

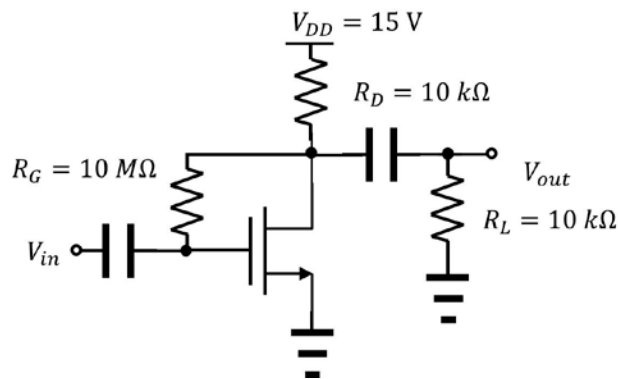
Due: 23:55, May 31 (Sunday night)

We have 8 problems.

In your answer file, specify both the **SOLUTION PROCEDURE** and the **FINAL SOLUTION**.

1. A common-source amplifier utilizes a MOSFET with $\mu_n C_{ox} = 400 \mu\text{A}/\text{V}^2$ and $W/L = 10$. In this problem, consider the channel-length modulation with $\lambda = \frac{1}{9} \text{V}^{-1}$. It is biased at a dc drain current of 0.2 mA and uses $R_D = 10 \text{k}\Omega$. let $V_{DD} = 3.0 \text{V}$. Calculate the voltage gain with a correct sign. You may neglect the channel-length modulation for the DC bias point.

2. Consider a circuit. The threshold voltage of the NMOSFET is 1.5 V. $\mu_n C_{ox} \frac{W}{L} = 0.25 \text{mA}/\text{V}^2$. A resistive load of $10 \text{k}\Omega$ is used. The output resistance of the NMOSFET is $47 \text{k}\Omega$. (Consider it only for the small-signal case.) Calculate the voltage gain with a correct sign.



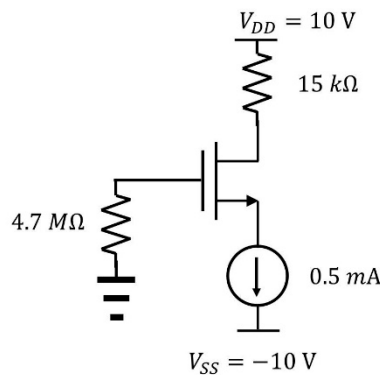
3. In the schematic for the Problem#2, a student omitted the capacitor connected to the drain terminal. In other words, the load resistor is directly connected to the drain terminal. Discuss what is wrong in the mistakenly-modified schematic.

4. A common-source amplifier utilizes a NMOSFET biased at 0.25 mA with $V_{GS} - V_{TH} = 0.25 \text{V}$. The NMOSFET is in the saturation region. The output resistance of the MOSFET is $200 \text{k}\Omega$. The drain resistance is $20 \text{k}\Omega$. Calculate the voltage gain with a correct sign.

5. Consider the same amplifier in the Problem#4. A load resistance of $5\text{ k}\Omega$ is additionally connected to the output. (Of course, a large capacitor is also used.) Calculate the voltage gain with a correct sign.

6. A common-source amplifier with a source-degeneration resistance, R_S , utilizes a NMOSFET biased at 0.25 mA with $V_{GS} - V_{TH} = 0.25\text{ V}$. The NMOSFET is in the saturation region. Ignore the output resistance of the MOSFET. The drain resistance is $20\text{ k}\Omega$ and a load resistance is $5\text{ k}\Omega$. Assume that $R_S = 1.5\text{ k}\Omega$. Calculate the voltage gain with a correct sign.

7. Consider the following circuit. The threshold voltage of the NMOSFET is 1.5 V and $\mu_n C_{ox} \frac{W}{L}$ is 1 mA/V^2 . Calculate the source voltage.



8. Consider the following circuit. Two NMOSFETs have the same threshold voltage, 0.7 V . $\mu_n C_{ox} = 200\text{ }\mu\text{A/V}^2$. The length and width of the left transistor are $1\text{ }\mu\text{m}$ and $10\text{ }\mu\text{m}$, respectively. The right NMOSFET has the same parameters, except for the width of $50\text{ }\mu\text{m}$. Calculate the drain current of the right NMOSFET.

