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303H Spring 2009 – Homework 4 Due Tu 03/03/09

1. Design a BJT OTA to give Iout=$I_T$tanh(Vin/(2V_T)) using a differential pair formed from the 2N3904 transistors for the main differential pair and tail current and the 2N3906 transistors for the output current mirror.. Use Vcc=-Vee=5V and the tail current to be 2mA using a circuit such as that of Figure 6.10 of page 569. Check operation by DC Spice simulations over the range Vee<Vin<Vcc (use an F component as a load with a resistor on its output; ground one of the inputs [repeat with the other input grounded]).

2. Replace each BJT by an MOS one, use the 1.2 micron ones, and compare the outputs of the two over a range of inputs, Vss=Vee<Vin<Vdd=Vcc.

3. For the following circuit (for which the op-amps are ideal) show that

   $$Zin(s) = Z0(s)+(Z1(s)\cdot Z3(s)\cdot Z5(s))/(Z2(s)\cdot Z4(s))$$

   Evaluate, and comment upon the results, when
   a) Z0=0, Z1(s)=Z2(s)=Z3(s)=Z5(s)=R, Z4(s)=1/(Cs)
   b) Z0=0, Z1=Z3=Z5=R, Z2(s)=Z4(s)=1/(Cs)