VLSI EXPERIMENT 1: NMOS, PMOS CHARACTERISTICS

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OBJECTIVE:

To analyze the V-I characteristics of NMOS and PMOS transistors.

TOOLS:

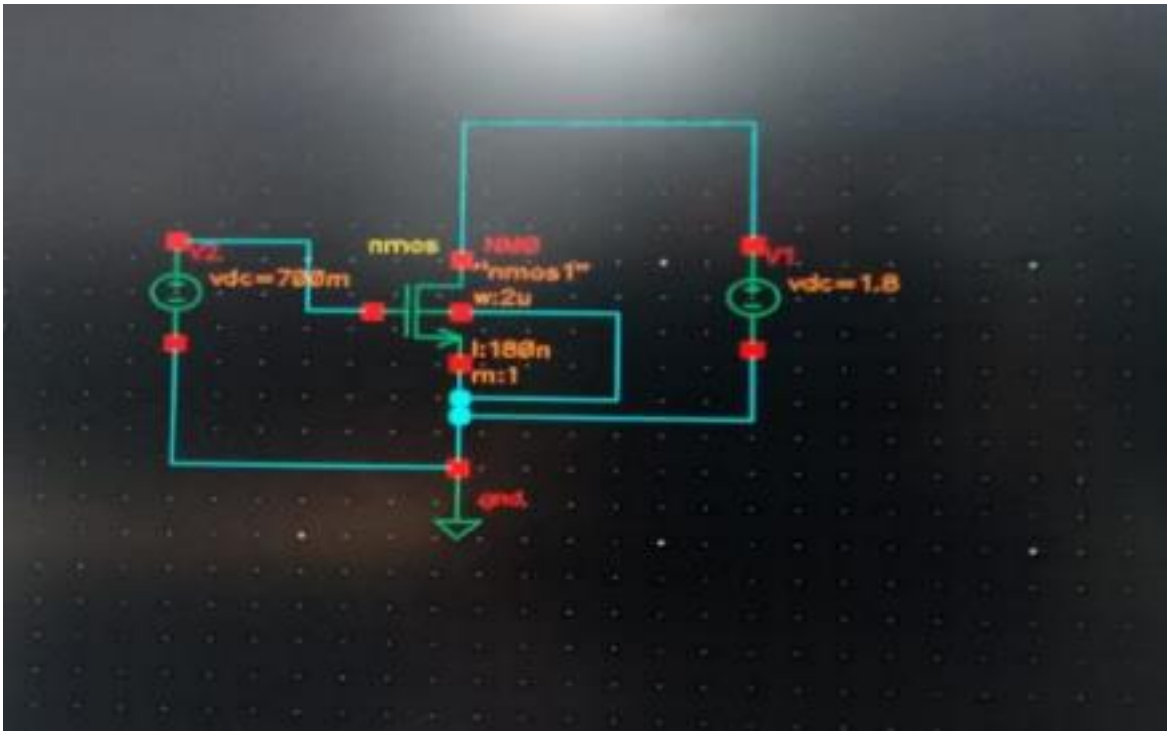
Linux operated computing system, Cadence® Virtuoso, gpdk 180nm technology library.

PROCEDURE FOR NMOS:

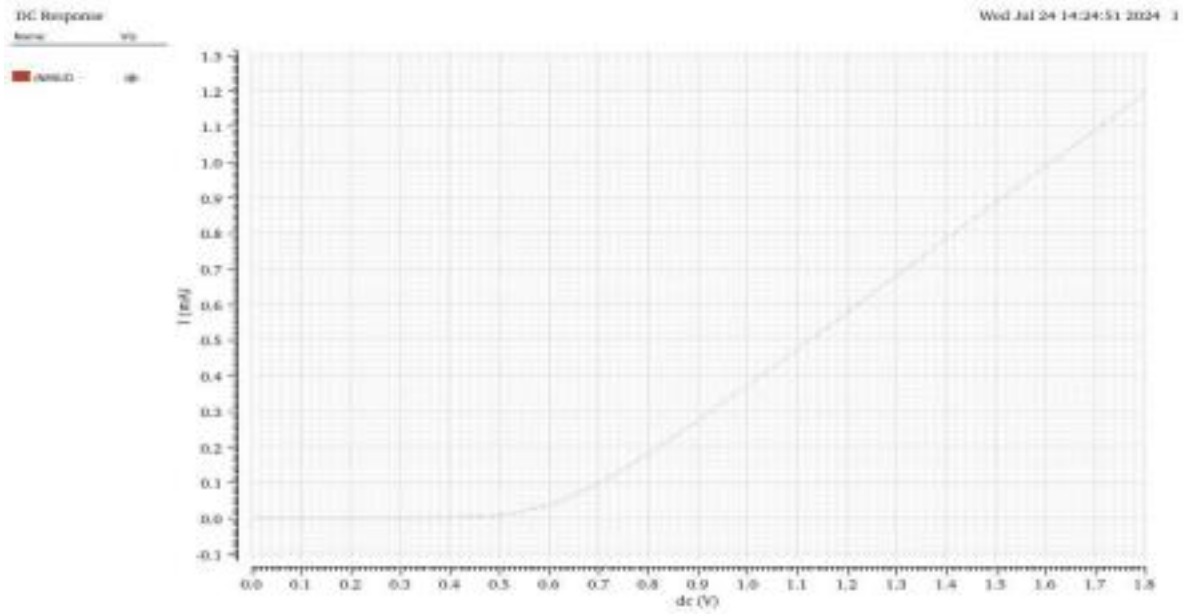
1. Create a schematic.
2. Configure DC Analysis with the input gate voltage Vgs as the component parameter and sweep range of 0 to 1.8V
    a) Plot the drain current Id.
3. Define the input gate voltage VGS as a variable parameter “x”
    a) Configure dc analysis for various drain source voltage Vds by defining it as the component parameter and sweep range of 0 to 1.8V.
    b) Plot the drain current Id.
    c) Perform the parametric analysis for various values of Vgs which is defined as “x”.
4. Vary the width of the NMOS as “w” and plot input characteristics for 7 different potentials using parametric analysis.

SCREENSHOTS:

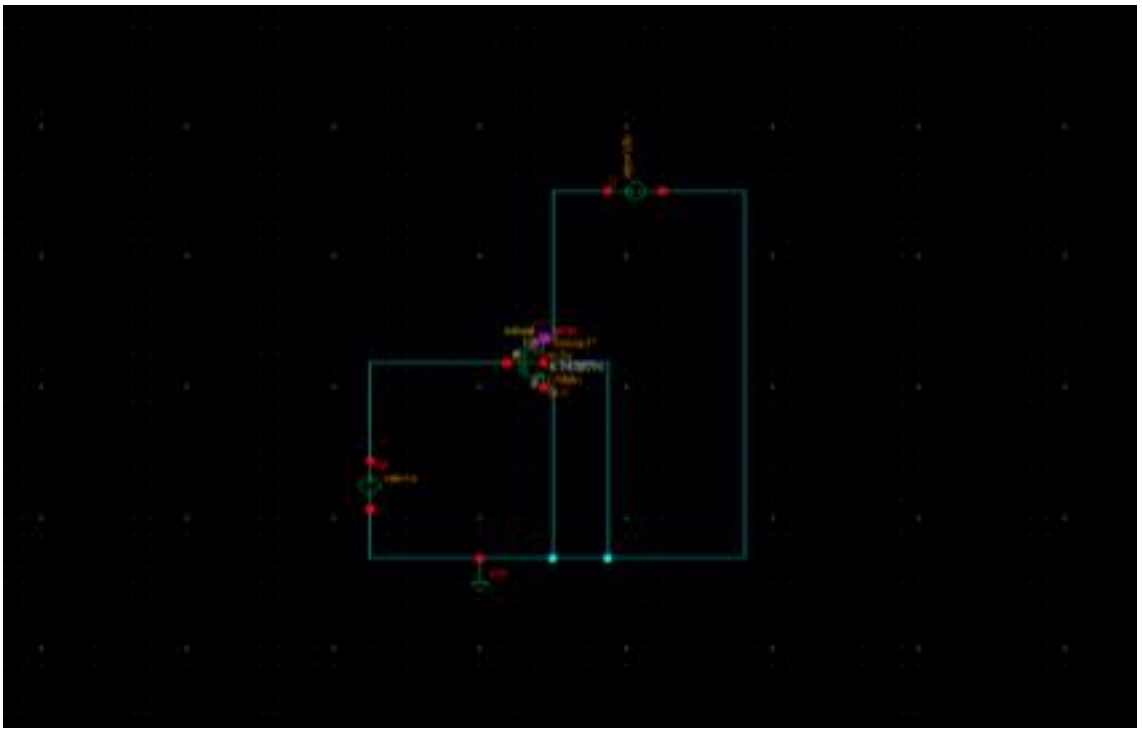
1. NMOS SCHEMATIC:



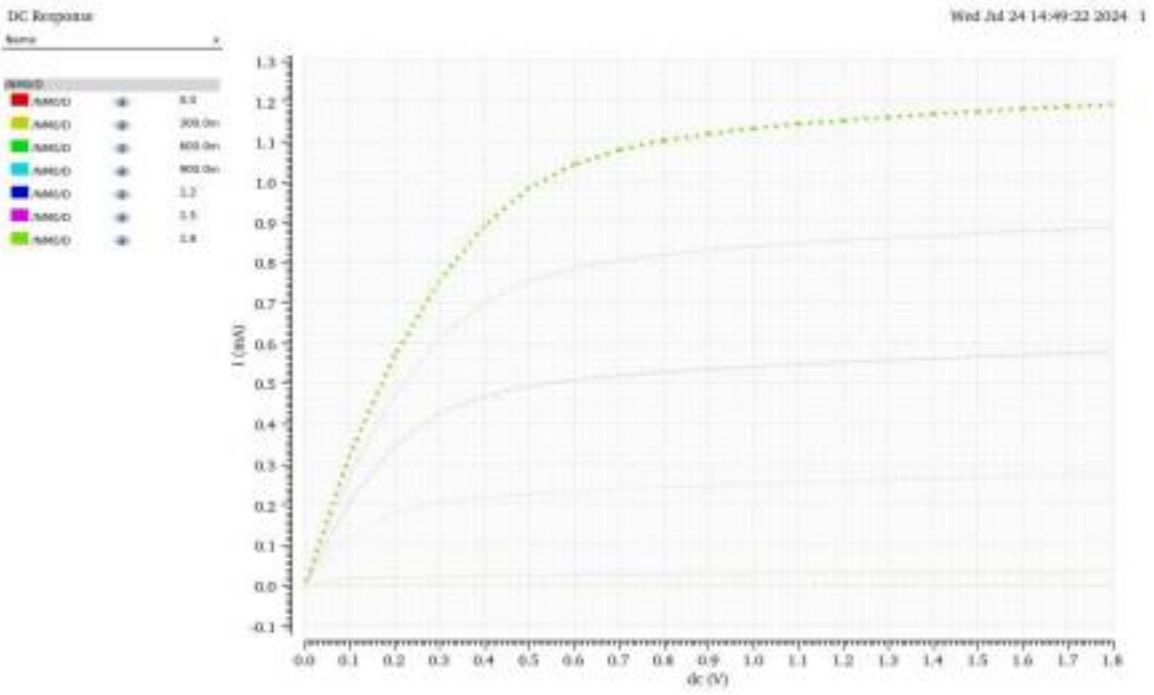
2. NMOS INPUT CHARACTERISTICS (Vgs vs Id):



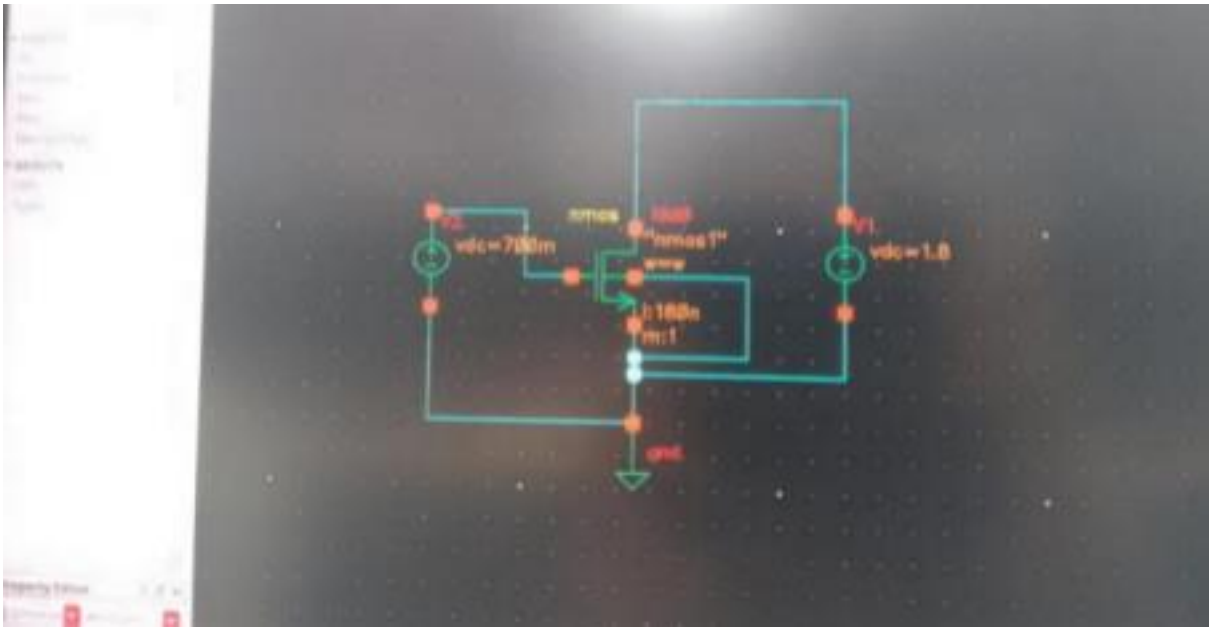
3. NMOS PARAMETRIC ANALYSIS:



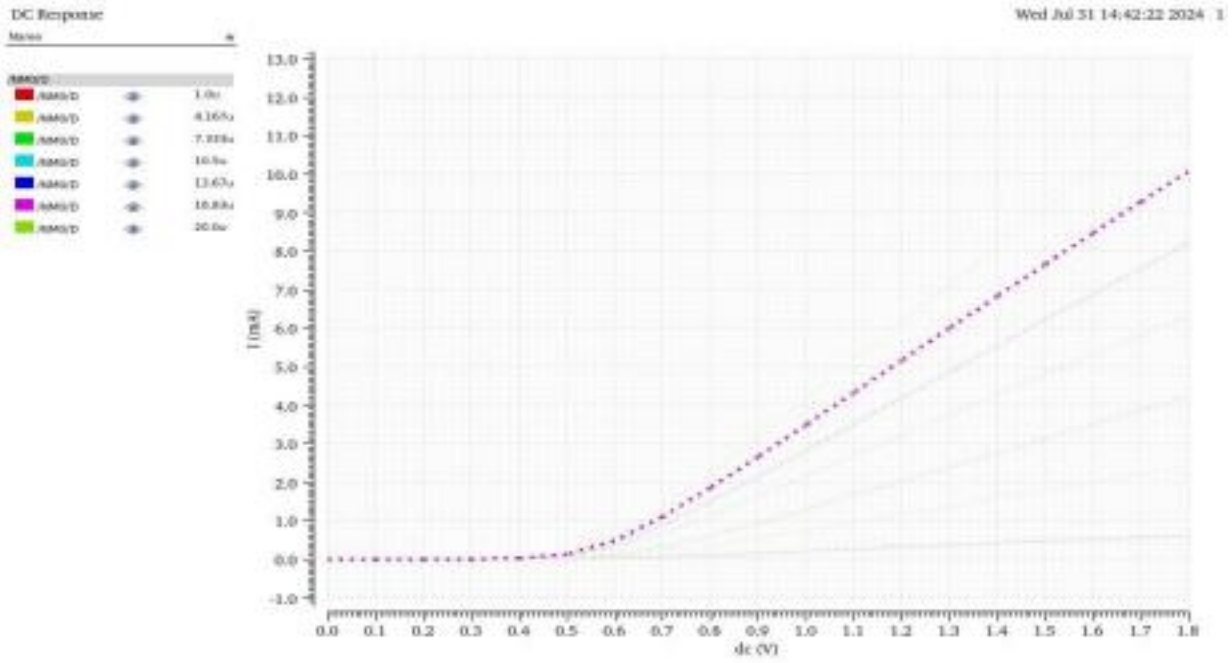
4. NMOS OUTPUT CHARACTERISTICS (Vds vs Id):



5. NMOS CHARACTERISTICS FOR VARIABLE WIDTH OF MOSFET:



6. CHARACTERISTICS OF ABOVE SCHEMATIC:



INFERENCE:

Characteristics of NMOS transistors were analyzed by visualizing the output graphs of Id v/s Vgs and Id v/s Vds.

As we can see from the observed graphs,

a) In the cut off region, Vgs < Vtn and Id=0

b) In the saturation mode,

Vgs > Vtn

Vds >= (Vgs – Vtn)

Id= ½*(μ*Cox*W/L (Vgs – Vtn) ^2

c) In the triode mode,

Vgs > Vtn,

Vds < (Vgs- Vtn),

Id = (μ*Cox*W/L) [Vgs-Vtn-(Vds/ 2)] Vds

d) If width (w) is increased, Id increases for each potential of Vgs once it becomes greater than Vtn.

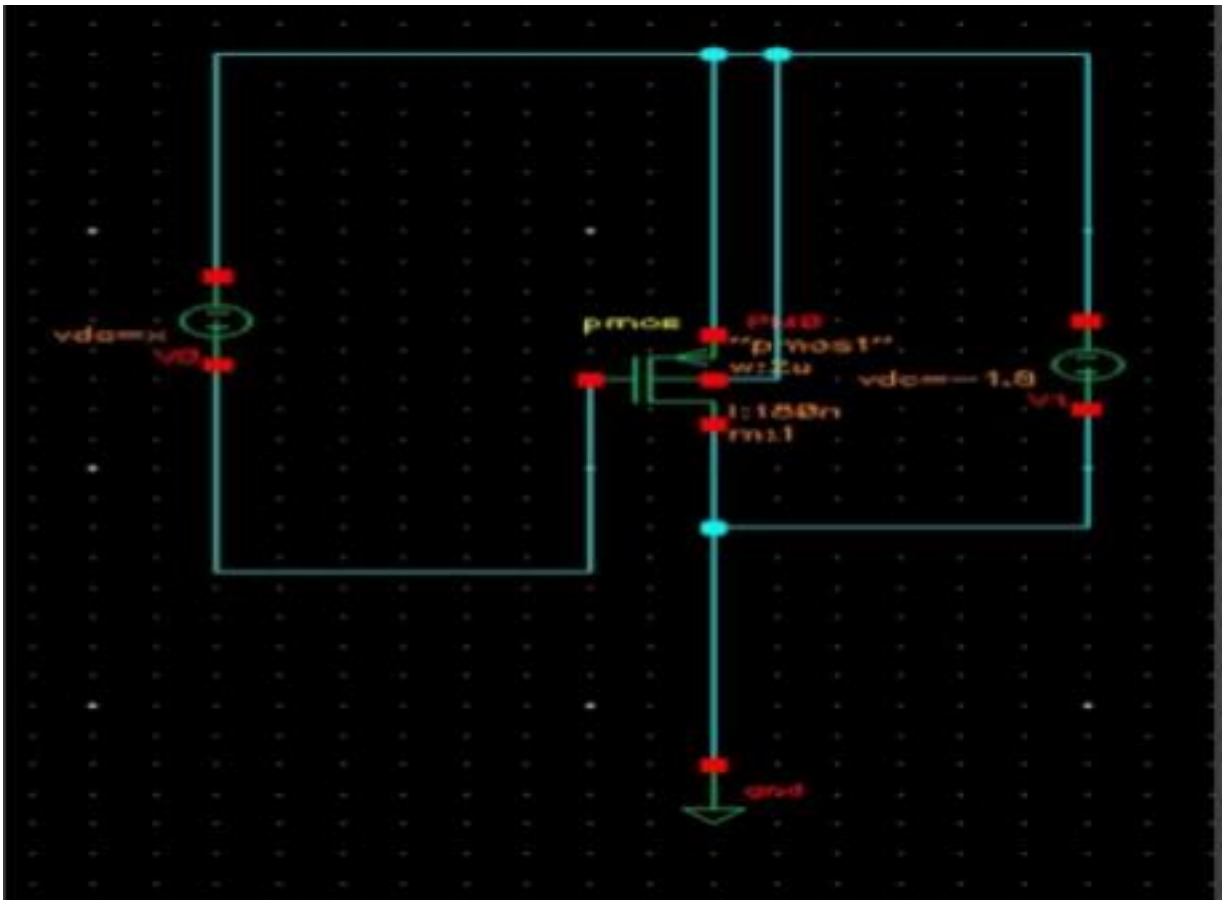
PROCEDURE FOR PMOS:

1. Create a schematic.
2. Configure DC Analysis with the input gate voltage Vsg as the component parameter and sweep range of 0 to 1.8V

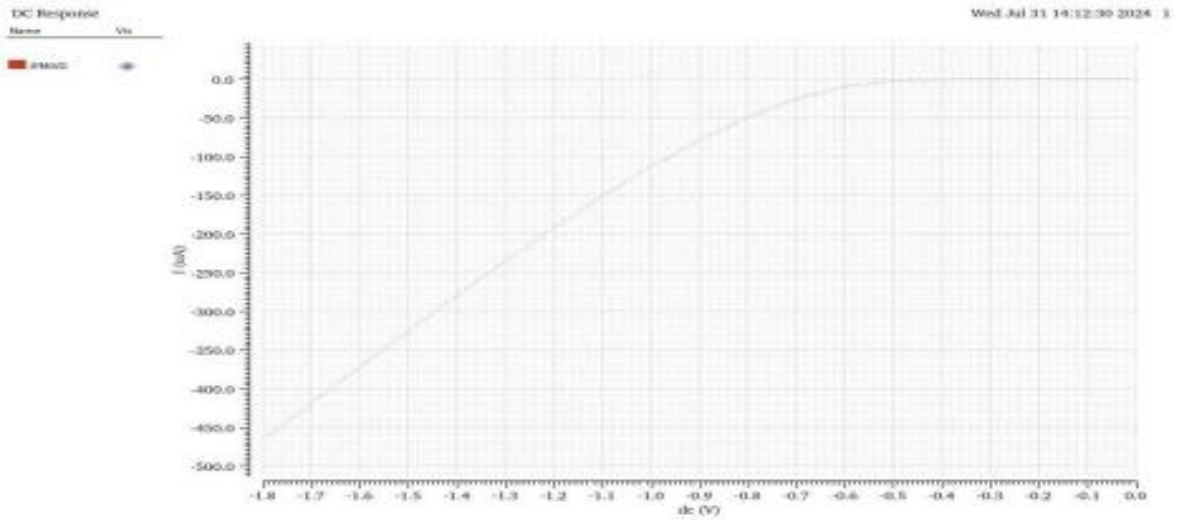
a) Plot the drain current Id.
b) Define the input gate voltage Vsg as a variable parameter “x”. c) Configure dc analysis for various drain source voltage Vsd by defining it as the component parameter and sweep range of 0 to 1.8V.
d) Plot the drain current Id.
e) Perform the parametric analysis for various values of Vsg is defined as “x”.

SCREENSHOTS:

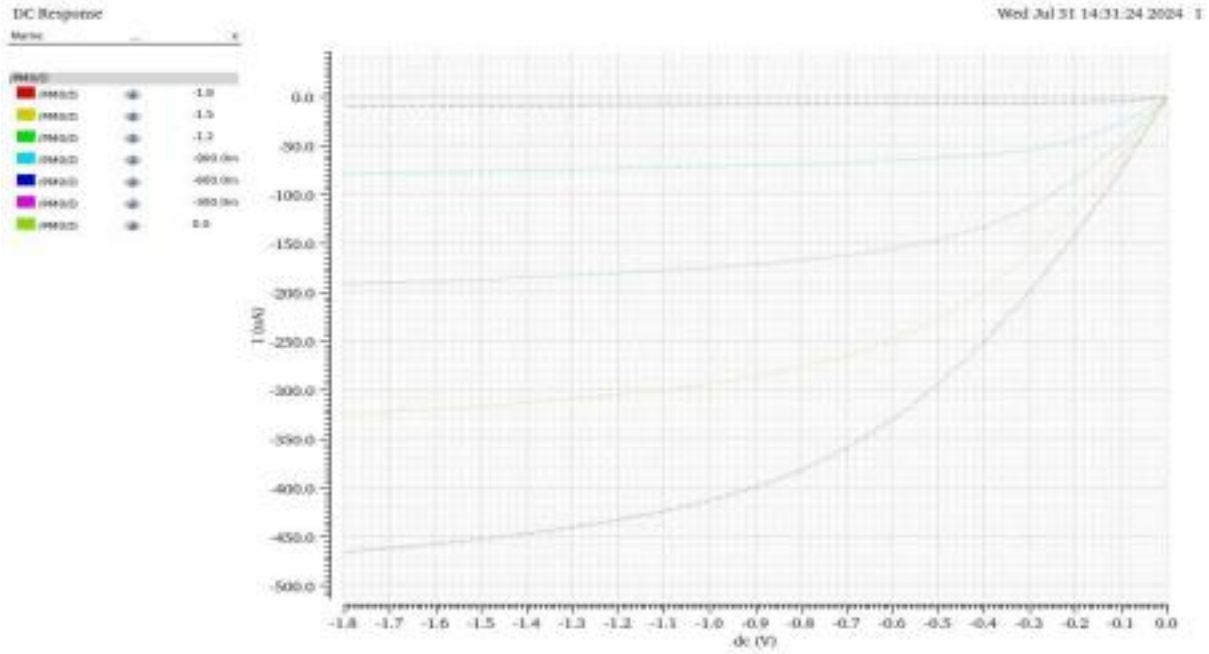
1. SCHEMATIC:



2. INPUT CHARACTERISTICS (Vsg vs Id):



3. OUTPUT CHARACTERISTICS (Vsd vs Id):



INFERENCE:

Characteristics of PMOS transistors were analyzed by visualizing the output graphs of Id v/s Vsg and Id v/s Vsd.

As we can see from the observed graphs,

a) In the cut off region, Vsg < (-Vtp) and Id=0

b) In the saturation mode,

Vsg > (-Vtp)

Vsd >= (Vsg + Vtp),

Id= ½*(μ*Cox*W/L (Vsg – Vtp) ^2

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c) In the triode mode,

Vsg > (- Vtp),

Vsd < (Vsg+ Vtp),

Id = (μ *Cox*W/L) [Vsg-Vtp-Vsd/2] Vsd