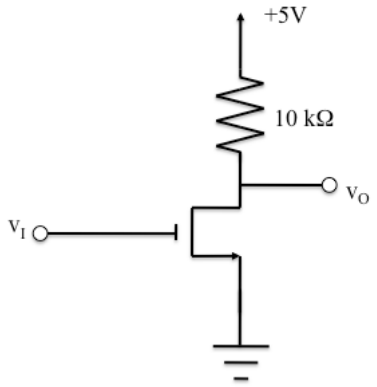
Module 6: Homework

EE 315

1. Consider the following common source amplifier, where V_t= 1.5V, k'_nW/L = .2 mA/V^2.



a. Sketch the voltage transfer characteristic, clearly labeling the transition points, A, B and C.
b. The device is biased for a 0.15 mA drain current. Find the Q-point.
c. Find the voltage gain at this bias point.

2. A common source amplifier uses an NMOS transistor with k'_n=0.4mA/V^2, W/L = 10, V_t=0.4V, V_{DD}=2.5 Vand V_A=10V. The amplifier Q-point is at I_{DQ}=0.2mA and uses a drain resistor of 6.2kohms.

a. Find V_{GSQ} and V_{DSQ}.
b. Draw the small signal model and find g_m, R_{in}, A_{vo}, and R_o.
c. If a load resistor is connected to the drain where R_L = 15kohms, what is the gain, A_v. Update your small signal model.
d. If a source signal, v_{sig} in series with a resistance of R_{sig} = 300kohms is connected to the gate, what is the gain, G_v.

3. A common gate amplifier uses an NMOS transistor with g_m=4mA/V and a drain resistor of 5kohms and a load resistor of 7.5 kohms. The amplifier is driven by a source, v_{sig}, that has R_{sig} = 500 ohms.

a. Find the input resistance (R_{in}) and the overall voltage gain, G_v. Draw the small signal model.
b. Suppose we want the input resistance to equal the signal resistance at the Q-point, I_{DQ}. What would the drain current Q-point need to change to for this to happen?

4. A common drain amplifier has the following characteristics: $k'_n=0.1mA/V^2$ and V_t = 0.6V. The operating point is $V_{GSQ}=0.85$ V.
   a. What is the W/L ratio for an output resistance of 300 ohms?
   b. What is the drain current at the operating point?
   c. This amplifier is connected to a 10kohm potentiometer as the load. What is the range of possible overall voltage gain?