Lab #6

Enhancement MOSFET Amplifiers

Purpose

This lab introduces the N-channel enhancement MOSFET amplifiers, and provides an opportunity to measure gain, input and output impedances and frequency response for common source, common drain and common gate configurations.

Skills to develop

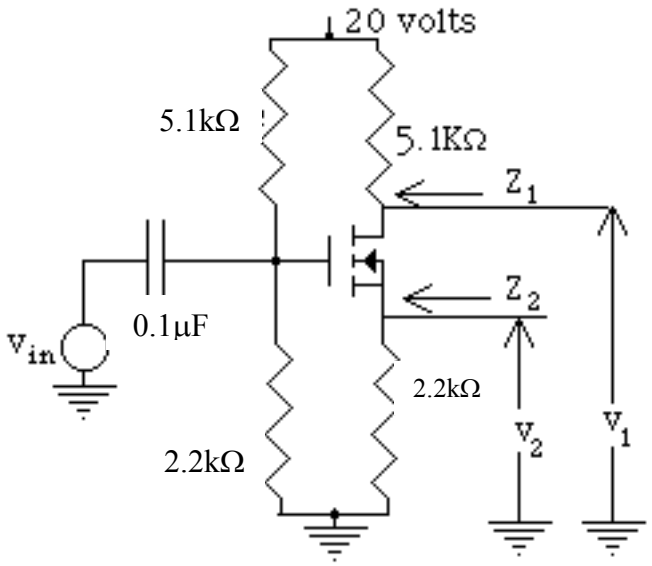
After completing this lab you should be able to:

- build an n-channel MOSFET common source amplifier and measure its gain and output impedance
- build an n-channel MOSFET common gate amplifier and measure its gain and input and output impedance
- predict analytically the gain and input and output impedances of common source and common gate amplifier circuits

Preliminary work

1) Using the data (V_T, r_o, and K (the K you calculated assuming n=2)) from the previous laboratory which you used to characterize your n channel enhancement mode MOSFET,
   a) For part I, find midband values (where the capacitor is considered as a short circuit) for:
      1) Calculate the gains $\frac{v_1}{v_{in}}$ and $\frac{v_2}{v_{in}}$ in db.
      2) Calculate the impedances Z_1 and Z_2.
   b) For part II:
      1) Calculate the gain $\frac{v_1}{v_{in}}$ in db.
      2) Calculate the impedances Z_1 and Z_2.

Part I: Amplifier Using a Voltage Divider Bias Scheme



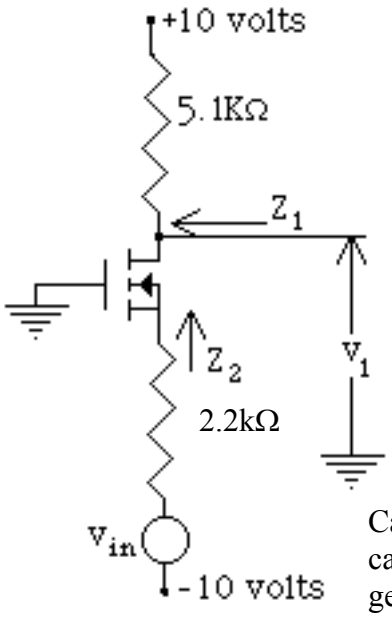
a) For the circuit shown, measure the voltage gains $\frac{v_1}{v_{in}}$ and $\frac{v_2}{v_{in}}$ in the frequency range from midband down to where the gain is down 3db from its midband value. Select the appropriate frequencies on a 1-2-5 basis in the range from 100Hz to10kHz. Try to determine the 3 dB frequency due to the input coupling capacitor.

b) Devise a technique to measure the impedances Z_1 and Z_2. Perform the measurement at 1kHz. Compare your results to your prelab calculations.

Reporting:

1) From part a), plot both the experimental and the calculated gains in db versus log frequency (Bode plot). Explain any SIGNIFICANT differences (differences greater than 5%) from your prelab calculations. Calculate the value of frequency at which the gains are down 3db. (Hint: At what value of frequency is the reactance of the input bypass capacitor EQUAL to the resistance it sees? Does this frequency agree with your measured 3dB frequency?)
2) Make a table comparing the calculated and experimental values of Z_1 and Z_2. Explain any SIGNIFICANT differences (differences greater than 5%) from your prelab calculations.

Part II: Common Gate Amplifier



Careful! Use the DC offset capability of the function generator for –10V supply.

a) For the circuit shown, measure the voltage gain $\frac{v_1}{v_{in}}$ in the frequency range from 100Hz to 10kHz. Select the appropriate frequencies on a 1-2-5 basis.

b) Devise a technique to measure the impedances Z_1 and Z_2. Perform the measurement at 1kHz.

Reporting:

1) From part a), plot both the experimental gain in db versus log frequency (Bode plot). What value of gain did you calculate and how did it compare to the experimental value of gain. Is the gain a function of frequency? Explain. Explain any SIGNIFICANT differences (differences greater than 5%) from your calculations.
2) Make a table comparing the calculated and experimental values of Z_1 and Z_2. Explain any SIGNIFICANT differences (differences greater than 5%) from your prelab calculations.