303H Fall 2015 – Homework 5 Due Th 10/15/15
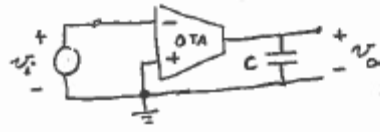
1. (60 points; OTA integrator design)

a) For the above connection give the nonlinear differential equation for the voltage output versus the voltage input using an MOS OTA. Design an OTA-C circuit to give this differential equation using a MOS OTA made of 4007 transistors (with one tail current setting resistor). Use two 6V power supply batteries, set the tail current at 5mA, and use a 10nFd capacitor.

b) Sketch (by hand) the low frequency output current versus input differential voltage that you expect for this integrator with small signal sine wave inputs. Determine the small signal gm and run Spice to check the integrator operation. Do a frequency response to determine over what frequency range it will work.

c) Run Spice transient analyses to check how the integrator works. Do this for small low frequency sine waves and for large amplitude ones.

2. (40 points; current sources, mirrors)

a) Compare NMOS current sources made with one input/output pair of transistors versus a circuit using a cascode of two input/output pairs.

b) Design a 4 transistor CMOS bidirectional current mirror (that is, one which will work with input currents of any sign). Note that this will require a bias offset current. Check your design in Spice.