Experiment #8 ENEE2103

The Field-Effect Transistor

Objectives:

1. To understand the difference between the bipolar and the field effect transistor.
2. To examine the characteristics of N-channel JFET when using as a common source and common drain.

Pre-lab Work:

1. Simulate the circuits in the procedure section and determine the required values (set the parameters that must be assigned by the instructor in the procedure to proper values).
2. Verify if Simulation Results match the expected results

Procedure:

I. CHARACTERESTICS OF AN N-CHANNEL JFET.

1. Connect the circuit of Fig.(8-1) taking into account the polarities.

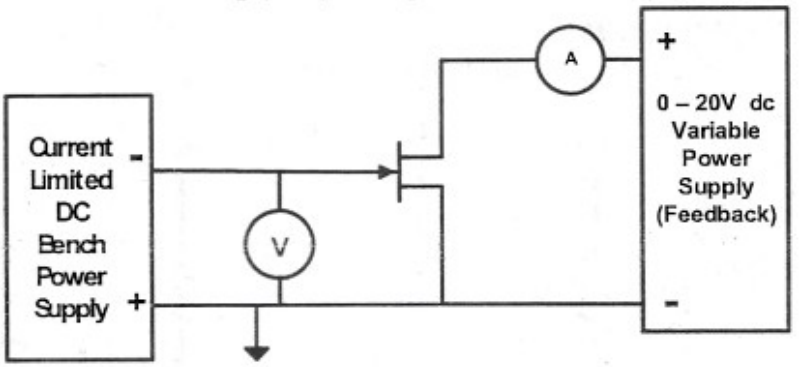

Fig. (8.1)

2. Set the current limit on the bench power supply to its minimum value .
3. Set the voltage to zero , then switch on the power supply.
4. Set the V_{DS} to the first value in table 8.1 , and then read I_D for each value of V_{GS}.
5. Repeat for all the values of V_{DS} in the table, recording the corresponding I_D values.
6. Plot the results from your table onto your graph, drawing one curve of I_D against V_{DS} for each value of V_{GS}.

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Table 8.1

V_{GS}(V)		I_D(mA) for V_{DS}=(V)						
Desired	**Actual**	**0**	**0.5**	**1**	**2**	**5**	**10**	**15**
0	0	33.9μA	1.2mA	2.8mA	4.7mA	5.8mA	6mA	6mA
-0.5	-0.5	34.7μA	1.1mA	2.4mA	3.6mA	4.5mA	4.7mA	4.7mA
-1.0	-1	33.3μA	.91mA	1.54mA	2.45mA	3.29mA	3.75mA	3.63mA
-1.5	-1.5	34.μA	0.7mA	1.22mA	1.79mA	1.76mA	1.82mA	1.85mA
-2.0	-2	28.5μA	0.52mA	0.75mA	0.89mA	0.97mA	1.01mA	1.03mA
-2.5	-2.5	22.5μA	0.24mA	0.26mA	0.31mA	0.34mA	0.36mA	0.37mA

7. Now go back to your circuit and set V_{DS} to 10 V and V_{GS} to -1.0 V ,then try to measure I_G.

Note: When preparing the prelab in Pspice use dc and parametric sweep to get the curves measured in Table 8.1

Questions:

- From your graph above which values of V_{DS} is I_D almost unaffected by V_{DS} when V_{GS}=0?
- For a given value of V_{DS} , (say 10 V),do equal changes of V_{GS} cause equal changes of I_D?
- Can you measure I_G or is it too small?
- From your graph, estimate the change in I_D for 0.5 change in V_{GS} when V_{DS} =10 V , and V_{GS} -1.0 V ,then find the trans conductance of the transistor(g_m).

Note: trans-conductance g_m =(change in I_D)/(change in V_{GS}).

II. A JFET AMPLIFIER.

1. Connect the circuit as shown in Fig. (8-2).

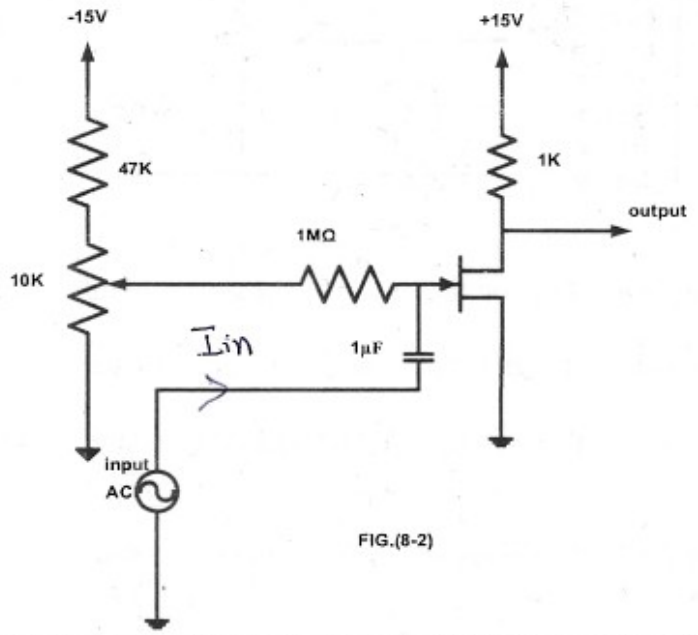

FIG.(8-2)

2. Set the sine wave generator to a frequency of 1 kHz ,but either disconnect its output ,or turn its output amplitude to zero, so there is no signal input to the circuit.
3. Set the potentiometer to give a value of +10 V for V_{DS}.
4. Now apply an input of 2volts peak-to-peak from the generator and observe the output on the oscilloscope.
5. Measure the peak-to-peak output voltage and calculate the voltage gain.

6. Measure the ac input current and voltage using DMM and calculate the input impedance Zin seen by the source.

III. COMMON DRAIN AMPLIFIER.

1. Connect the circuit as shown in fig. (8-3).

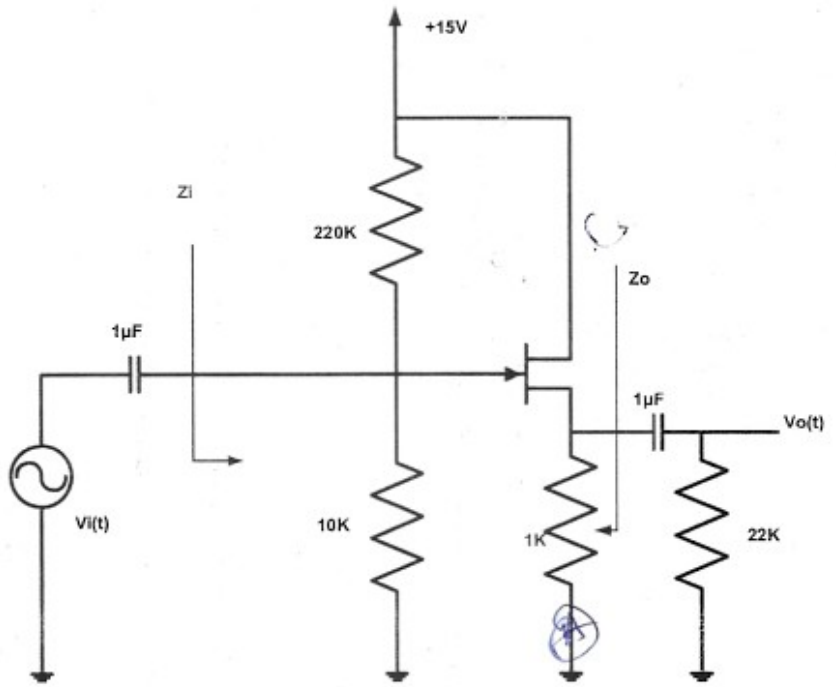

Fig.(8-3)

2. Set the sine wave generator to a frequency of 1 kHz ,but either disconnect its output ,or turn its output amplitude to zero, so there is no signal input to the circuit.
3. Measure the DC voltages of V_G, and V_S.
4. Now apply an input of 0.4 volts peak-to-peak from the generator and observe the output on the oscilloscope.
5. Calculate the voltage gain and the phase shift between the input and output voltage.
6. Measure the values of Z_{in} and Z_{out} using the appropriate voltages and currents at the places shown in the previous figure.

Question:

- Compare the voltage gain of step 5 with the theoretical gain value.