VE311 Electronic Circuits
Summer 2023 — Lab 3
Instructor: Dr. Xuyang Lu
Due: 11:59 pm, July 15, 2023 (Saturday)

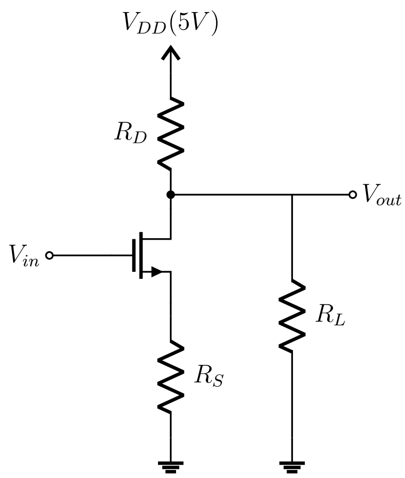
Note:

1. Please use A4 size papers.
2. The lab report should be submitted online individually.
3. Use Proteus 8.10 for simulation before the lab session. In the Proteus library, you should be able to find all the components used in the schematics. The lab report must include both the simulation and measurement results.

Exercise 3.1

[Common-Source with Source Degeneration Amplifier]

1. [20%] ($\mathrm{R_L} = \infty$) Design and build a common-source with source degeneration amplifier, which has a voltage gain $A_v > 5$, using NMOS **(VN0104)**. Plot V_{OUT} vs V_{IN}. Is the voltage gain A_v close to $\mathrm{R_D}/\mathrm{R_S}$? (Hint: First choose appropriate R_D and R_S. Second, perform DC sweep to find out a V_{IN} at which the magnitude of slope is more than 5. At the same time, make sure the NMOS is in the saturation region. If not, change for another R_D and R_S, and repeat the DC sweep again.)
2. [15%] ($\mathrm{R_L} = \infty$) For $\mathrm{V_{in}} = \mathrm{V_{IN}} + 0.01 \sin(2\pi 10^2 \cdot \text{ time })$, plot $V_{\mathrm{out}} = V_{\mathrm{OUT}} + v_{\mathrm{out}}$ vs time. Confirm that the amplitude of v_{out} is equal to $0.01 \times \mathrm{A}_v$.
3. [15%] ($\mathrm{R_L} = 50\mathrm{k}\Omega$) For $\mathrm{V_{in}} = \mathrm{V_{IN}} + 0.01 \sin(2\pi 10^2 \cdot \text{ time})$, plot $\mathrm{V_{out}} = \mathrm{V_{OUT}} + v_{\mathrm{out}}$ vs time. Does the amplitude of v_{out} become smaller than $0.01 \times \mathrm{A_v}$? If so, explain the reasons. (Note: Make sure the NMOS remains in the saturation region.)



Exercise 3.2

[Source Follower]

1. [20%] ($\mathrm{R_L} = \infty$) Design and build a source follower, which has a voltage gain $A_v > 0.5$, using NMOS **(VN0104)**. Plot V_{OUT} vs V_{IN}. Is the voltage gain A_v close to unity? (Hint: First choose appropriate R_S. Second, perform DC sweep to find out a V_{IN} at which the magnitude of slope is more than 0.5. Here the NMOS is always in the saturation region.)

2. [15%] ($\mathrm{R_L} = \infty$) For $\mathrm{V_{in}} = \mathrm{V_{IN}} + 0.05 \sin(2\pi 10^2 \cdot \text{ time })$, plot $V_{\mathrm{out}} = V_{\mathrm{OUT}} + v_{\mathrm{out}}$ vs time. Confirm that the amplitude of v_{out} is equal to $0.05 \times A_v$.

3. [15%] ($\mathrm{R_L} = 50\mathrm{k}\Omega$) For $\mathrm{V_{in}} = \mathrm{V_{IN}} + 0.05 \sin(2\pi 10^2 \cdot \text{ time })$, plot $V_{\mathrm{out}} = V_{\mathrm{OUT}} + v_{\mathrm{out}}$ vs time. Does the amplitude of v_{out} still maintain around $0.05 \times \mathrm{A_v}$? If so, explain the reasons.