

EXPT NO: 9

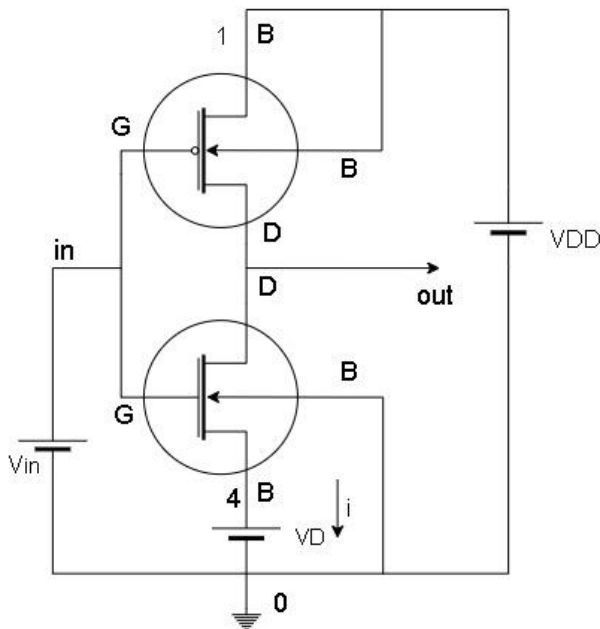
DATE:

CMOS INVERTER VOLTAGE TRANSFER CURVE USING SPICE

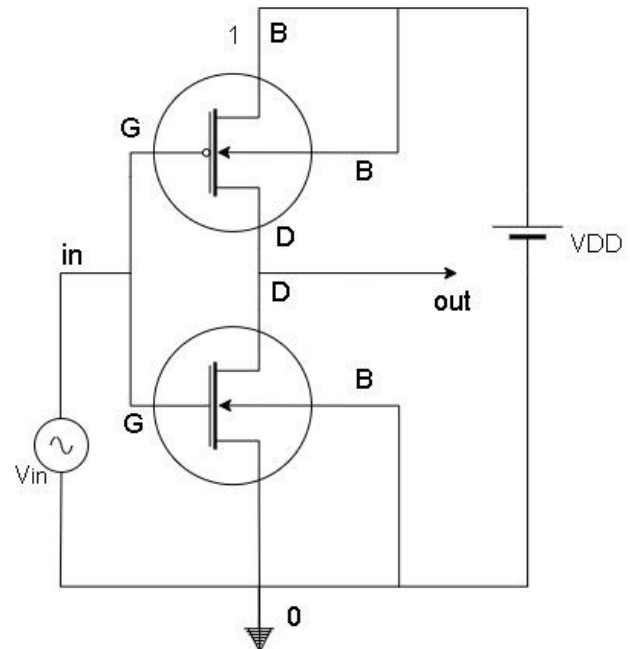
Aim: To plot the CMOS INVERTER VTC using SPICE.

Software required: Ubuntu 22.04, NGSPICE.

Circuit Diagram:



(Circuit for CMOS inverter VTC & (i vs V_{in}))



(Circuit for CMOS Transient Analysis)

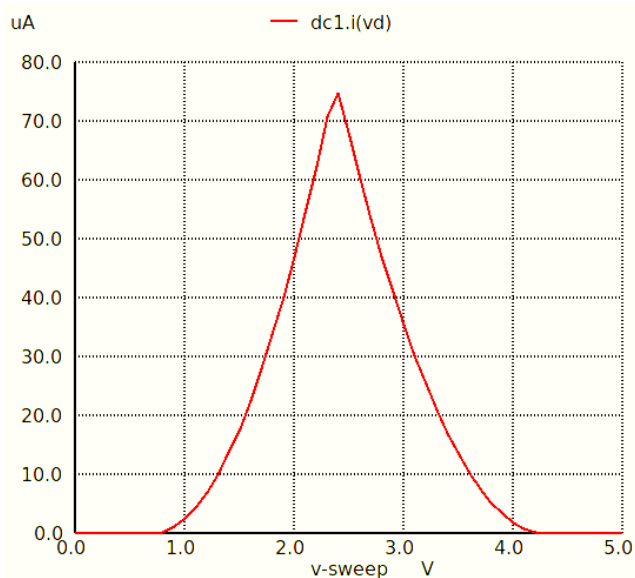
SPICE program for CMOS inverter VTC and (i vs V_{in}):

```
1 CMOS Inverter Voltage Transfer Characteristics
2
3 *Circuit parameters
4 VDD 1 0 5
5 VD 4 0 0
6 M1 out in 1 1 p_mos l=2u w=4u
7 M2 out in 4 0 n_mos l=3u w=8u
8 Vin in 0 5
9
10 * Defining model
11 .model n_mos NMOS(kp=20u vto=0.7 lambda=0.01 gamma=0.001)
12 .model p_mos PMOS(kp=20u vto=-0.7 lambda=0.01 gamma=0.001)
13
14 * DC analysis:
15 .control
16 * Plotting parameters:
17 set color0=rgb:f/f/b
18 set color1=rgb:0/0/0
19 set color2=rgb:f/0/0
20 set xbrushwidth=2
21
22 dc Vin 0 5 0.1
23
24 plot dc1.i(VD)
25 set color2=rgb:0/0/f
26 plot dc1.V(out)
27 .endc
28
29 .end
```

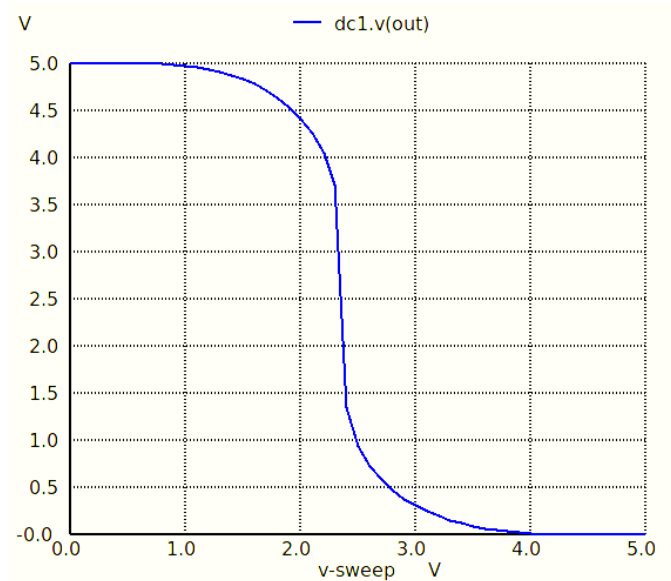
SPICE program for CMOS inverter Transient Analysis:

```
1 CMOS Inverter Transient Analysis
2
3 *Circuit parameters
4 VDD 1 0 5
5 M1 out in 1 1 p_mos l=2u w=4u
6 M2 out in 0 0 n_mos l=3u w=8u
7
8 Vin in 0 pulse(5 0 0p 50p 50p 200p 600p)
9
10 * Defining model
11 .model n_mos NMOS(kp=20u vto=0.7 lambda=0.01 gamma=0.001)
12 .model p_mos PMOS(kp=20u vto=-0.7 lambda=0.01 gamma=0.001)
13
14 * Transient Analysis
15 .control
16 * Plotting parameters:
17 tran 3p 1000p
18 set color0=rgb:f/f/b
19 set color1=rgb:0/0/0
20 set color2=rgb:f/0/0
21 set color3=rgb:0/0/f
22 set xbrushwidth=2
23
24 plot in out
25
26 .endc
27 .end
```

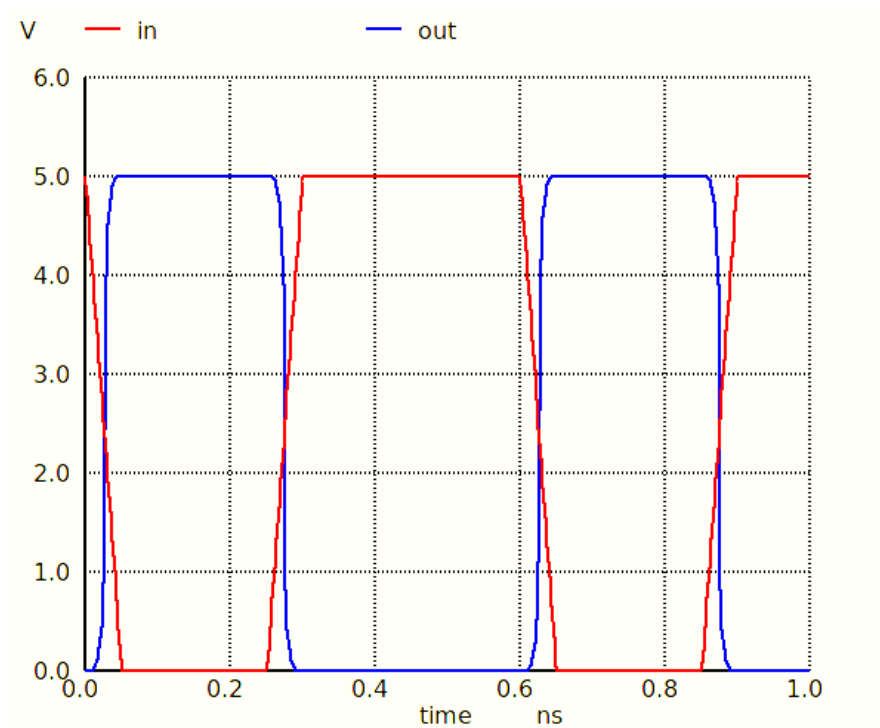
Plots:



(I_D vs V_{in} for CMOS inverter)



(VTC for CMOS inverter)



(Transient Analysis CMOS inverter)

Conclusion: The SPICE programs were written successfully to plot the CMOS inverter Voltage Transfer Characteristics, (i vs V_{in}) and Transient Analysis.