2017 Analog IC Design Homework 4 ***due date: 05/30/2017***

1. Use composer and hspice to simulate the common source and source follower as shown in Fig. 1 with Vdd=1.5V. Every single one of MOS's cgtot, cstot, cdtot, and cbtot can't have more than 70fF under your design. (40%)
   (a) Design a common source with gain A1>90 and plot the output noise's spectrum as shown in Fig. 1. (a). Identify the corner frequency and pole of thermal noise. (5%)
   (b) Design a source follower with gain A2>0.8 and plot the output noise's spectrum as shown in Fig. 1. (b). Identify the corner frequency and pole of thermal noise. (5%)
   (c) Compare between (a) and (b). Which one has higher output flicker noise? Which one has higher thermal noise's pole? Why? (10%)
   (d) Find the output thermal noise of CS and SF. Which one is bigger? Why? (10%)
   (e) Find the input referred thermal noise of CS and SF. Which one is bigger? Why? (10%)

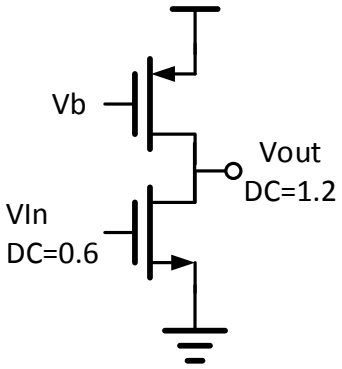

Fig. 1. (a)

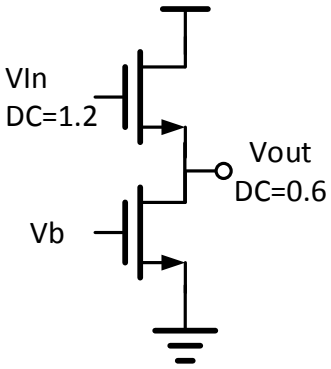

Fig. 1. (b)

2. Use the problem 1's design to perform two stage operation. (20%)
   (a) Connect CS and SF as shown in Fig. 2. (a) and find the input referred thermal noise. (You are allowed to "slightly" adjust the bias condition to make sure the overall gain equals to A1*A2.) (1%)
   (b) Connect SF and CS as shown in Fig. 2. (b) and find the input referred thermal noise. (You are allowed to "slightly" adjust the bias condition to make sure the overall gain equals to A1*A2.) (2%)
   (c) Comment on what makes the difference between (a) and (b). (16%)

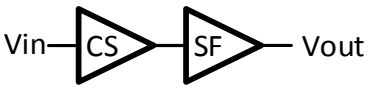

Fig. 2. (a)

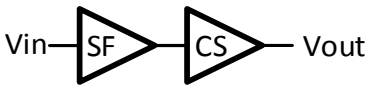

Fig. 2. (b)

✧ ***Before you start to simulate the .ac noise***
   1. ***Find the title "Flicker and Thermal noise Model Parameters" in "cic018.l".***
   2. ***Use the "replace all" to change value of the parameter into KF=1E-29.***
   3. ***Hint: use ".noise V(vout) vin 10000"***

by CCHsieh

3. Design a differential to single-ended amplifier with Vdd=1.5V as shown in Fig. 3. (40%)
   (a) Design a differential to single-ended amplifier to get voltage gain Av >20dB. (10%)
   (b) Use the .op's parameters to calculate the first zero of Vout/Vin(s) frequency response. (20%)
   (c) Use the .pz to check your calculation and simulate the bode plot. (10%)

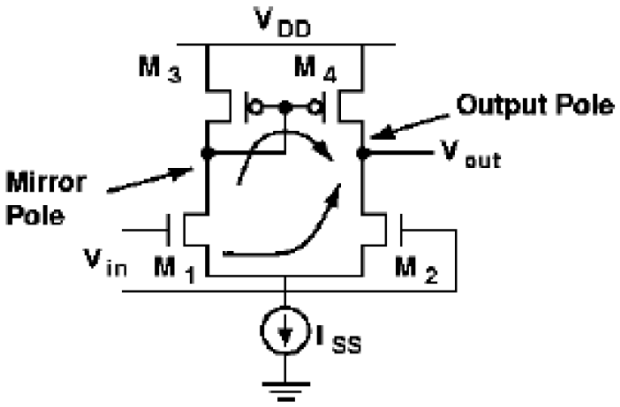

Fig. 3.

✧ ***The following should be included in your report (a) schematic (b) HSPICE netlist & simulation file (c) waveform with cursor values (d) comments.***