VE311 Electronic Circuit Lab 5 Manual
Due: **Aug 3th 11:59 a.m.**

1 Objectives

- Get familiar with differential amplifier

2 Exercises

2.1 Differential Amplifier

Take $V_{DD} = 5V$, $I_{SS} = 1mA$, $R_{D1} = R_{D2} = 10k\Omega$. M_1 and M_2 are the same NMOS (RN7000). (For the simulation, you may use the 2N7000 file we have provided before)

(a) Simulation: Build the differential amplifier as shown below:
$V_{in1} = 1.45 + 0.03\sin(2\pi 10^2 \cdot t)$, $V_{in2} = 1.45 - 0.03\sin(2\pi 10^2 \cdot t)$.
Plot V_{out1} vs. t, V_{out2} vs. t and $V_{out1} - V_{out2}$ vs. t.

(b) Simulation: Replace two input voltages as $V_{in1} = V_{in2} = V_{in,CM}$ as DC input from 0 V to 3 V. Assume $V_{out1} = V_{out2} = V_{out,CM}$. Plot $V_{out,CM}$ vs. $V_{in,CM}$ from 0 V to 3 V. Calculate A_{CM} for $V_{in,CM}$ = 2V.

(c) In-lab: Build the differential amplifier as shown in Fig.2, use $V_{in1} = 1.45+0.03\sin(2\pi 10^2 \cdot t)$, $V_{in2} = 1.45 - 0.03\sin(2\pi 10^2 \cdot t)$. Plot V_{out1} and V_{out2} vs. t. Calculate the A_{DM} for this case.

(d) In-lab: Build the differential amplifier as shown in Fig.2, use $V_{in1} = V_{in2}$= 2V . Plot V_{out1} and V_{out2} vs. t. Calculate the A_{CM} for this case and compare it with your result in (b).

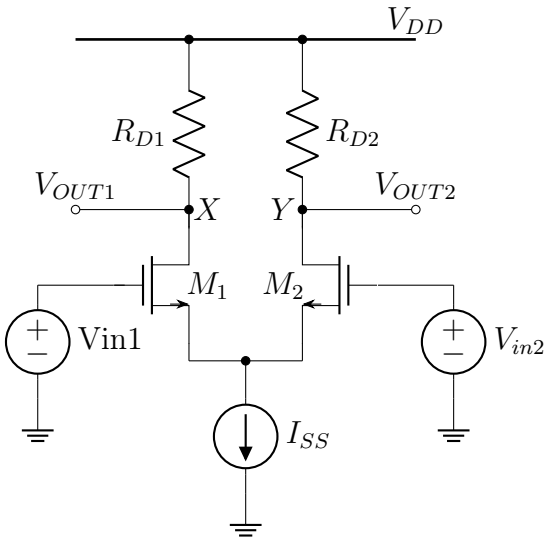

Figure 1: Differential Amplifier

2.2 Current Mirror

(a) Calculate the small-voltage gain of the circuit below.

(b) Pspice simulation: TakeV_{DD}=5V,R_L=10kΩ. PlotV_{out} vs. V_{in} from 1V to 3V. Calculate the voltage gain. NMOS(2N7000), PMOS(TP2104).

(c) In-lab: Take V_{DD}=5V, R_L=10kΩ, build the curent mirror, plot V_{out} vs, time,at V_{in}=1V; 1.5V and 2.5V. Use these V_{out} you got in lab, plot V_{out} vs. V_{in} curve on your own.

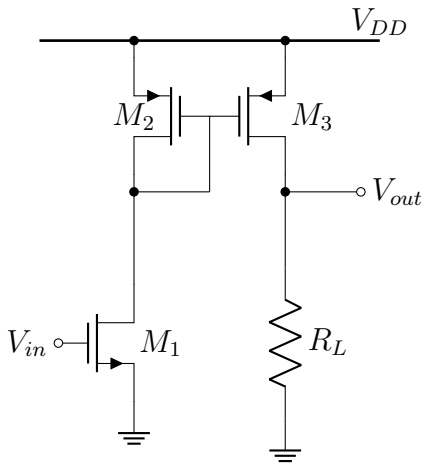

Figure 2: Current Mirror

3 Deliverable

You should attend the regular lab session and demonstrate your lab exercise to the TA. You should submit a lab report containing the following:

- Objectives
- Experimental results (numerical results, figures)
- Simulation results (numerical results, figures)
- Error analysis, and discussion
- Conclusion

Everyone needs to submit the report individually.