EE 315
Problem Set 7

1. An NMOS transistor is characterized as follows: V_{DS}=0.1V, V_t=1.5V, k'_n= 25 μA/V^2, and W/L = 10. Find the drain current for V_{GS}=0V, 1V, 2V, and 3V.

2. An NMOS transistor is characterized as follows: V_{DS}=3.3V, V_t=1.V, k'_n= 37.5 μA/V^2, and W/L = 10. Find the drain current for V_{GS}=0V, 1V, 2V, and 3V.

3. Identify the region of operation and the drain current for an NMOS transistor where the k'_n= 25 μA/V^2, V_t=1Vand W/L = 10.

a. V_{GS}=5V and V_{DS}=6V
b. V_{GS}=0V and V_{DS}=6V
c. V_{GS}=2V and V_{DS}=2V
d. V_{GS}=2V and V_{DS}=-0.5V

4. An NMOS transistor has V_t=0.8V, k'_n= 0.05 mA/V^2, and W/L = 2. The device is biased at V_{GS}=2.5 V. Calculate the drain current and the resistance r_O for V_{DS}=2V and 10V for

a. λ=0
b. λ=0.02
c. V_A=35V

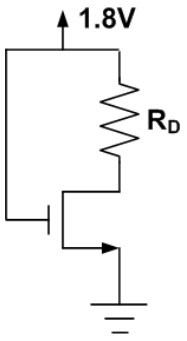
5. An NMOS transistor has V_t=0.8V, k'_n= 0.05 mA/V^2, and W/L = 2. The device is biased at V_{GS}=2.5 V. If V_{DS}=4V and V_A=40V,

a. Find λ.
b. Find the drain current for no channel length modulation.
c. Find the drain current assuming channel length modulation.
d. If the drain source voltage changes by 2V, what is the corresponding change in the drain current.

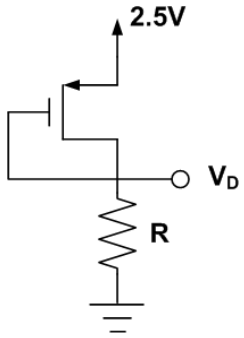
6. A PMOS transistor has k'_p= 0.1 mA/V^2, W/L = 2, V_t= -2V and V_{SG}= 3V. Find the region of operation and the drain current for:

a. V_{SD}=0.5V
b. V_{SD}=2V
c. V_{SD}=5V

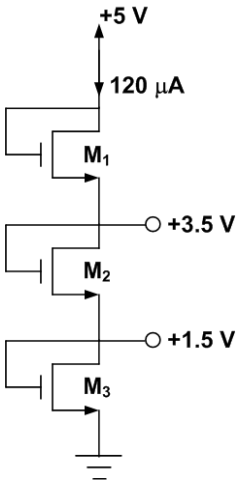
7. Consider the following NMOS circuit where V_t=0.5V, k'_n= 0.4 mA/V^2, and W/L = 5. If the circuit operates at the edge of saturation with a drain current of 1mA, find the resistor, R_D.



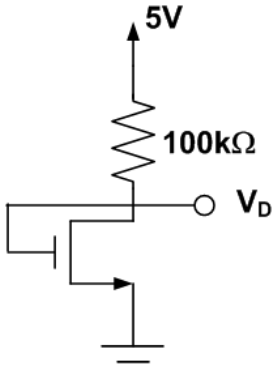
8. Consider the following PMOS circuit where V_t=-0.6V, k'_p= 250 μA/V^2, and L = 0.25μm. find the values required for W and R such that the drain current is 0.8mA and the drain voltage is 1.5V

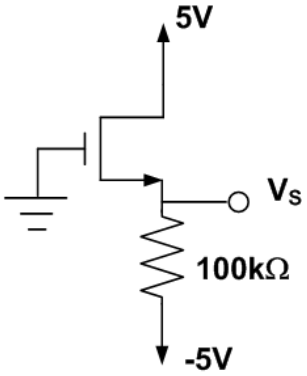


9. Consider the following circuit which contains three transistors that are matched with V_t=1V, k'_n= 120 μA/V^2, and L= 1μm. Find the gate width for each transistor for the given drain current and voltages.

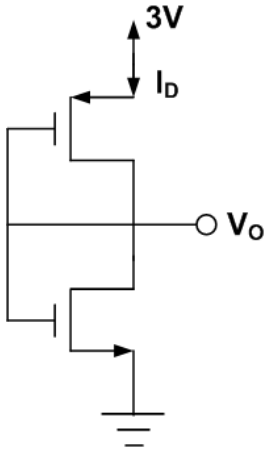


10. Find the labeled voltages on the following circuits. For all the transistors, V_t=0.8V, k'_n= 0.25 mA/V^2, and W/L = 2.





11. Find the labeled voltages and currents in the following circuit where V_{tn} =+1V, V_{tp} = -1V, k'_n= 20 μA/V^2, k'_p= 8 μA/V^{2}and W/L = 3 (for both n and p-type transistors).



12. For the following circuit, find V_{DS}, V_{GS}, and I_D assuming V_t=2V, k'_n= 0.02 mA/V^2, and W/L = 5.