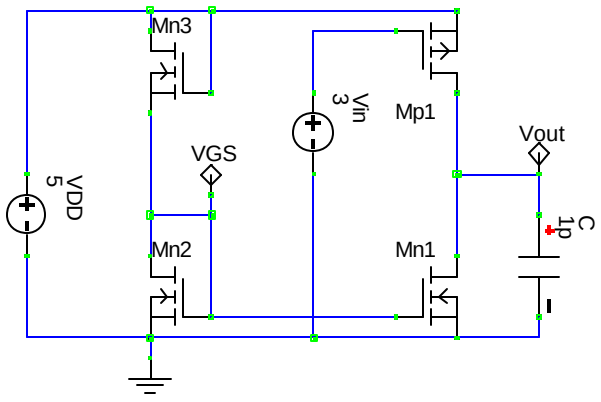
Homework 7 Due: Thursday, 10/19/00

Problem 1: Derive an expression for the input resistance of a common-gate amplifier connected to a load with resistance R_L. Your final answer should be in terms of g_m, r_o, and R_L, and in the final step of this derivation you should assume that $g_m >> g_{mb}$ and g_{ds} (where $g_{ds} = 1/r_o$).

Problem 2: Problem 3.11 from the textbook.

Problem 3: Problem 3.12 form the textbook. Assume $\mu C_{OX} = 90\mu A/V^2$.

Problem 4: Common-Source Amplifier
If we attach a pMOS transistor to the current mirror of Homework 6 Problem 5, we can create the common-source amplifier shown below with a pMOS amplifier transistor.
a) Using SPICE, determine the small signal gain if this amplifier if the pMOS device is W=18µm and L=2µm. Attach a 1pF capacitor to the output to create a defined high frequency roll-off. Be sure to use the Homework 6 Problem 5 circuit with a reference current close to 100µA. See circuit below.
*Set Vin to 3.0V DC and click on Use AC.
*You may want to use the .OP and .SHOW analysis to check if your circuit is biased correctly.
*Perform a .AC analysis (start=10, stop=10Meg) and plot the gain (use mag(V(out)/V(in)) where mag = magnitude and 'out' and 'in' are the output and input node numbers).
*Set the x-axis to log scale.
b) How could we increase the gain of this circuit? (Look back at HW6 Problem 1).
c) Describe what you would expect to happen to the gain if we set the pMOS input transistor to W=40µm and L=2µm. Try this in SPICE and comment on the results.



SPICE MOS Model Statements for L=2µm transistors.
.model cmosn nmos level = 1 vto = 0.77 kp = 7.7e-5 gamma = 0.71 phi = 0.73
lambda = 0.0625 tox = 3e-8 ld = 2e-7 u0 = 670 nsub = 2e16
.model cmosp pmos level = 1 vto = -1.1 kp = 2.1e-5 gamma = 0.355 phi = 0.66
lambda = 0.053 tox = 3e-8 ld = 5e-8 u0 = 180 nsub = 5e15