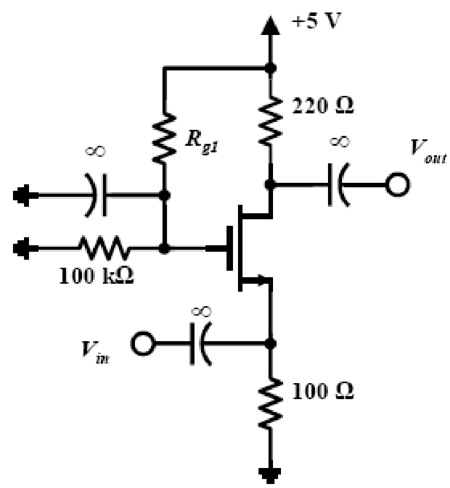
Reading Assignment: S&S: 4.6-4.9, 5.6-5.7

Homework #3 Due: 10/20/2009 at 5PM

Note: for some problems you may find it helpful to refer to Table 4.4 (p.319) and Table 5.6 (p.484) in S&S. Show DC and AC equivalent circuits for your calculations where appropriate. The common-gate circuit is similar to one that you will build in lab 1. For this exercise, the MOSFET has a $V_t = 2V$, a $Kn = 200\ mA/V^2$ and a $|V_A| = \infty$.

Part I: Hand Calculation

a) Find the gate resistance R_{g1} that will give $I_d = 10mA$, and calculate the resulting quiescent (DC) value of V_{ds}. Is the device in saturation?
b) Calculate the transconductance, $\boldsymbol{g_m}$.
c) Draw the ac small-signal equivalent circuit for this amplifier.
d) Calculate the small-signal voltage gain, input resistance, and output resistance for this amplifier.
e) What will be the gain if a 1-kΩ load resistor is connected to the output terminal at V_{out}?
f) Use the method of open-circuit time constant (MOTC) to calculate the lower corner frequency and the upper corner frequency. Then sketch the bode plots. You only need to consider Cgs=12.3 pF and Cgd=33.4 pF in our high-frequency ac small-signal model.



Part II: Computer-aid Simulation

Based on 2N7000 SPICE model provided, change the parameters to satisfy V_t=2V, Kn=200mA/V^2, and I_d=10mA, we can build this amplifier and perform the AC simulation in Multisim.

a) If we want Kn=200mA/V^2, for the μ_n and C_{ox} given in SPICE model, what is W/L?
b) Simulate the small-signal voltage gain, input resistance, and output resistance for this amplifier.
c) What would be the new gain if a 1kΩ load resistor is connected to the output terminal?
d) Obtain the Bode Plot from Simulation to determine the –3-dB bandwidth? How does it compare to what you calculated?