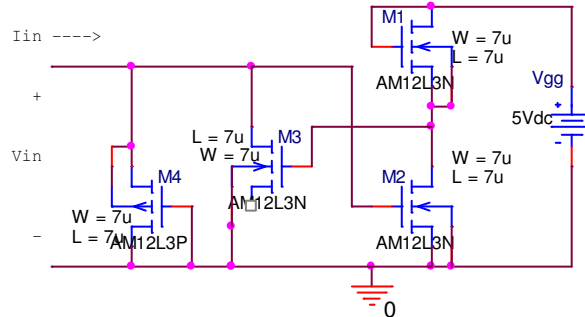


303H Spring 2009 – Items to look at

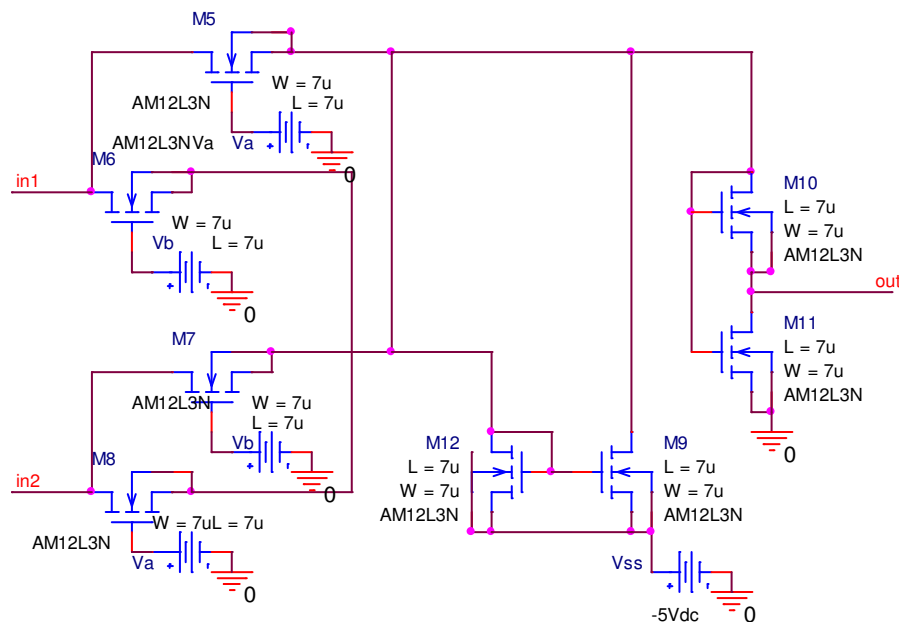
- Set up the following circuit in PSpice, insert a DC source at the input, and do a DC run to get I_{in} vs V_{in} to show that this gives a negative differential resistance.
[reference: D.S. Liang, ..., "Four-Valued Memory Circuit Designed by Multiple-Peak MOS-NDR Devices and Circuits," Proceedings of the 9th International Database Engineering & Application Symposium (IDEAS'05), 2005, from IEEE xplore]



- The following circuit is said to give

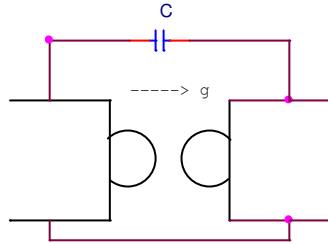
$$V_{out} = 2\left(\sqrt{\left(\frac{1}{k_{10}} + \frac{1}{k_{11}}\right)} - \sqrt{\frac{1}{k_{11}}}\right)\left(\sqrt{K(V_a - V_b)(V_{in1} - V_{in2})}\right)$$

Where k_{10} and k_{11} are $KP(W/2L)$ for M10 and M11 and K is $KP(W/2L)$ for all the other transistors. The voltages V_1 , V_2 and V_{out} are measured with respect to ground.
[reference: A. Lahiri, "MOSFET-based, analog circuit calculates square root," EDN, February 19, 2009, pp. 52-53.]



- Find the scattering matrix for the gyrator, for the ideal transistor, for the ideal op-amp and for 1-port R 's, L 's, and C 's. Check for the lossless conditions.

4. For the following gyrator-C 2-port circuit
- Find the admittance matrix and from it the input admittance when a load $y_L(s)$ is placed on port 2.
 - Find the 2-port scattering matrix and the input reflection coefficient when y_L is placed on port 2.



5. (reasonably hard) The scattering matrix in class was normalized to $z_0=1$. Using a real z_0 define the scattering matrix by

$$2V^i = V + z_0 I$$

$$2V^r = V - z_0 I$$

$$V^r = S_u V^i$$

Relate this scattering matrix, S_u , to the normalized one, S of $z_0=1$.