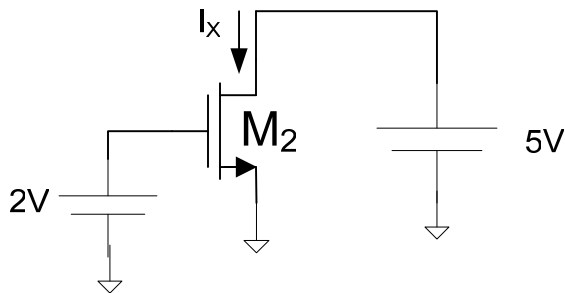
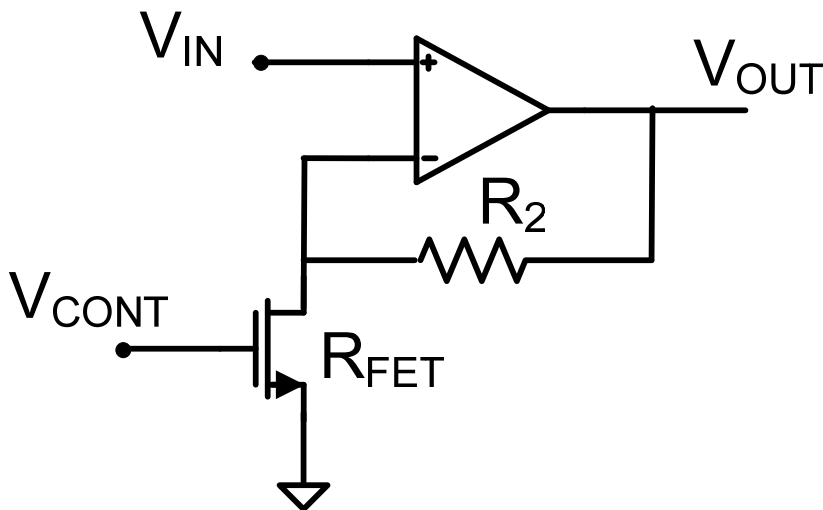


EE 230
 Homework 10
 Spring 2010

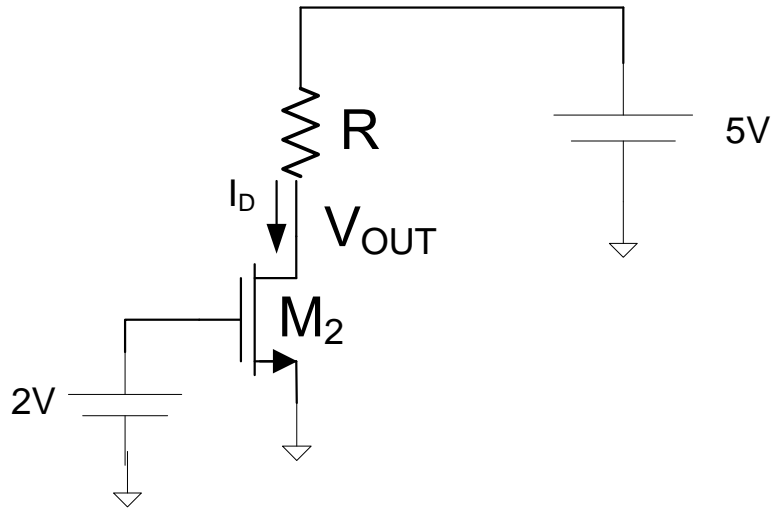
Problem 1 Assume the transistor M_2 shown below is characterized by the model on the last page of this HW assignment. Determine I_X .



Problem 2 If the Op Amp is ideal and $R_2=50K$, determine the gain of the amplifier if $V_{CONT}=4V$. Assume the transistor has dimensions $W=10\mu$, $L=6\mu$. and that it is modeled by the parameters $V_T=1V$, $\mu C_{OX}= 1E-4 A/V^2$, and $\lambda=0V^{-1}$.

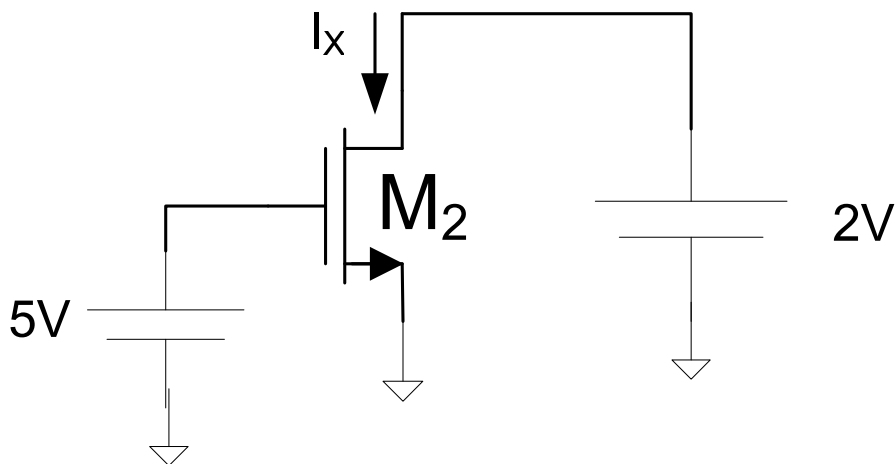


Problem 3 Determine V_{OUT} if the resistor $R=5K$ and the transistor has dimensions $W=10\mu$, $L=1\mu$. Assume the transistor is modeled by the parameters $V_T=1V$, $\mu C_{OX}= 1E-4 A/V^2$, and $\lambda=0V^{-1}$.

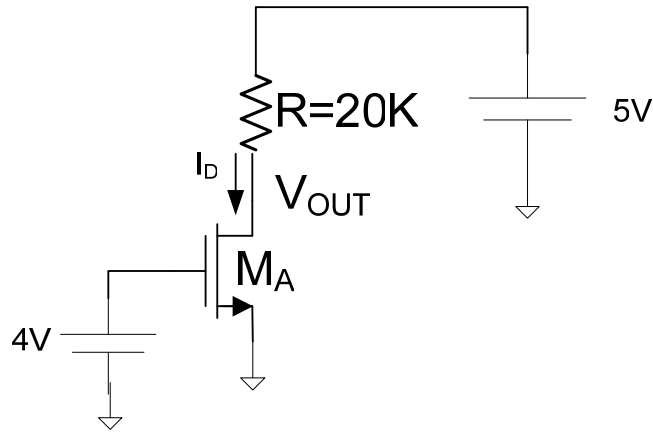


Problem 4 If a transistor has gate dimensions of $W=45nm$ and $L=45nm$, how many transistors could be placed in an area equal to the cross-section of a 24ga copper wire? (neglect any spacing requirements between the transistors – this assumption introduces an error in the number of transistors that is somewhere around a factor of 10).

Problem 5 Size the transistor so that $I_X=20mA$. Assume the transistors is modeled by the parameters $V_T=1V$, $\mu C_{OX}= 1E-4 A/V^2$, and $\lambda=0V^{-1}$.



Problem 6 Size the transistor so that $V_{OUT}=1V$. Assume the transistor is modeled by the parameters $V_T=1V$, $\mu C_{OX}= 1E-4 A/V^2$, and $\lambda=0V^{-1}$.



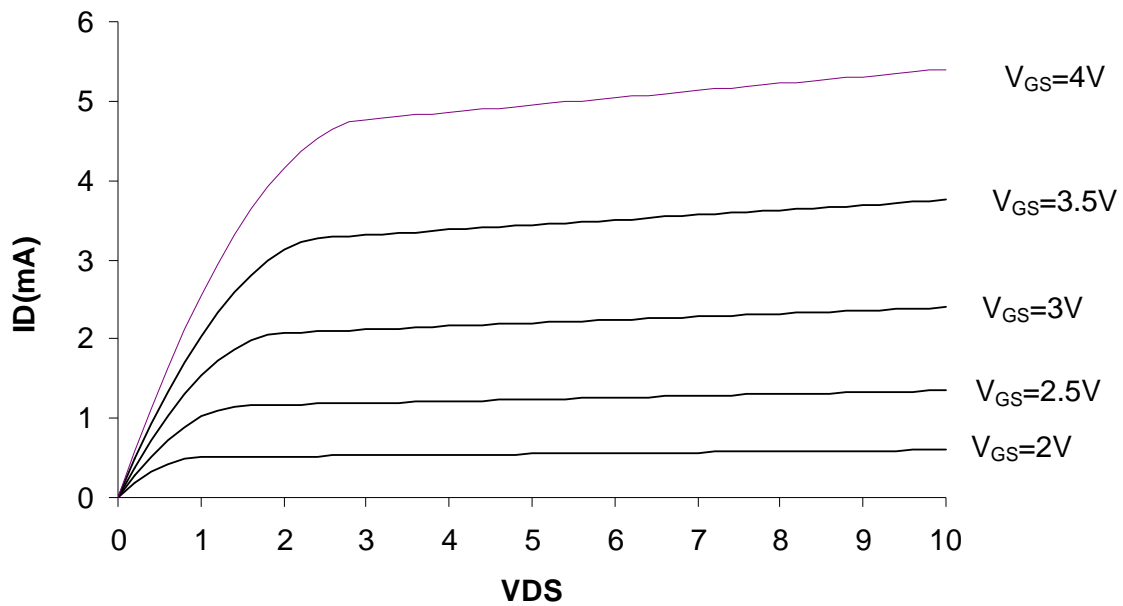
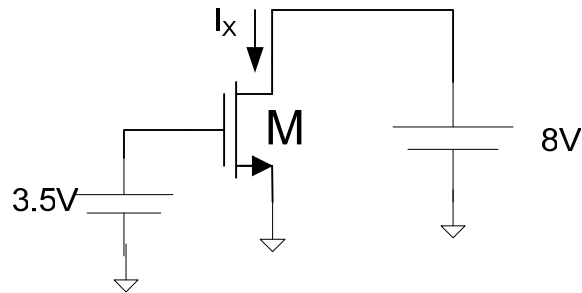
Problem 7 Assume the transistor is modeled by device designated as M_2 on the last page of this assignment. Obtain the simplified switch-level for this device shown below.



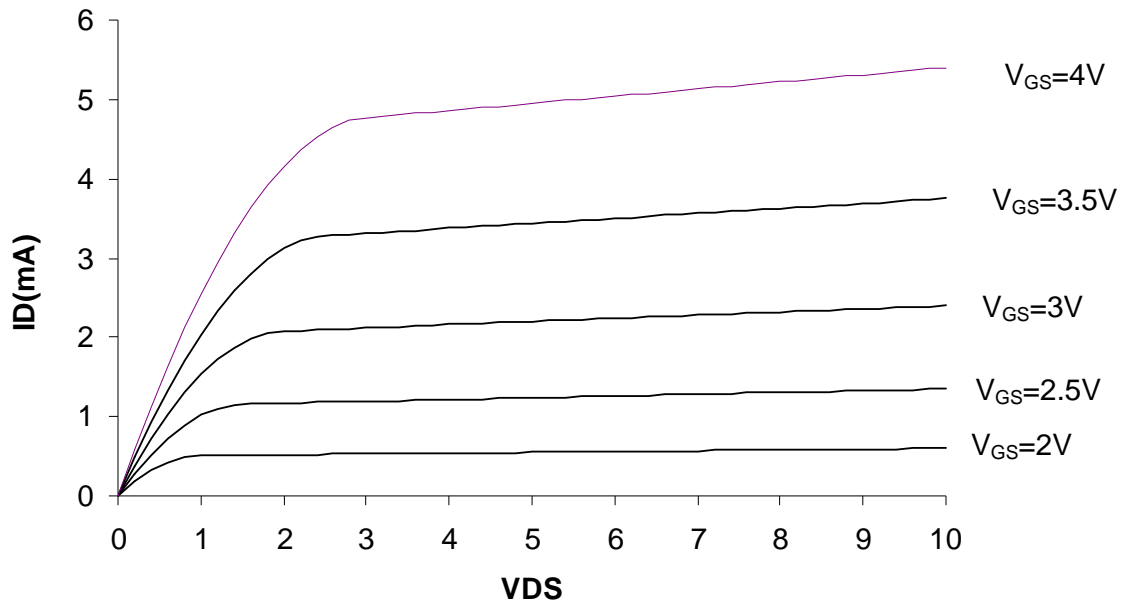
Problem 8 Give the circuit schematic of a 3-input NOR gate using n-channel and p-channel transistors. Assume the inputs are A, B, and C.

Problem 9 Assume the transistor M is characterized by the characteristics shown.

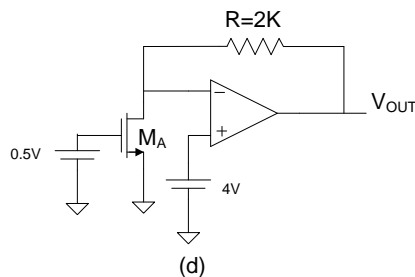
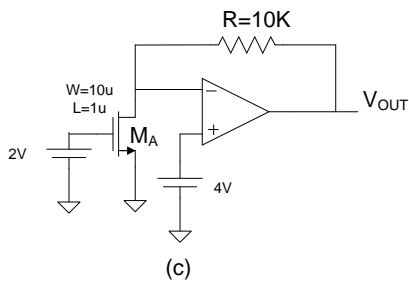
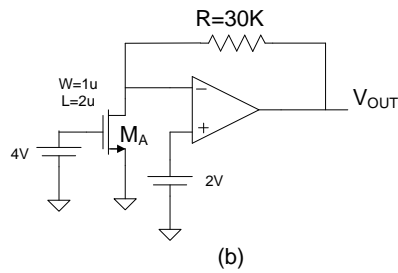
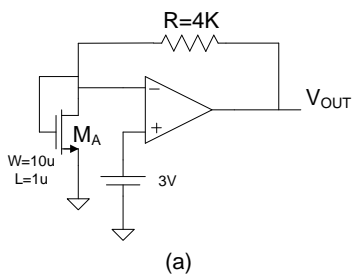
- a) Determine the current I_X .
- b) What region is the device operating in
- c) Repeat parts a) and b) if the 8V source is reduced to 2V.

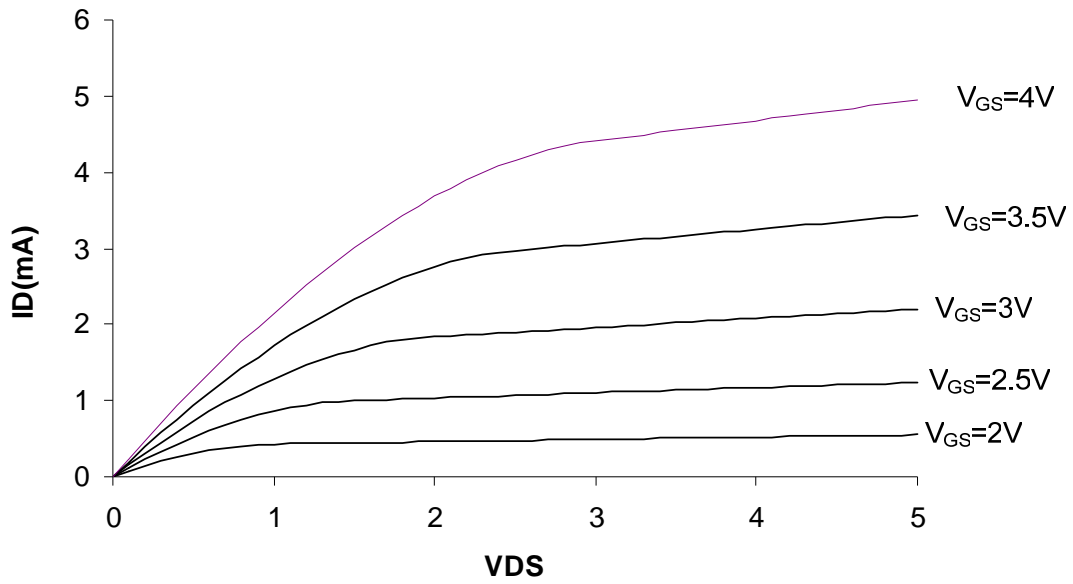


Problem 10 If an n-channel with dimensions $W=20\mu$ and $L=4\mu$ has the device characteristics shown below, determine the model parameters V_T and the product μC_{OX} .

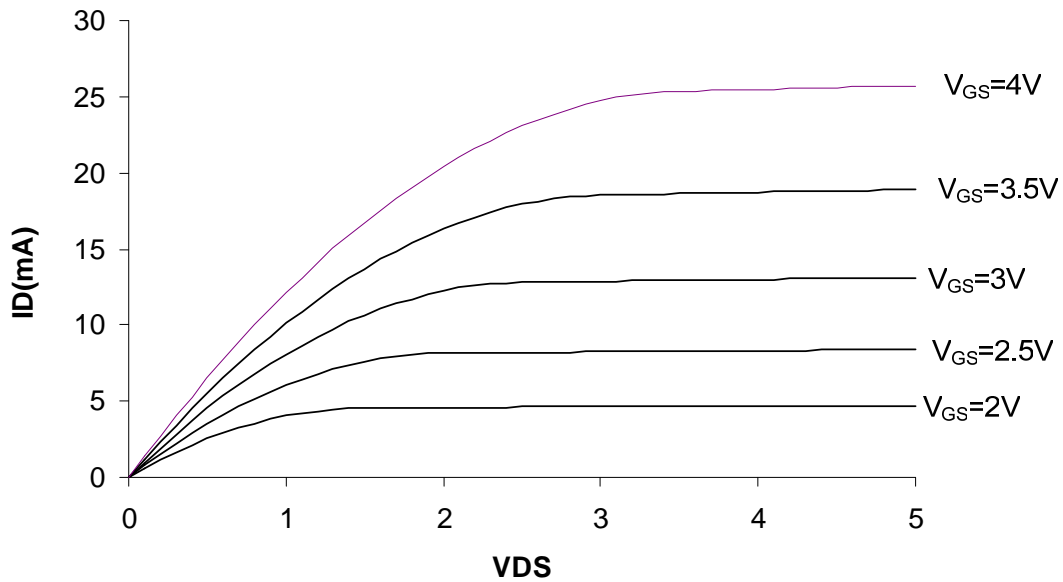


Problem 11 Determine V_{OUT} for the following circuits. Assume the transistors are modeled by the parameters $V_T=1V$, $\mu C_{OX}= 1E-4 A/V^2$, and $\lambda=0V^{-1}$.





Transistor M_1 $W=4\mu$, $L=2\mu$, $V_T=1V$, $\mu_{COX}=4E-4 A/V^2$, $\lambda=.075V^{-1}$



Transistor M_2 $W=80\mu$, $L=2\mu$, $V_T=0.5V$, $\mu_{COX}=1E-4 A/V^2$, $\lambda=.01V^{-1}$