Electrical and Computer Engineering Department

Written by:

Group K

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ECE 2200L:

Experiment Number 10

MOSFET Transistor Current-Voltage characteristics

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Background Information:

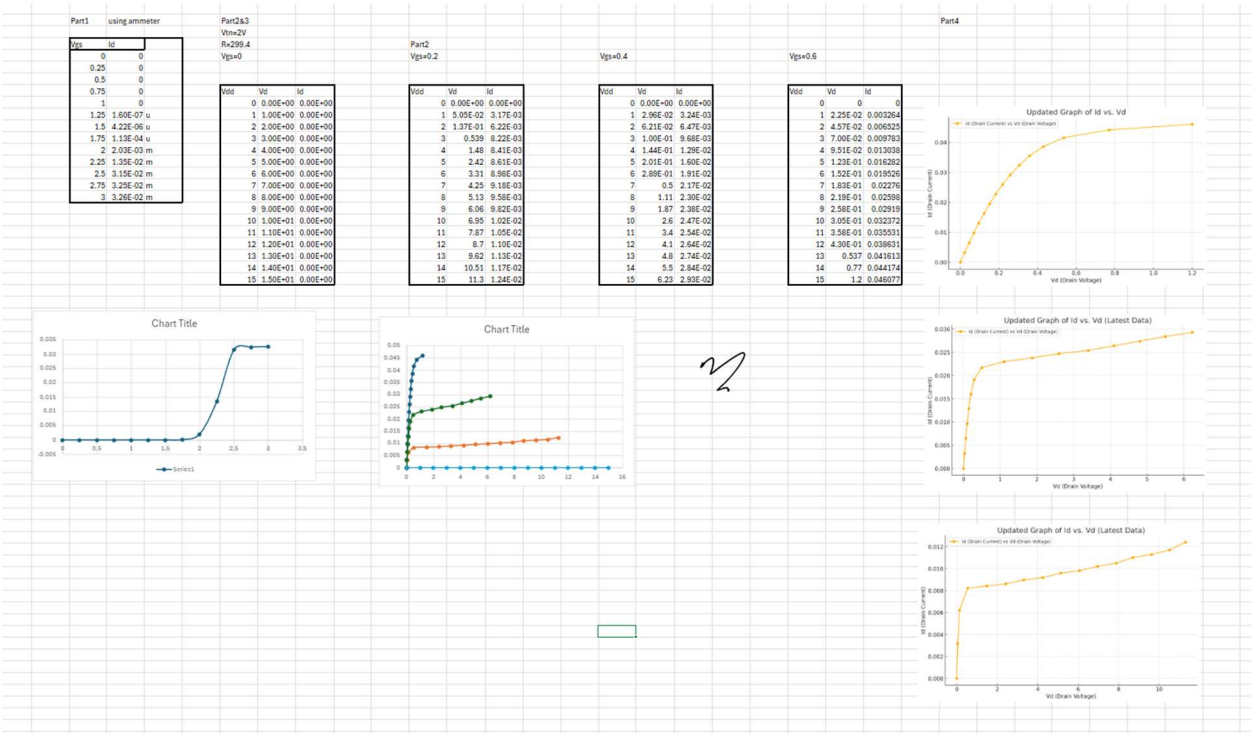
A MOSFET is a different type of FET. It stands for metal oxide semiconductor field effect transistor.

Objective:

To study the transfer characteristic and output characteristics of the Metal Oxide Semiconductor Field Effect Transistor (MOSFET) through Spice simulations.

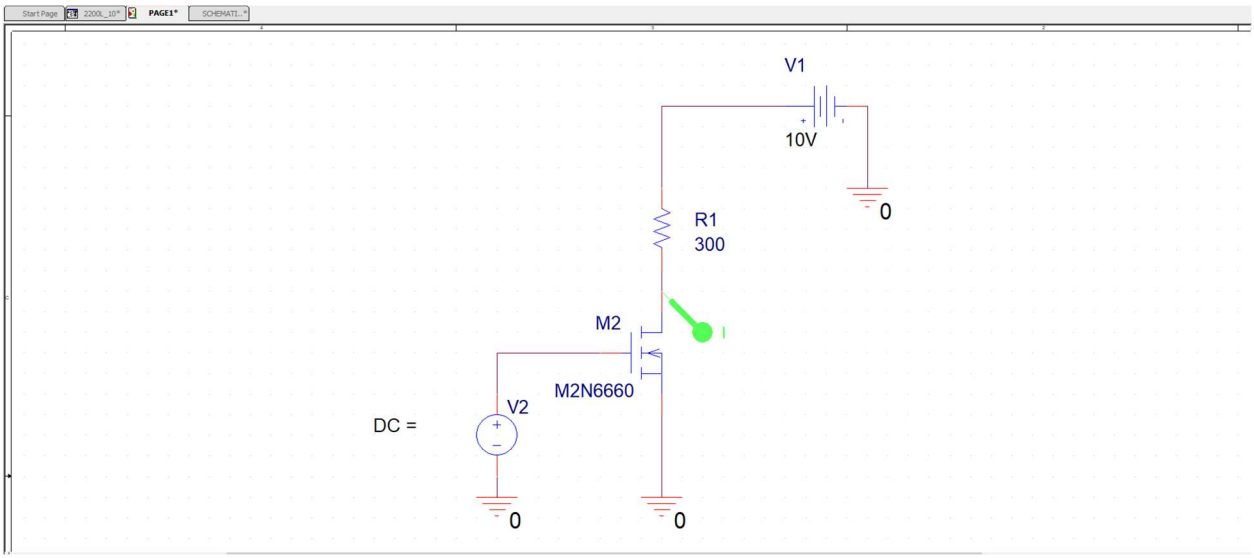
Evidence:

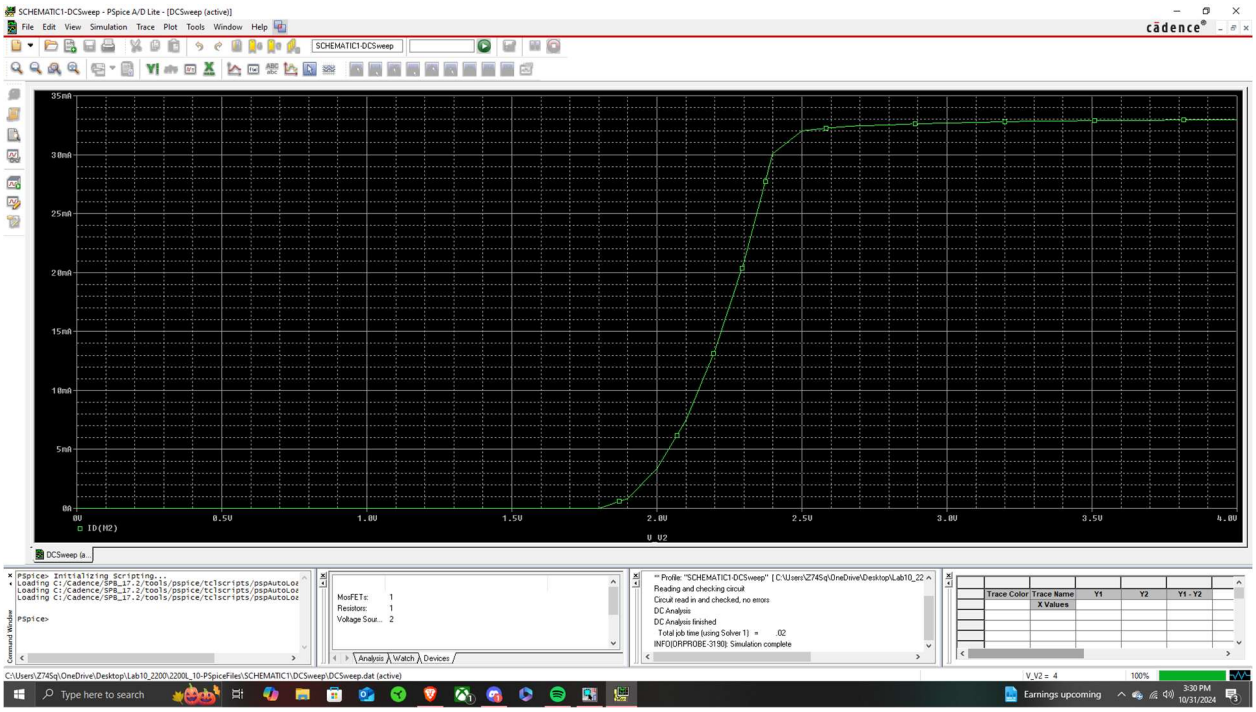
Proof of work approved



Pre-Lab:

1) Capture the circuit of Figure 1 in PSpice.
2) Run simulation (DC sweep) changing V_{gs} from 0 to 2.5V or 3V with increments of 0.1V
3) Determine the Threshold voltage V_{TH}





Lab Report:

Figure 1:

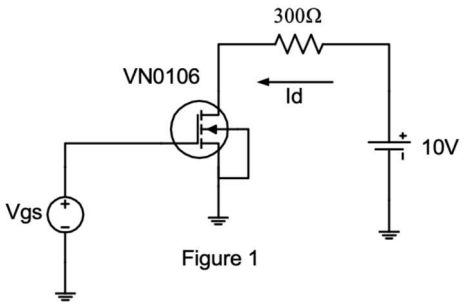


Figure 1

1. Determine the Transfer Characteristics of Figure 1.

Part 1

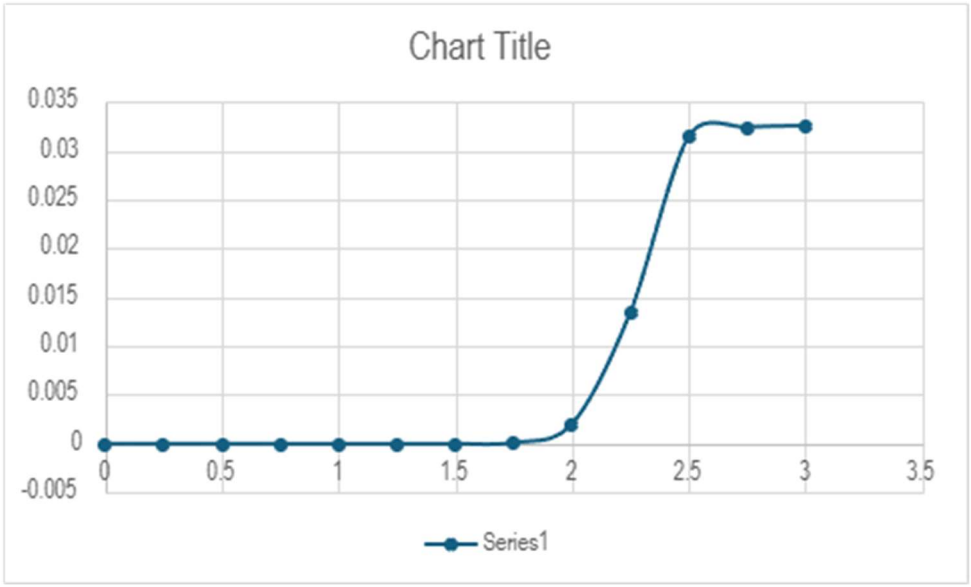
Using ammeter

Vgs	Id	
0	0	
0.25	0	
0.5	0	
0.75	0	
1	0	
1.25	1.60E-07	u
1.5	4.22E-06	u
1.75	1.13E-04	u
2	2.03E-03	m
2.25	1.35E-02	m
2.5	3.15E-02	m
2.75	3.25E-02	m
3	3.26E-02	m

Part 2&3

Vtn = 2V ; R = 299.4 ; Vgs = 0

Vdd	Vd	Id
0	0.00E+00	0.00E+00
1	1.00E+00	0.00E+00
2	2.00E+00	0.00E+00
3	3.00E+00	0.00E+00
4	4.00E+00	0.00E+00
5	5.00E+00	0.00E+00
6	6.00E+00	0.00E+00
7	7.00E+00	0.00E+00
8	8.00E+00	0.00E+00
9	9.00E+00	0.00E+00
10	1.00E+01	0.00E+00
11	1.10E+01	0.00E+00
12	1.20E+01	0.00E+00
13	1.30E+01	0.00E+00
14	1.40E+01	0.00E+00
15	1.50E+01	0.00E+00



Part 1 Graph – Using ammeter

2. Find the Output characteristics Curve (done before)
3. Do the same but with 0.2 , 0.4 , 0.6 volts increments

Vgs = 0.2

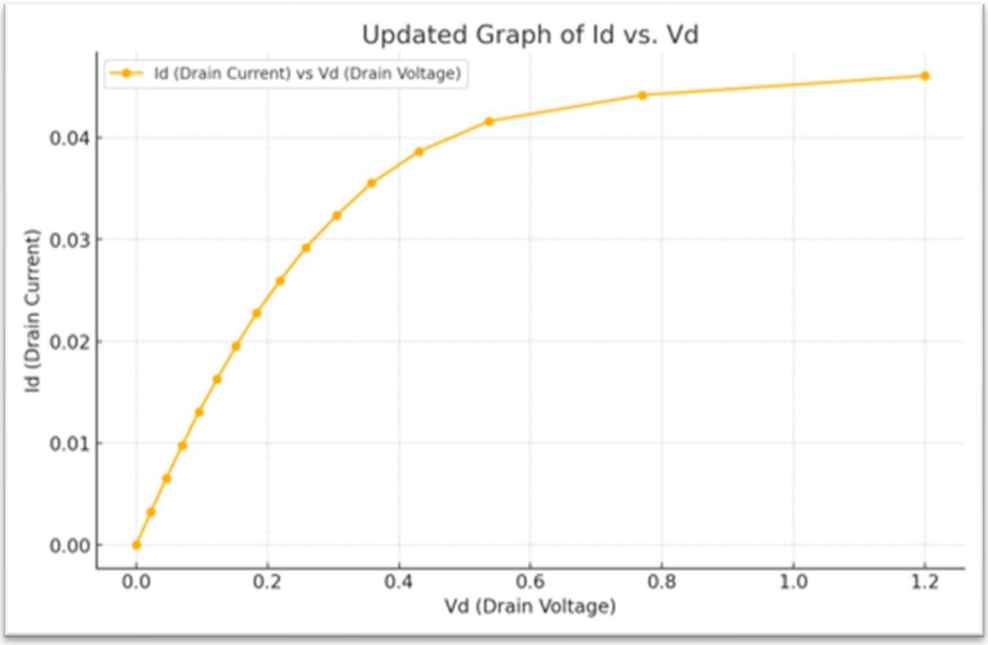
Vdd	Vd	Id
0	0.00E+00	0.00E+00
1	5.05E-02	3.17E-03
2	1.37E-01	6.22E-03
3	0.539	8.22E-03
4	1.48	8.41E-03
5	2.42	8.61E-03
6	3.31	8.98E-03
7	4.25	9.18E-03
8	5.13	9.58E-03
9	6.06	9.82E-03
10	6.95	1.02E-02
11	7.87	1.05E-02
12	8.7	1.10E-02
13	9.62	1.13E-02
14	10.51	1.17E-02
15	11.3	1.24E-02

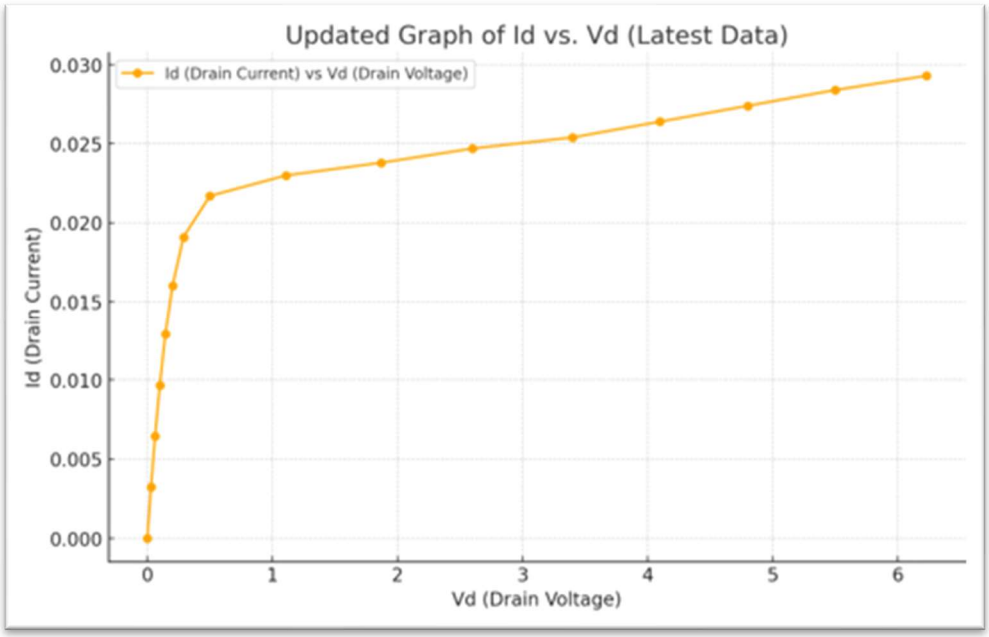
Vgs = 0.4

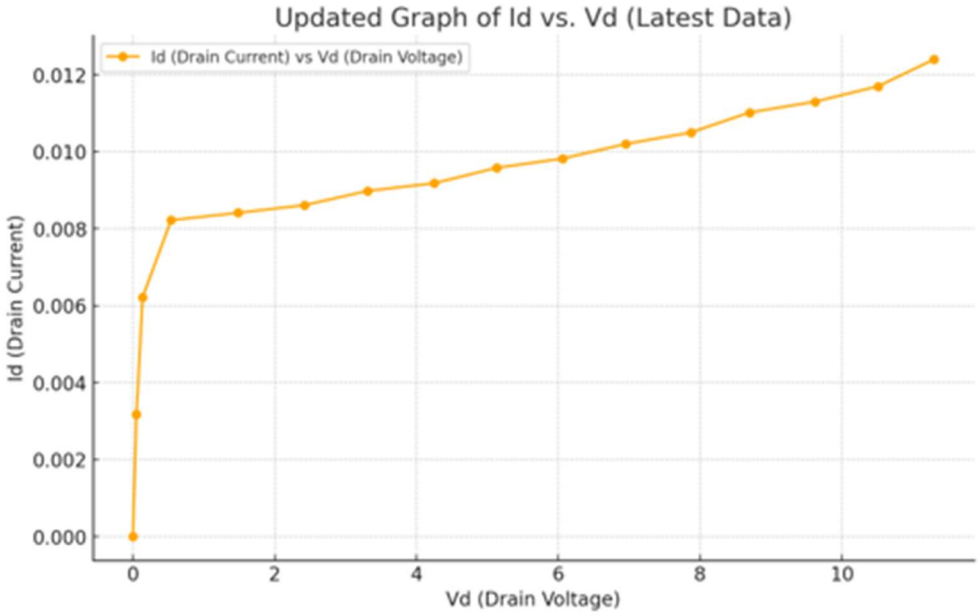
Vdd	Vd	Id
0	0.00E+00	0.00E+00
1	2.96E-02	3.24E-03
2	6.21E-02	6.47E-03
3	1.00E-01	9.68E-03
4	1.44E-01	1.29E-02
5	2.01E-01	1.60E-02
6	2.89E-01	1.91E-02
7	0.5	2.17E-02
8	1.11	2.30E-02
9	1.87	2.38E-02
10	2.6	2.47E-02
11	3.4	2.54E-02
12	4.1	2.64E-02
13	4.8	2.74E-02
14	5.5	2.84E-02
15	6.23	2.93E-02

Vgs = 0.6

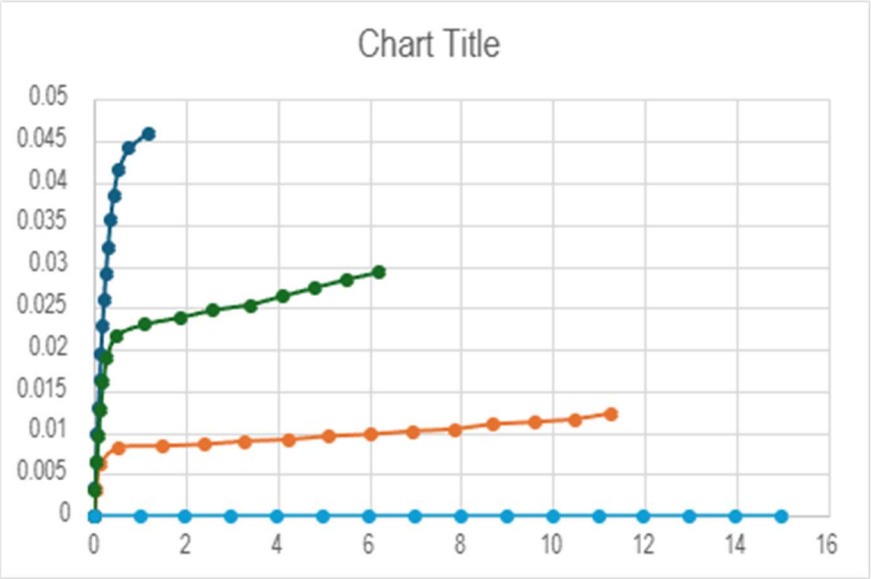
Vdd	Vd	Id
0	0	0
1	2.25E-02	0.003264
2	4.57E-02	0.006525
3	7.00E-02	0.009783
4	9.51E-02	0.013038
5	1.23E-01	0.016282
6	1.52E-01	0.019526
7	1.83E-01	0.02276
8	2.19E-01	0.02598
9	2.58E-01	0.02919
10	3.05E-01	0.032372
11	3.58E-01	0.035531
12	4.30E-01	0.038631
13	0.537	0.041613
14	0.77	0.044174
15	1.2	0.046077


Updated Graph of Id vs. Vd
Id (Drain Current) vs Vd (Drain Voltage)
Id (Drain Current)
0.00
0.01
0.02
0.03
0.04
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Vd (Drain Voltage)


Updated Graph of Id vs. Vd (Latest Data)
Id (Drain Current) vs Vd (Drain Voltage)
Id (Drain Current)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0
1
2
3
4
5
6
Vd (Drain Voltage)


Updated Graph of Id vs. Vd (Latest Data)
Id (Drain Current) vs Vd (Drain Voltage)
Id (Drain Current)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0
2
4
6
8
10
Vd (Drain Voltage)

4. Determine the K (“Gain Factor”) for the MOSFET.



- From the above graph and data, we can estimate that $V_{DS} \approx 10V \; at \; I_{DS} \approx 1mA$
- $V_{GS} = V_{TH} + 0.2$
- $I_D = \frac{K}{2}[V_{GS} - V_{TH}]^2$ => $K = \frac{2I_D}{[V_{GS} - V_{TH}]^2} = 0.052$

Conclusion:

In this lab, we worked with a MOSFET and studied the current-voltage characteristics. We calculated the value of K at the end of the experiment.