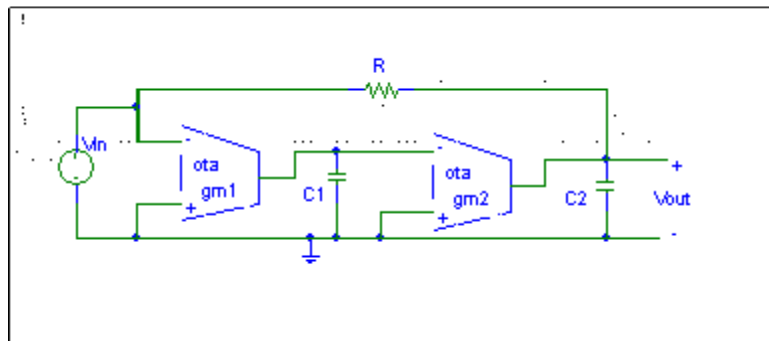


303 Fall 2017 – Homework 5 Due Th 10/12/17

1. (30 points; current sources, mirrors)
 Use two 4.5V batteries for power supply and 4007 transistors.
 - a) Design a four transistor CMOS bidirectional current mirror (that is, one which will work with input currents of any sign). Note that this will result in a bias quiescent current (that is a current in the transistors when there is no input). Check your design in Spice.
 - b) Calculate analytically the quiescent power and compare with that found by Spice.
2. (35 points; OTA double integrator with feedback design)



For the above connection assume the OTA's are linear with no input current and $i_{out} = gm(v_+ - v_-)$.

- a) Find the voltage gain, $A_v(s) = v_{out}/v_{in}$
 - b) Run Spice to obtain the frequency response magnitude $|A_v(j\omega)|$ over 10Hz to 1MEGHz assuming $gm1 = gm2 = 10^{-3}$ Mho, $R = 1K\Omega$, $C1 = C2 = 10$ NanoFd.
 - c) Under the same conditions run Spice to obtain the unit step response.
3. (35 points; Thevenin's equivalent)
 Find the small signal Thevenin's equivalent seen looking between the output and ground of the following circuit. Assume complementary transistors biased at collector currents of 5ma, Early voltages of 20V, $C\pi = 1$ pFd and $C\mu = 0$.

