CSE 251
Electronic Devices And Circuit Lab

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Group: 01

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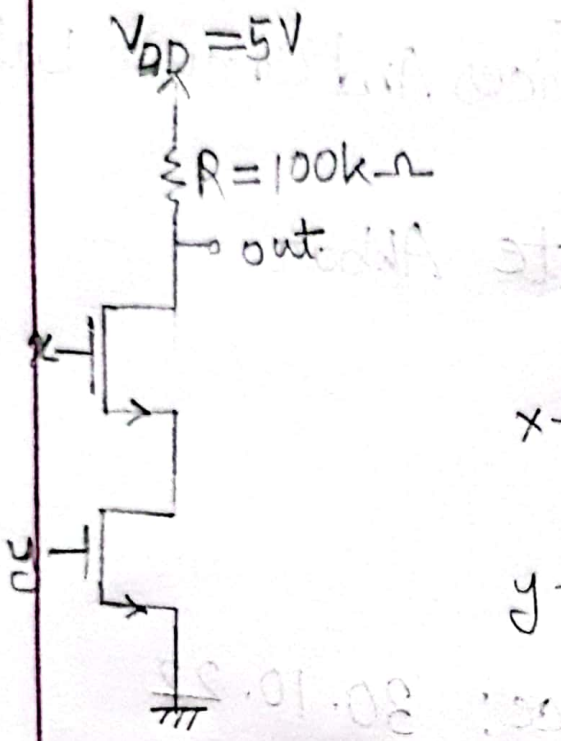
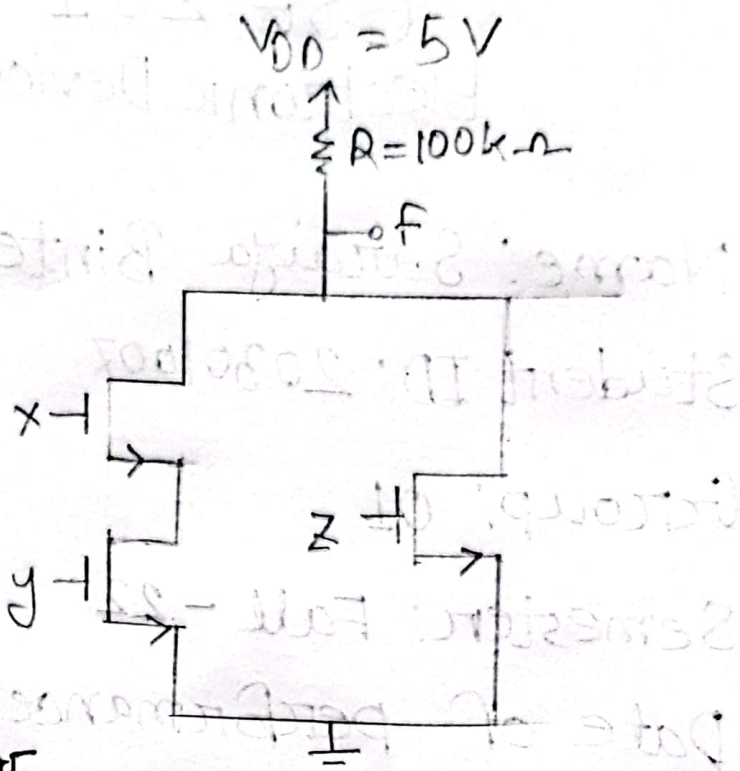
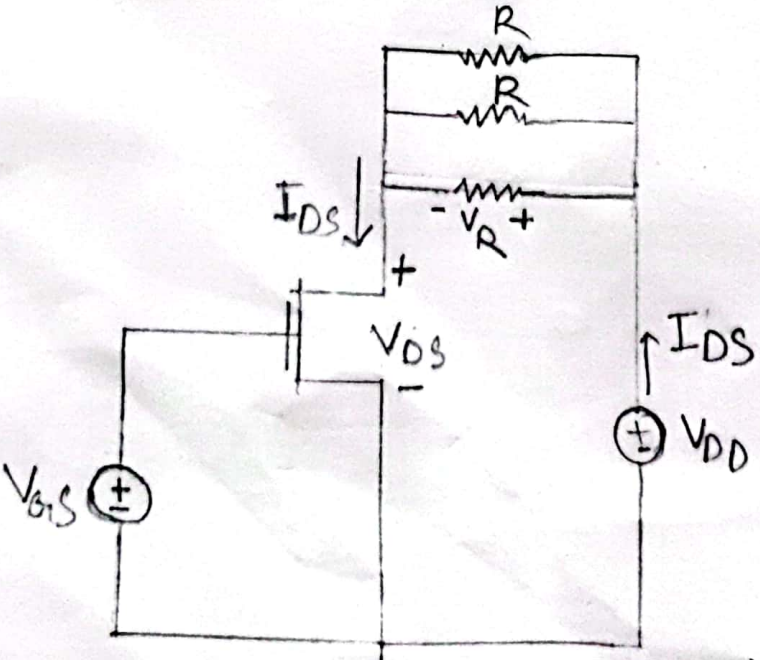
Circuit Diagrams:



Circuit1: NAND GATE USING MOSFET



Circuit 2: Logical function $f = \overline{xy+z}$ using MOSFET



Circuit 3: Circuit for measurement of IV characteristics (I_{DS} Vs V_{DS}) of MOSFET

Data Table 1: Verification of The Truth Tables of Logic Gate and Logical Function

1. NAND Gate

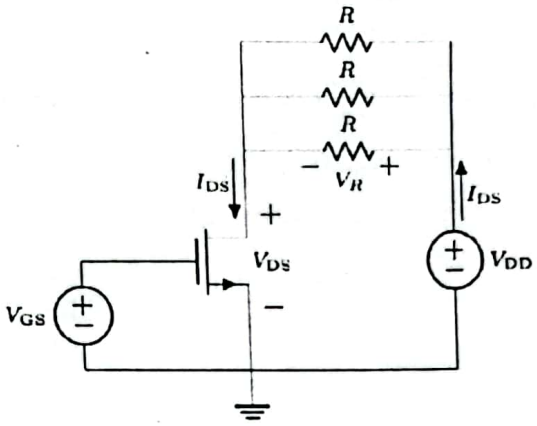
Input Voltage, V_x (volt)	Input Voltage, V_y (volt)	State of LED (On/Off)	Boolean Output (0 or 1)
0V	0V	ON	1
0V	5V	ON	1
5V	0V	ON	1
5V	5V	OFF	0

2. Logical Function, f = $\overline{xy + z}$

Input Voltage, V_x (volt)	Input Voltage, V_y (volt)	Input Voltage, V_z (volt)	State of LED (On/Off)	Boolean Output (0 or 1)
0V	0V	0V	ON	1
0V	0V	5V	off	0
0V	5V	0V	ON	1
0V	5V	5V	off	0
5V	0V	0V	ON	1
5V	0V	5V	off	0
5V	5V	0V	off	0
5V	5V	5V	off	0

30.08.21

Task-02: I-V Characteristics of a MOSFET



Circuit 3: Circuit for measurement of IV characteristics (I_{DS} vs V_{DS}) of MOSFET

Procedure

1. For studying the IV characteristics of MOSFET, construct the Circuit 3, keeping R = 2.2 kΩ.
2. Now, keeping V_{GS} constant **exactly** at 2.9 V, increase V_{DD} from 0 V to 20 V and measure the corresponding voltage across the resistor V_R. Calculate the drain current, I_{DS} for each value of V_{DD} by using, $I_{DS} = \frac{V_R}{R}$. In addition to this, measure the drain-source voltage V_{DS}. Fill in the Data Table 2.
3. Repeat Step-2 for V_{GS} = 2.85 V and Fill in the Data Table 3.

Data Table 2: I-V Characteristics Data for V_{GS} = 2.9 V

Equivalent Resistance, R_{eq} = 0.79 (using Multimeter)

V_{DD} (volt)	V_{DS} (volt)	V_R (volt)	$I_{DS} = V_R/R_{eq}$ (mA)
0	1.5mV	45.7mV	0.063
2	0.793	1.15V	1.599
4	2.77	1.195V	1.662
6	4.74	1.20V	1.66
8	6.78	1.203	1.673
10	8.29	1.22	1.69
12			
12	10.52	1.28	1.78
14	12.80	1.28	1.78

V_{DD} (volt)	V_{DS} (volt)	V_R (volt)	$I_{DS} = V_R/R_{eq}$ (mA)
1	49mV	0.915	1.273
1.5	0.29V	1.057	1.47
2.5	1.30V	1.115	1.550
3	1.83V	1.28	1.780
5	3.82V	1.156	1.60

Data Table 3: I-V Characteristics Data for V_{GS} = 2.85 V

Equivalent Resistance, R_{eq} = 0.719 (using Multimeter)

V_{DD} (volt)	V_{DS} (volt)	V_R (volt)	$I_{DS} = V_R/R_{eq}$ (mA)
0	1.6mV	1.8mV	2.50×10^{-3}
2	1.23	0.731V	1.016
4	3.19	0.722	1.004
6	5.3	0.729	1.006
8	7.28	0.730	1.01
10	9.17	0.733	1.01
12	11.28	0.734	1.02
14	13.22	0.738	1.02

V_{DD} (volt)	V_{DS} (volt)	V_R (volt)	$I_{DS} = V_R/R_{eq}$ (mA)
1	233mV	0.65	0.90
1.5	0.767V	0.72	1.001
2.5	1.712V	0.716	0.995
3	2.299V	0.727	1.011
5	4.27V	0.705	0.981

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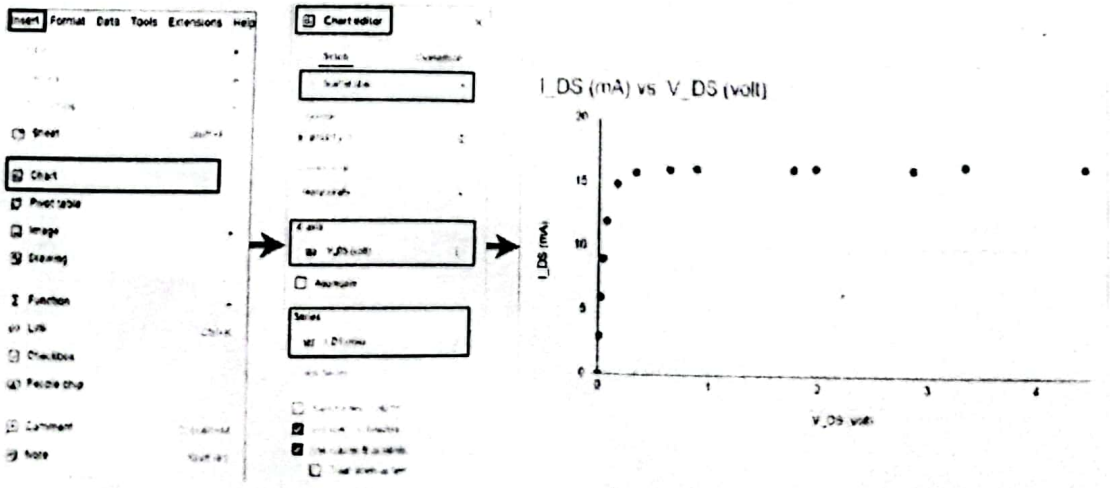
Task-03: Plotting Graphs on Excel (Home Task)

In this task, we will use the experimental data to plot the I-V characteristics of MOSFET.

1. Create a Google spreadsheet by visiting https://docs.google.com/spreadsheets
2. Fill in the spreadsheet with the data of Table 2 for V_{GS} = 2.9 V (refer to your labsheet). Select both the columns of V_{DS} and I_{DS} (to select a column, click on the column head, e.g., 'B'. Then hold CTRL while clicking the second column, e.g., 'D', to select both columns).

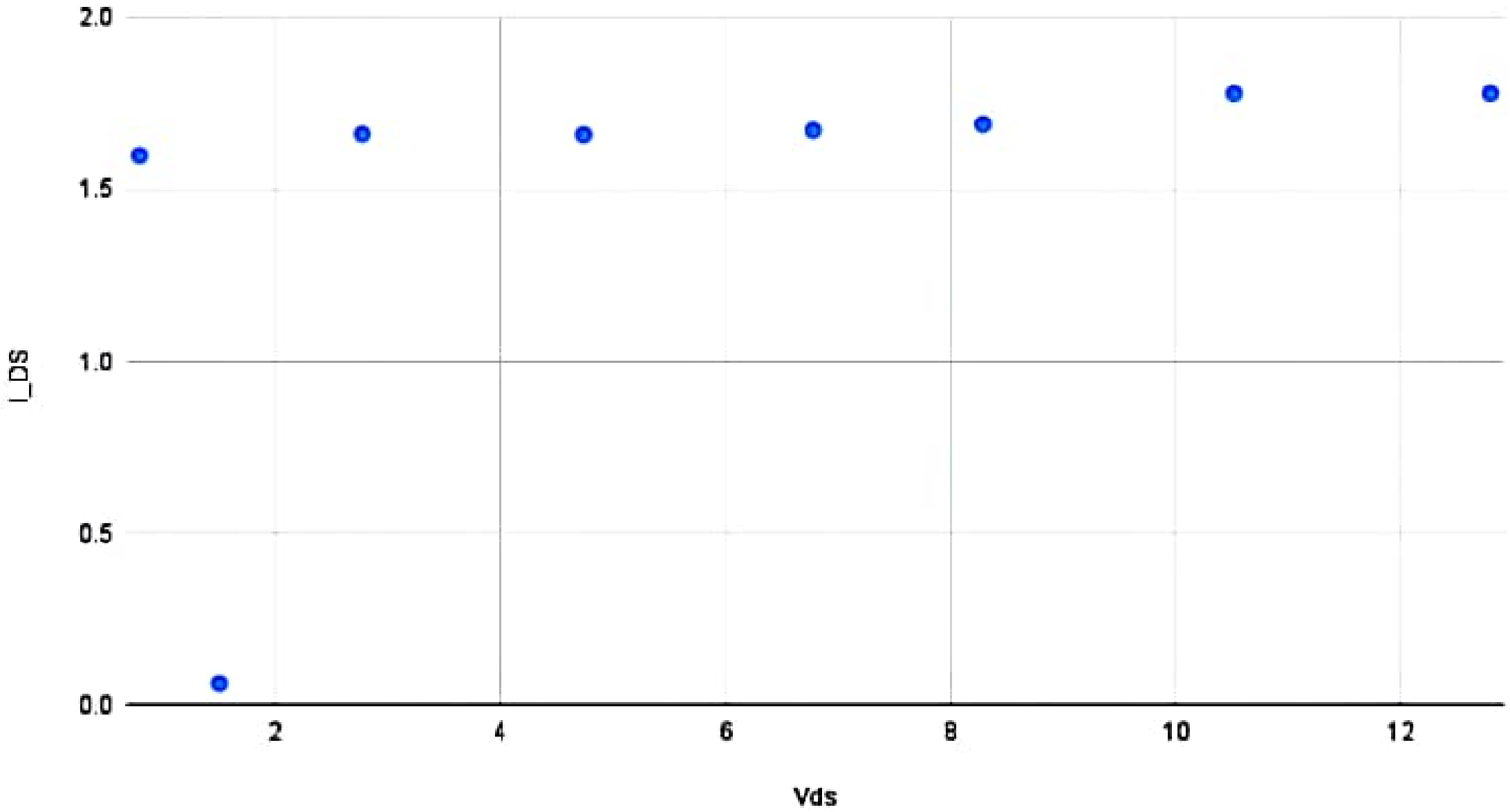
V_DD (volt)	V_DS (volt)	V_R (Volt)	I_DS (mA)
0	0	0	0
3	9.00E-03	2.942	2.971717172
6	2.15E-02	5.93	5.98989899
9	3.87E-02	8.87	8.95959596
12	6.97E-02	11.79	11.90909091
15	1.57E-01	14.68	14.82828283
16	3.35E-01	15.56	15.71717172
16.5	8.44E-01	15.79	15.94949495
17	8.87E-01	15.85	16.01010101
17.5	1.78E+00	15.9	16.06060606
18	1.98E+00	15	16.16161616
19	2.67E+00	15.97	16.13131313
20	3.35E+00	16.27	16.43434343
21	4.48E+00	16.29	16.45454545

3. Select Insert → Chart.

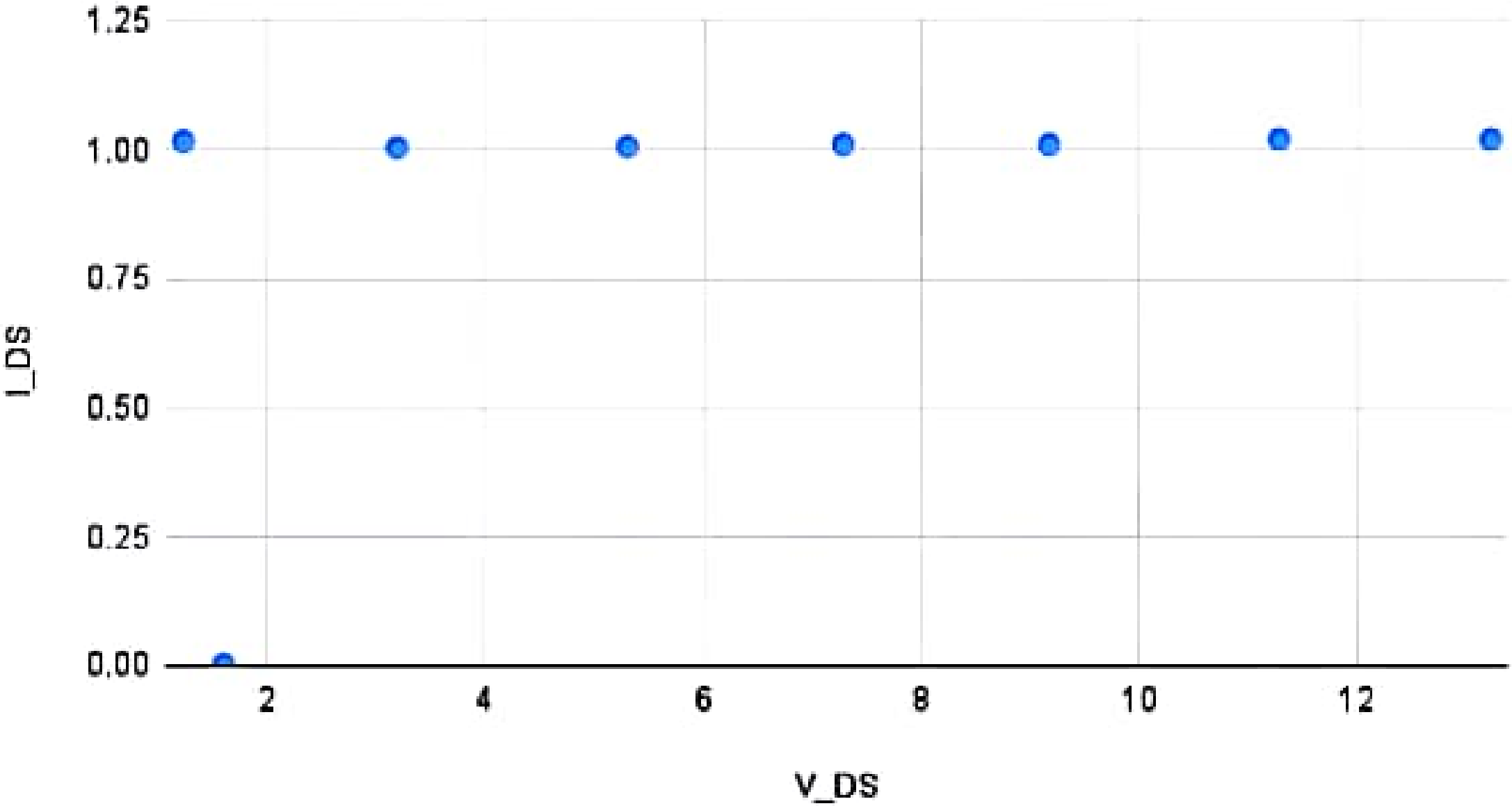


4. A Chart Editor section should pop up at the right side of your screen. If it doesn't show up, then double click on the graph. Go the setup section in the chart editor and change the 'Chart type' to 'Scatter Chart' or 'Line Chart'. Keep V_{GS} on the x-axis, and the current I_D on the y-axis.

I_DS vs. V_DS #Table 2



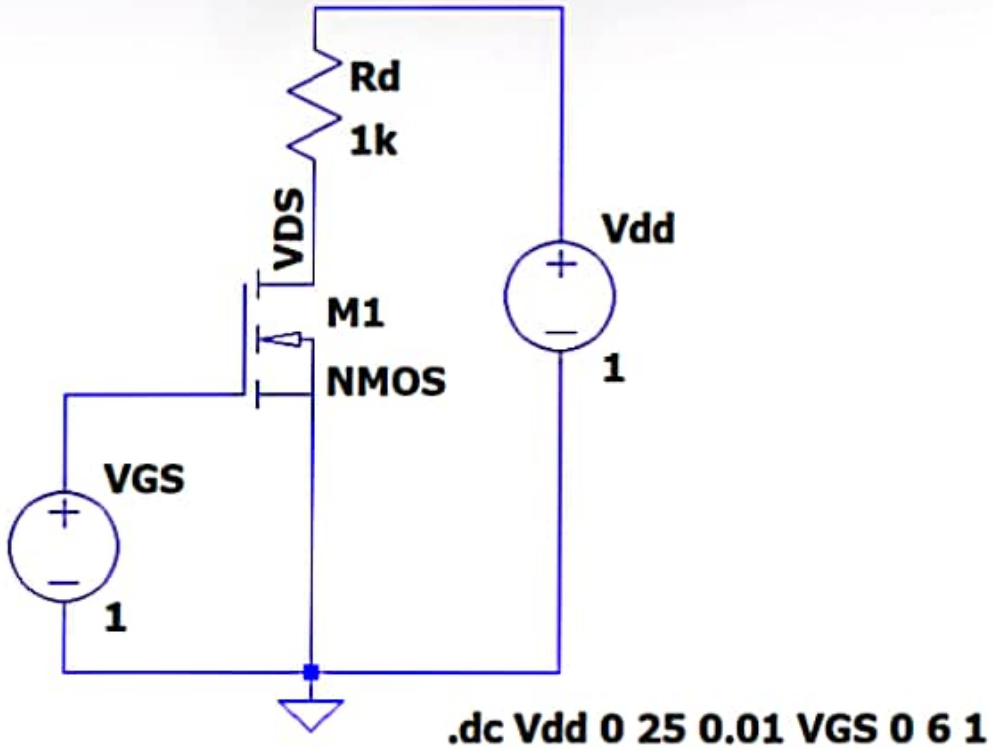
I_DS vs. V_DS #Table 3



LTspice XVII - [Aaisha]

File Edit Hierarchy View Simulate Tools Window Help

Aaisha Draft1




LTspice XVII - [Draft1]
File View Plot Settings Simulation Tools Window Help
Draft1 Draft1
I(Rd)
400µA
360µA
320µA
280µA
240µA
200µA
160µA
120µA
80µA
40µA
0µA
-3V
0V
3V
6V
9V
12V
15V
18V
21V
24V
27V
V(VDS)
Right-Click to manually enter Horizontal Axis Limits

Discussion:

While doing the experiment there was fluctuation of voltage source. We also faced problem in the voltage meter. There were also problem when implementing the circuit in breadboard.