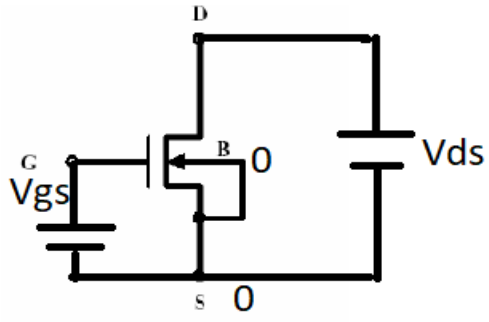
Expt. No. 3 - NMOS, PMOS Characteristics using HSpice	
NAME : S. Chandra Moulee	**Date :** 07/05/2022
ROLL No.: CB.EN.P2VLD21016	**Marks :** out of 10

AIM:

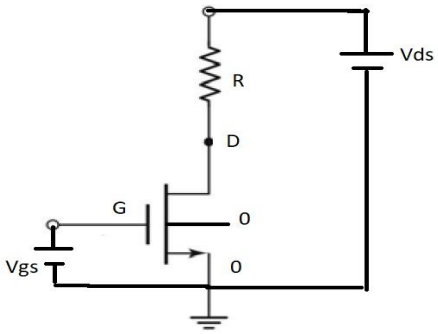
To Perform AC and DC analysis for an enhancement type n channel and p channel MOSFEET for different gate, drain and substrate potential, with and without resistive or capacitive loads to be analyzed and find transconductance and Vth

BLOCK/CIRCUIT DIAGRAM:

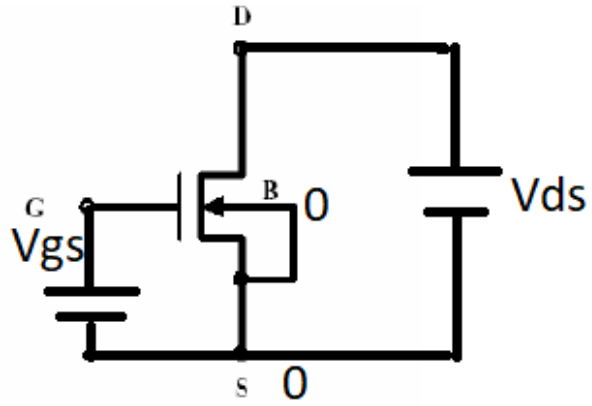
NMOS Vds:



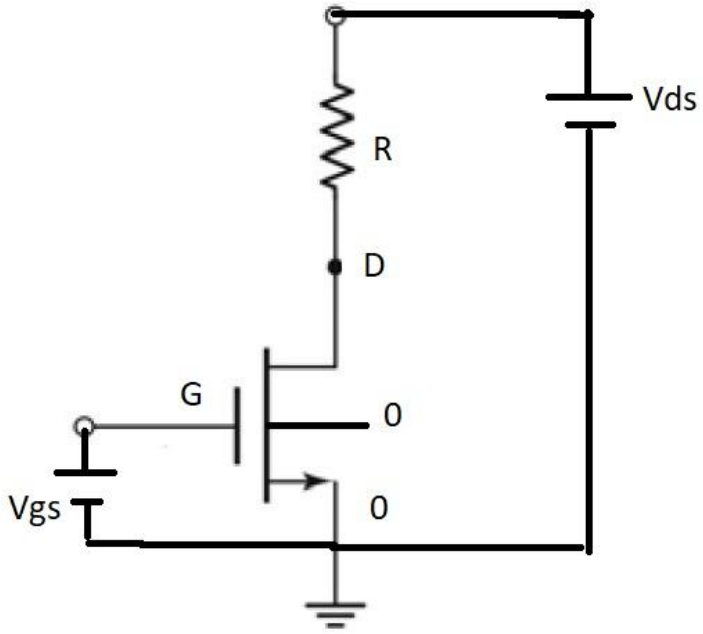
NMOS Vds with Resistance:



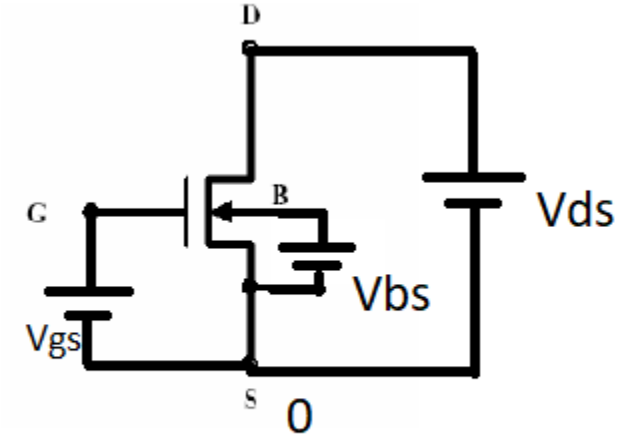
NMOS Vgs:



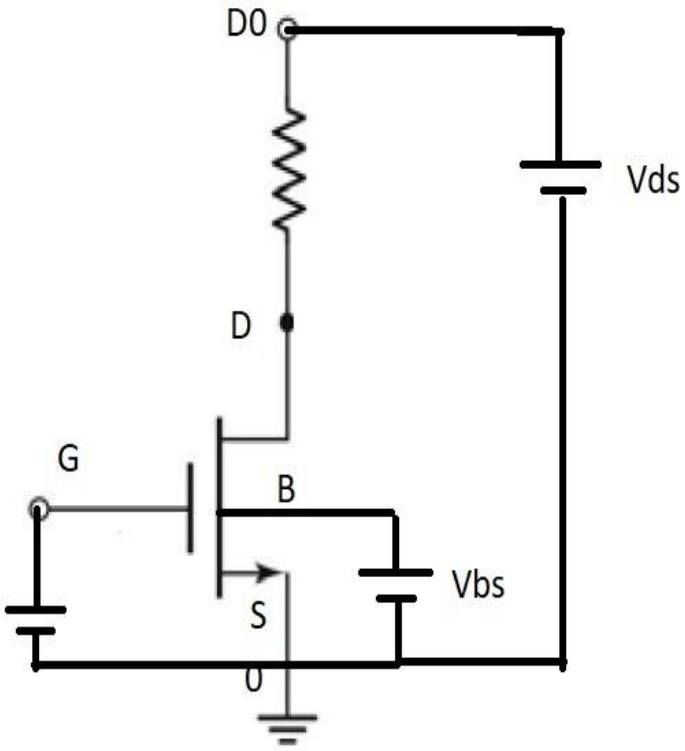
NMOS Vgs with resistance:



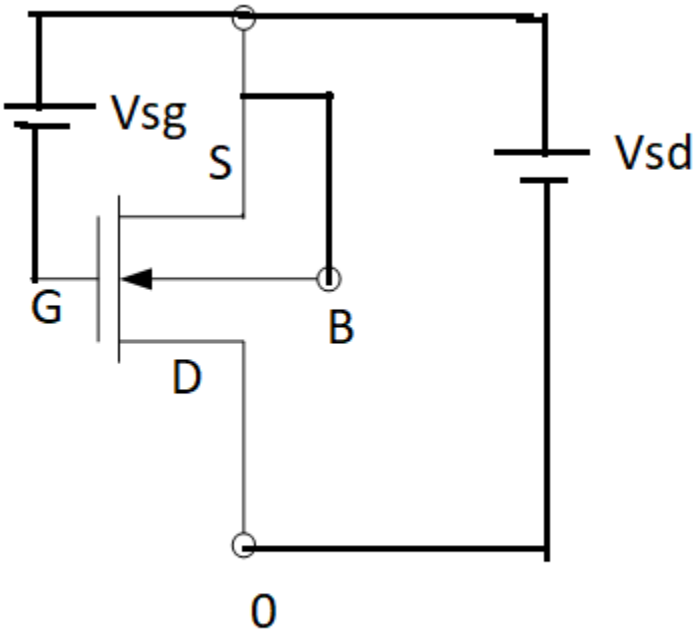
NMOS Vbs:



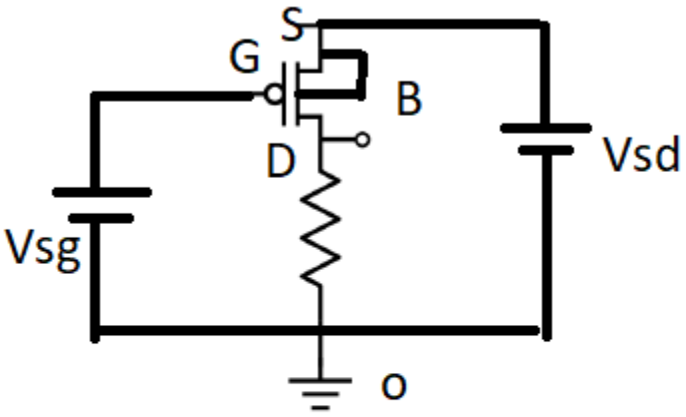
NMOS Vbs with resistance:



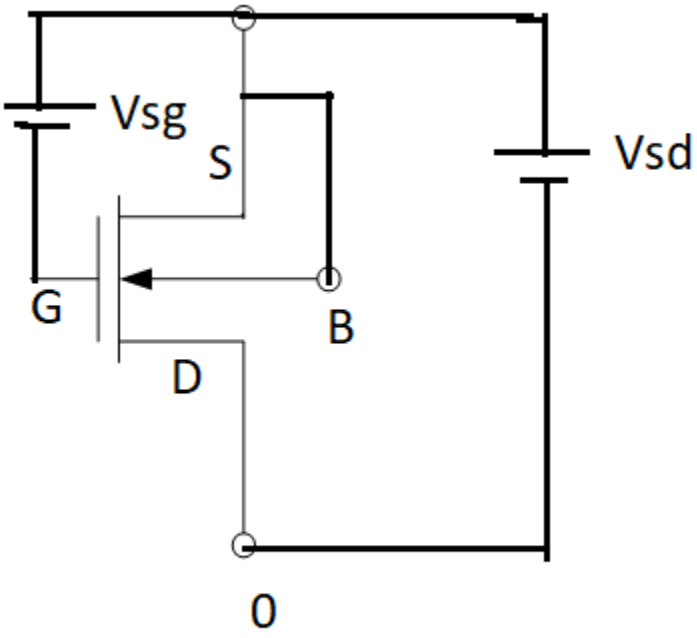
PMOS Vsd:



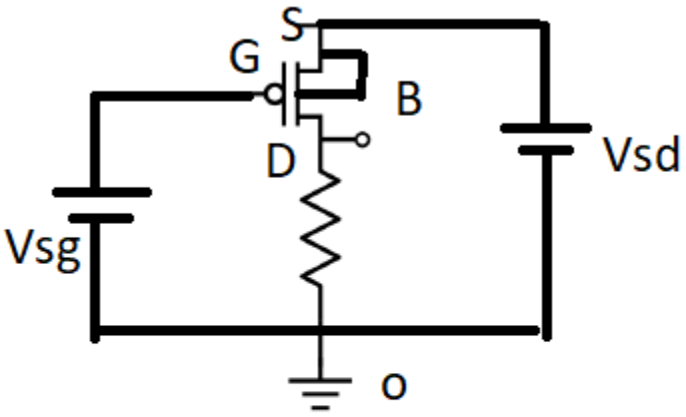
PMOS Vsd with resistance:



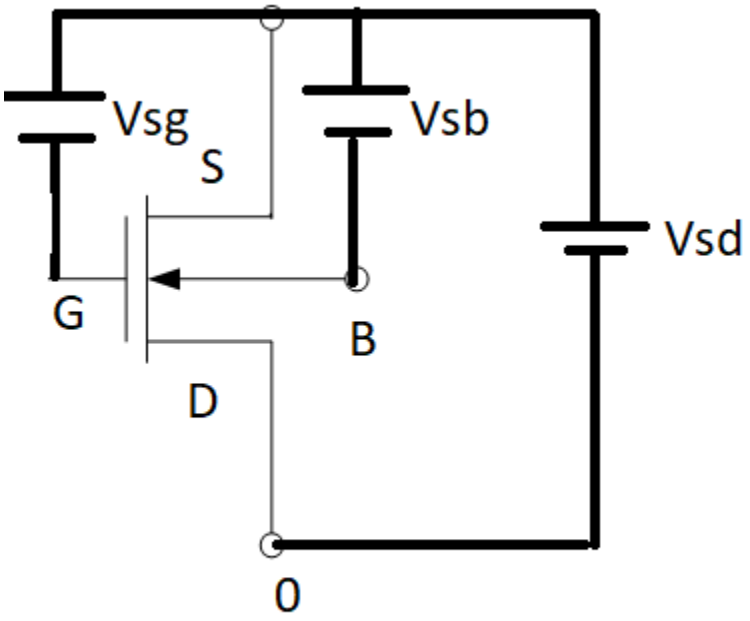
PMOS Vsg:



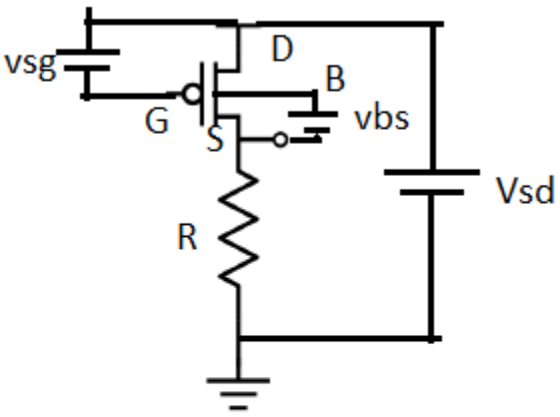
PMOS Vsg with resistance:



PMOS Vbs:



PMOS Vbs with resistance:



CODE:

NMOS Vds:

```
*NMOS CHARACTERISTICS
.MODEL NCH NMOS LEVEL=54
M1 d g 0 0 NCH L=90n W=170n
vds d 0 dc 3
vgs g 0 dc 2
*.PARAM L=60n
.DC vds 0 3 0.01 SWEEP vgs 0 5 1
.ENDDATA
.plot DC lX4(M1)
.option post
.end
```

NMOS Vds with Resistance:

```
*NMOS CHARACTERISTICS
.MODEL NCH NMOS LEVEL=54
M1 d g 0 0 NCH L=90n W=170n
R d0 d 100
vds d0 0 dc 4
vgs g 0 dc 2
*.PARAM L=60n
.DC vds 0 5 0.01 SWEEP vgs 0 5 1
.ENDDATA
.plot DC lX4(M1)
.option post
.end
```

NMOS Vgs:

```
*NMOS CHARACTERISTICS
.MODEL NCH NMOS LEVEL=54
M1 d g 0 0 NCH L=90n W=225n
vds d 0 dc 3
vgs g 0 dc 0
*.PARAM L=60n
.DC vgs 0 3 0.01
.ENDDATA
.plot DC lX4(M1)
.option post
.end
```

NMOS Vgs with resistance:

```
*NMOS CHARACTERISTICS
.MODEL NCH NMOS LEVEL=54
M1 d g 0 0 NCH L=90n W=225n
R d0 d 1K
vds d0 0 dc 3
vgs g 0 dc 0
*.PARAM L=60n
.DC vgs 0 3 0.01
.ENDDATA
.plot DC lX4(M1)
.option post
.end
```

NMOS Vbs:

```
*NMOS CHARACTERISTICS
.MODEL NCH NMOS LEVEL=54
M1 d g 0 s NCH L=90n W=170n
vds d 0 dc 3
vgs g 0 dc 0
vbs s 0 dc 0
*.PARAM L=60n
.DC vbs 0 -3 -0.01
.ENDDATA
.plot DC lX4(M1)
.option post
.end
```

NMOS Vbs with resistance:

```
*NMOS CHARACTERISTICS
.MODEL NCH NMOS LEVEL=54
M1 d g 0 s NCH L=90n W=170n
R d0 d 10K
vds d0 0 dc 3
vgs g 0 dc 0
vbs s 0 dc 0
*.PARAM L=60n
.DC vbs 0 -3 -0.01
.ENDDATA
.plot DC lX4(M1)
.option post
.end
```

PMOS Vsd:

```
*PMOS VDD sweep
.MODEL PCH PMOS LEVEL=54
M1 0 g s s PCH L=90n W=225n
vsd s 0 DC 3
vsg s g DC 3

.DC vsd 0 3 0.01 SWEEP vsg 0 5 1
.plot DC lx4(M1)
.option post
.end
```

PMOS Vsd with resistance:

```
*PMOS VDD sweep
.MODEL PCH PMOS LEVEL=54
M1 0 g s s PCH L=90n W=225n
R s0 s 1K
vsd s0 0 DC 3
vsg s g DC 3

.DC vsd 0 3 0.01 SWEEP vsg 0 5 1
.plot DC lx4(M1)
.option post
.end
```

PMOS Vsg:

```
*PMOS VDD sweep
.MODEL PCH PMOS LEVEL=54
M1 0 g s s PCH L=90n W=235n
vsd s 0 DC 3
```

```
vsg s g DC 3

.DC vsg 0 3 0.01
.plot DC lx4(M1)
.option post
.end
```

PMOS Vsg with resistance:

```
*PMOS VDD sweep
.MODEL PCH PMOS LEVEL=54
M1 0 g s s PCH L=90n W=225n
R s0 s 1K
vsd s0 0 DC 5
vsg s g DC 3

.DC vsg 0 -5 -0.01
.plot DC lx4(M1)
.option post
.end
```

PMOS Vbs:

```
*PMOS VDD sweep
.MODEL PCH PMOS LEVEL=54
M1 0 g s b PCH L=90n W=225n
vsd s 0 DC 3
vsg s g DC 3
vsb s b DC 3

.DC vsb 0 -3 -0.01
.plot DC lx4(M1)
```

.option post

.end

PMOS Vbs with resistance:

*PMOS VDD sweep

.MODEL PCH PMOS LEVEL=54

M1 d g s b PCH L=90n W=190n

R d 0 1K

vsd s d DC 3

vsg s g DC 3

vsb s b DC 3

.DC vsb 0 -5 -0.01

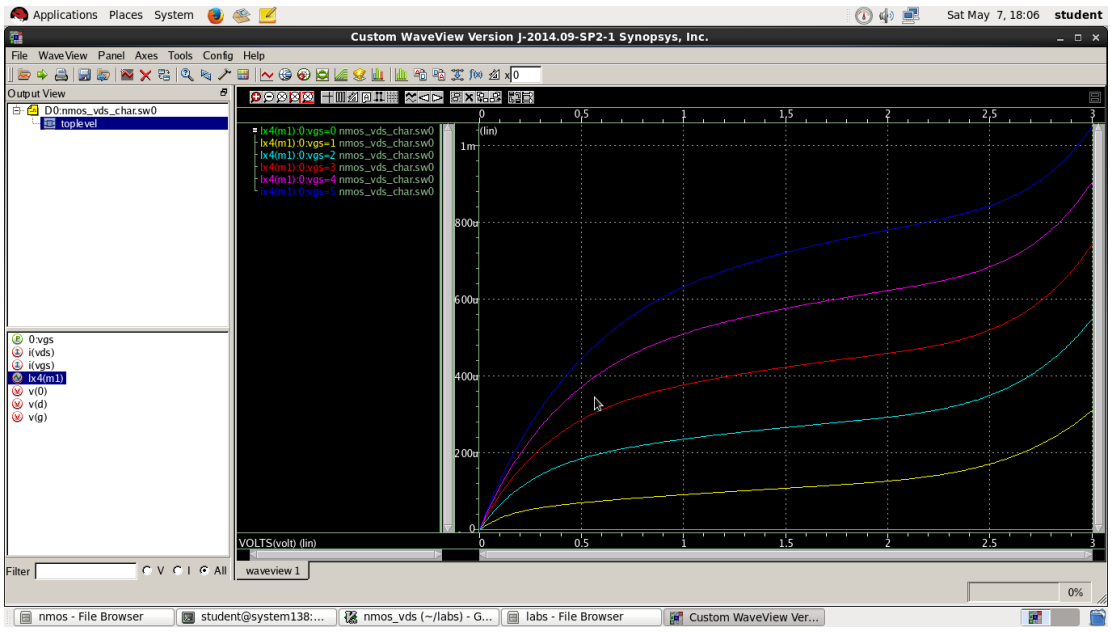
.plot DC lx4(M1)

.option post

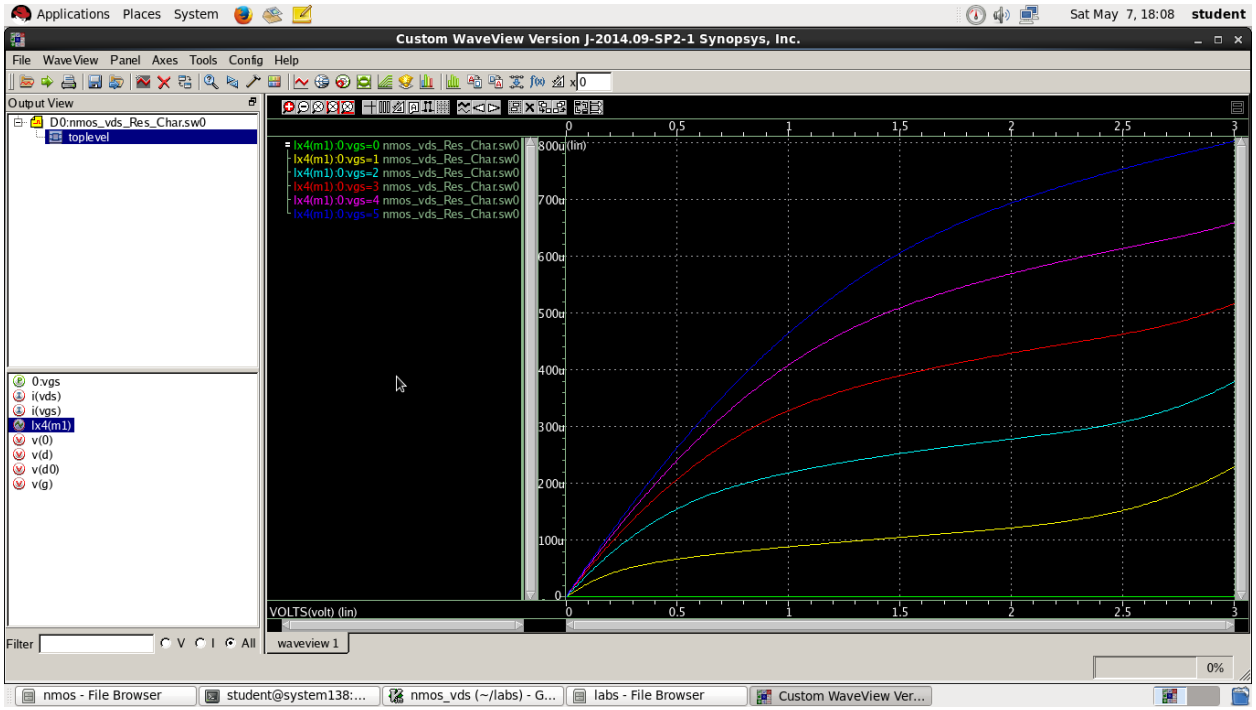
.end

OUTPUT:

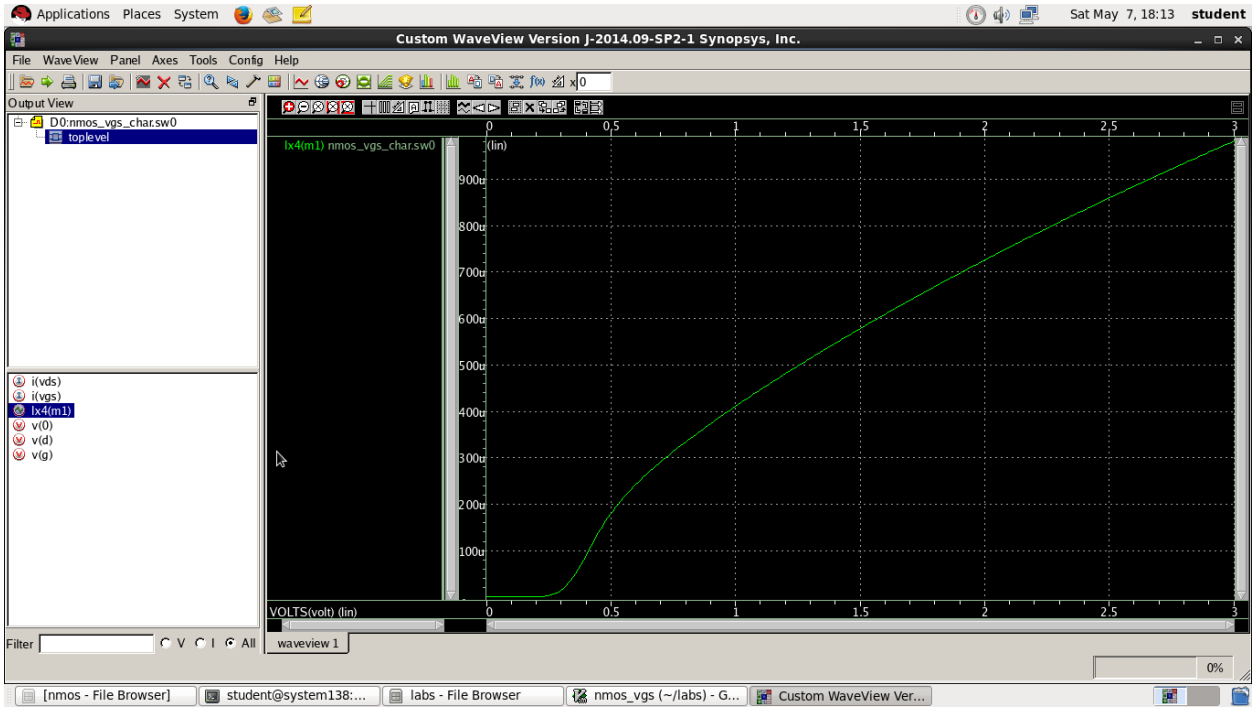
NMOS Vds:



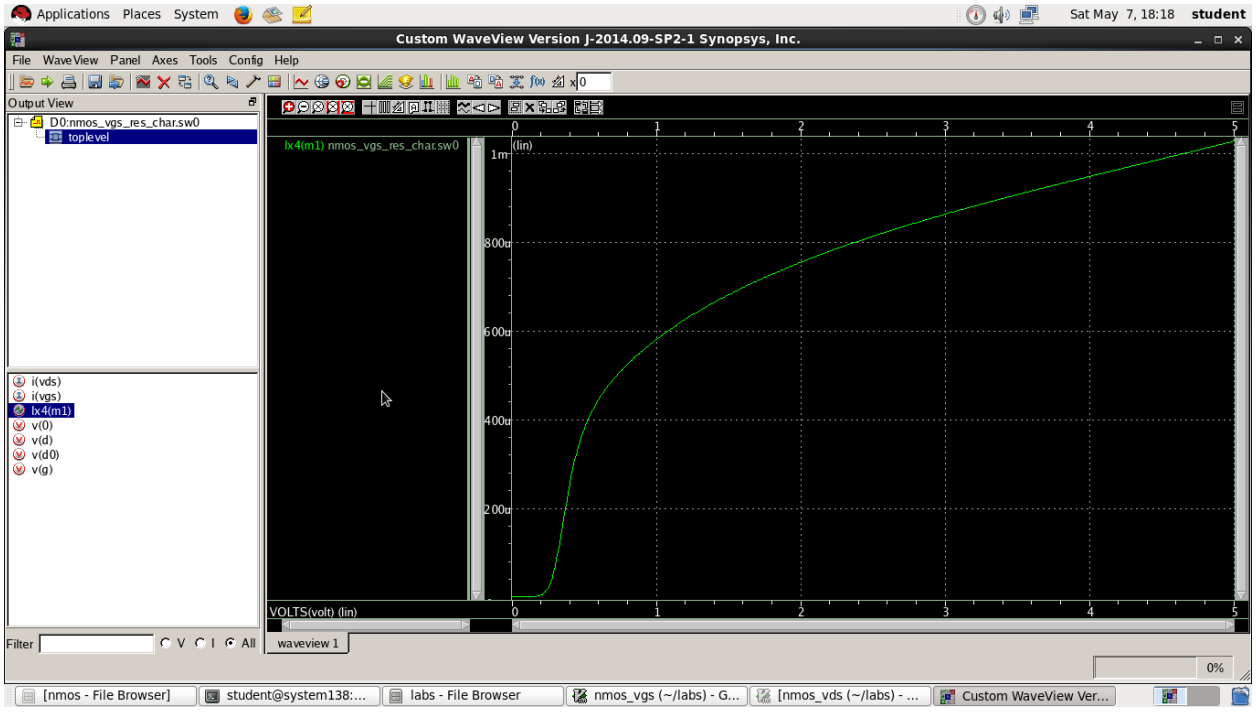
NMOS Vds with Resistance:



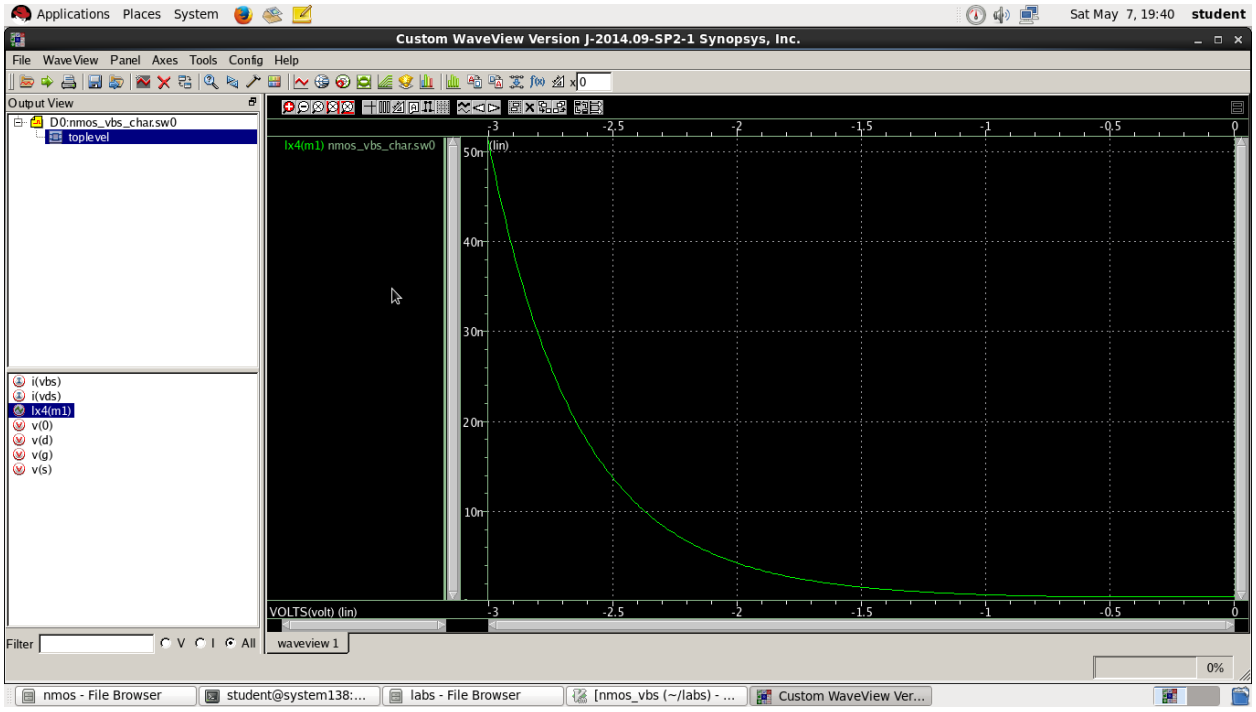
NMOS Vgs:



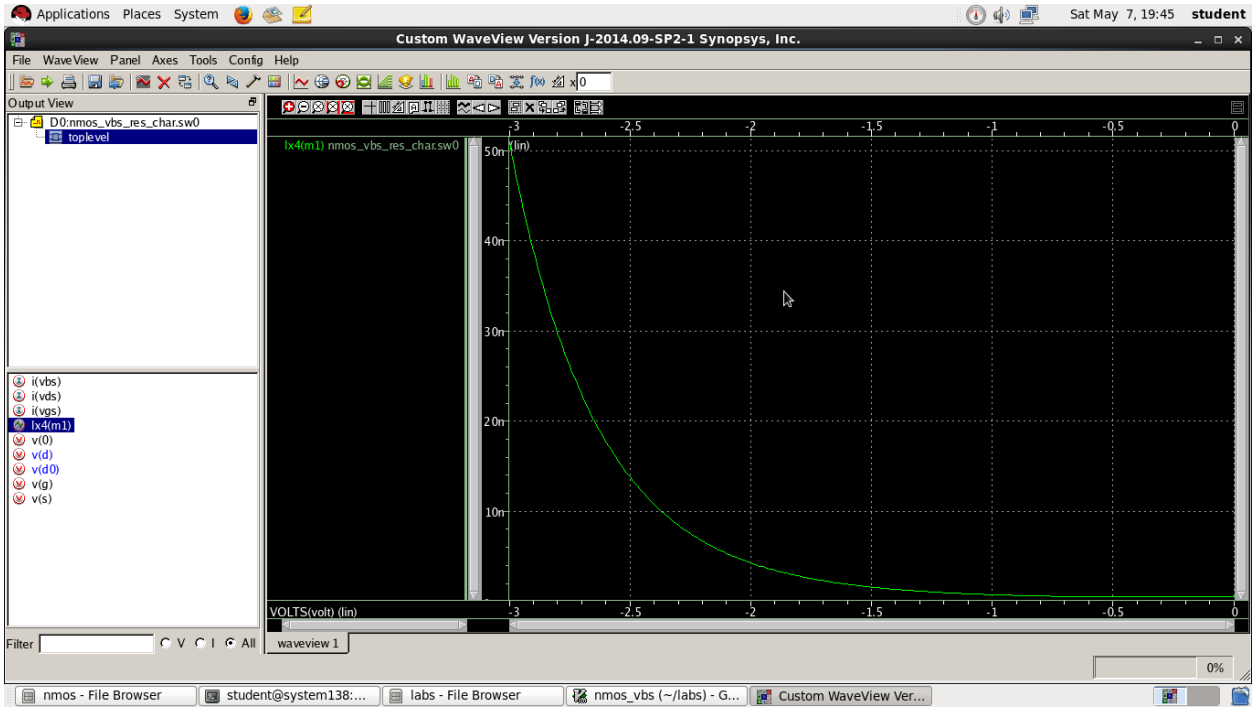
NMOS Vgs with resistance:



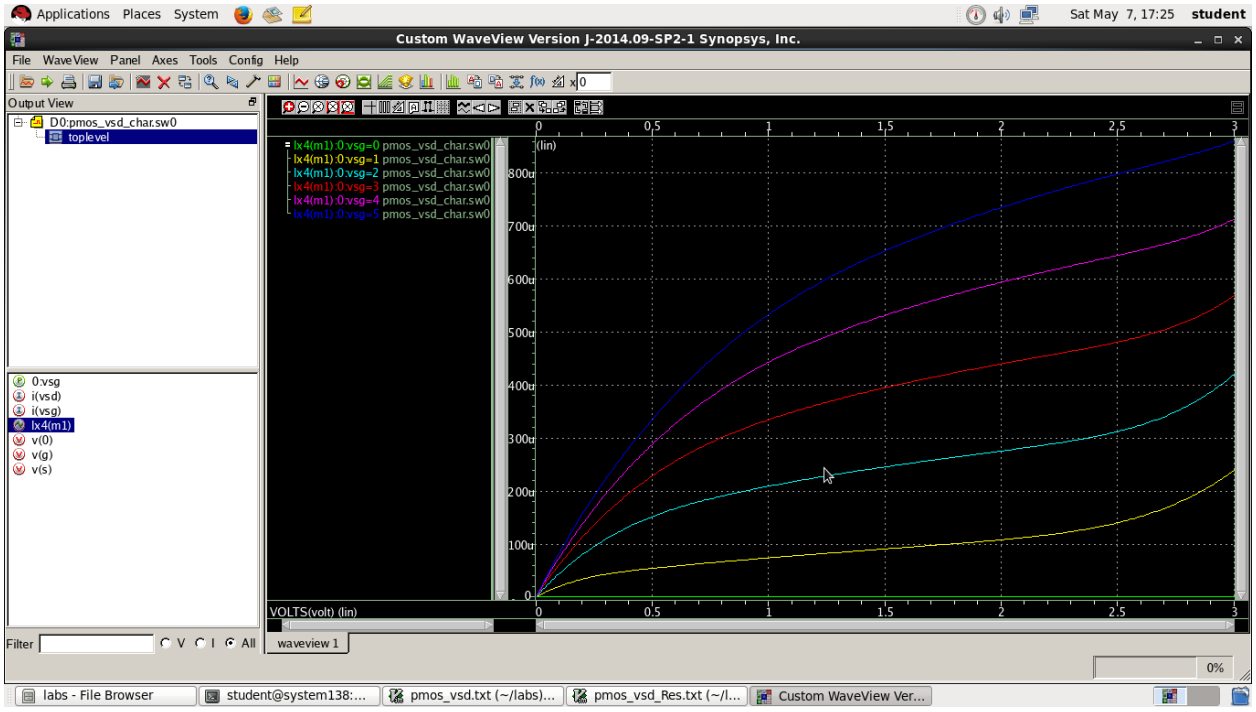
NMOS Vbs:



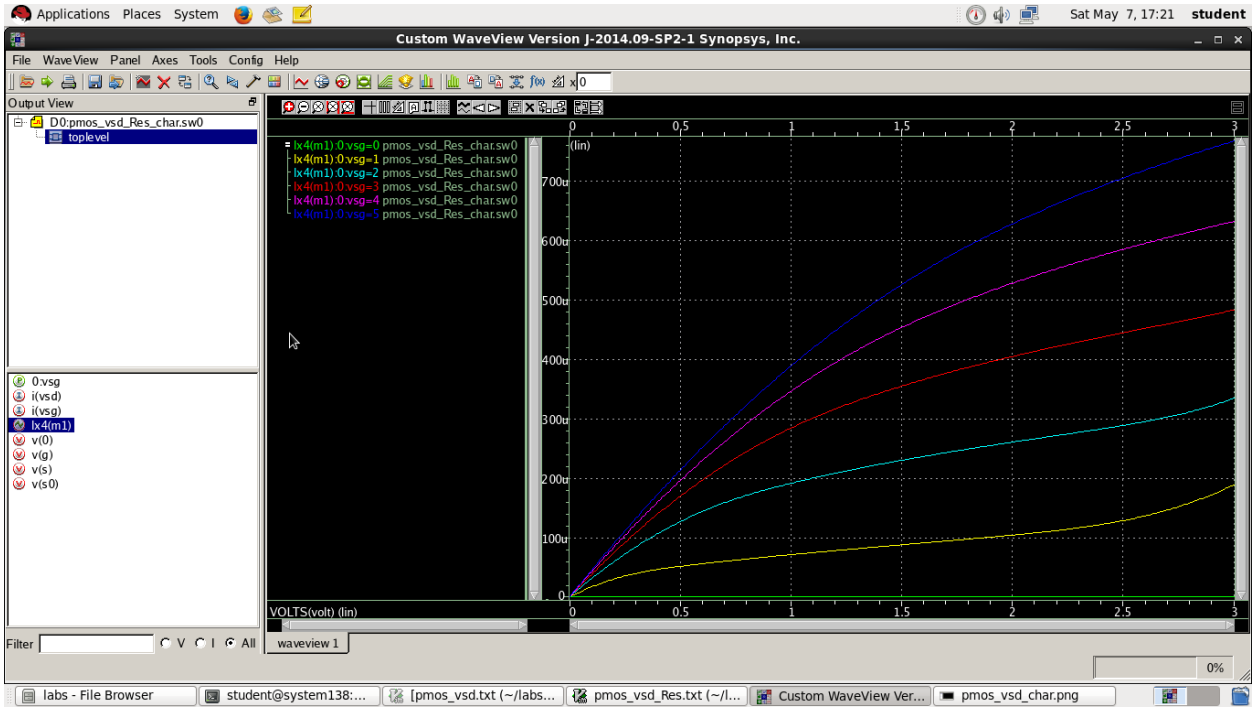
NMOS Vbs with resistance:



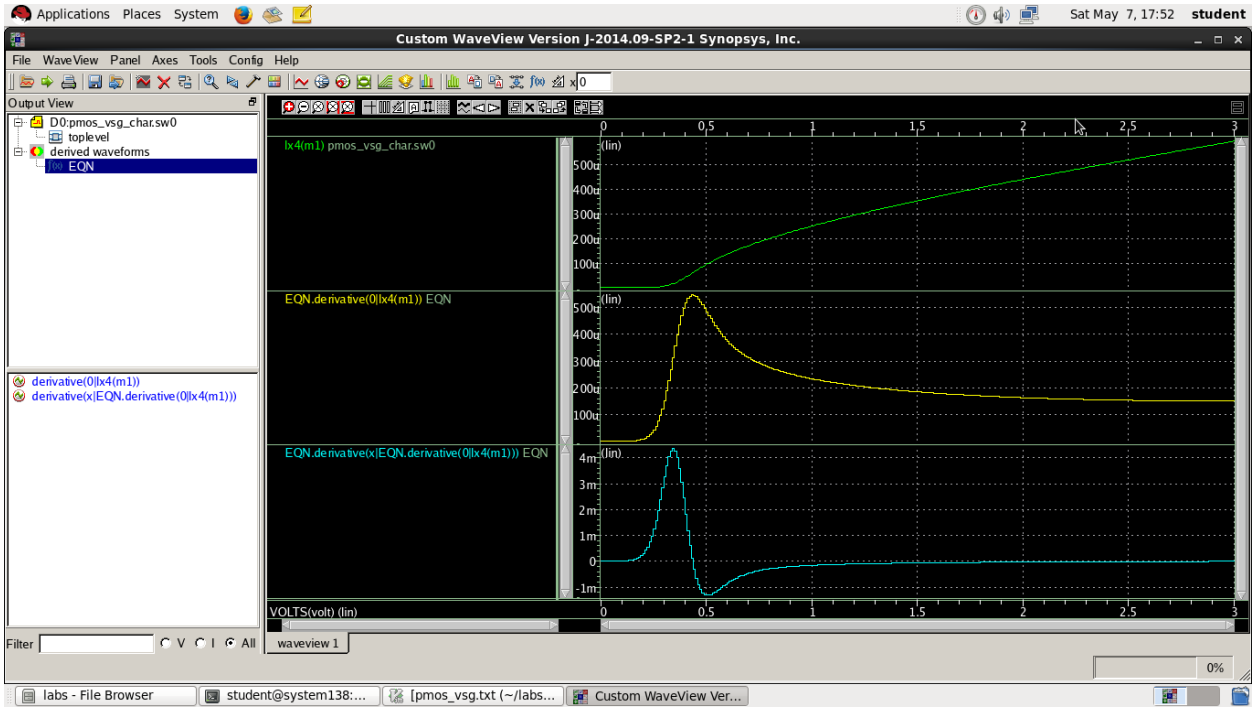
PMOS Vsd:



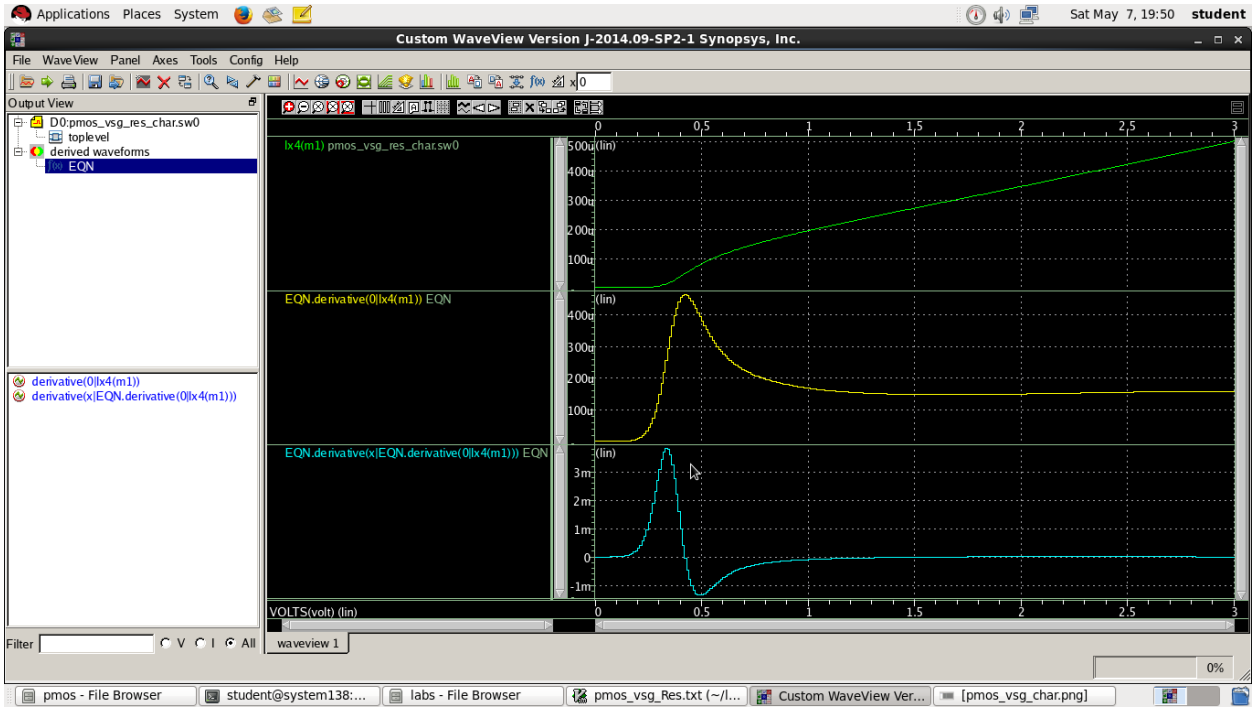
PMOS Vsd with resistance:



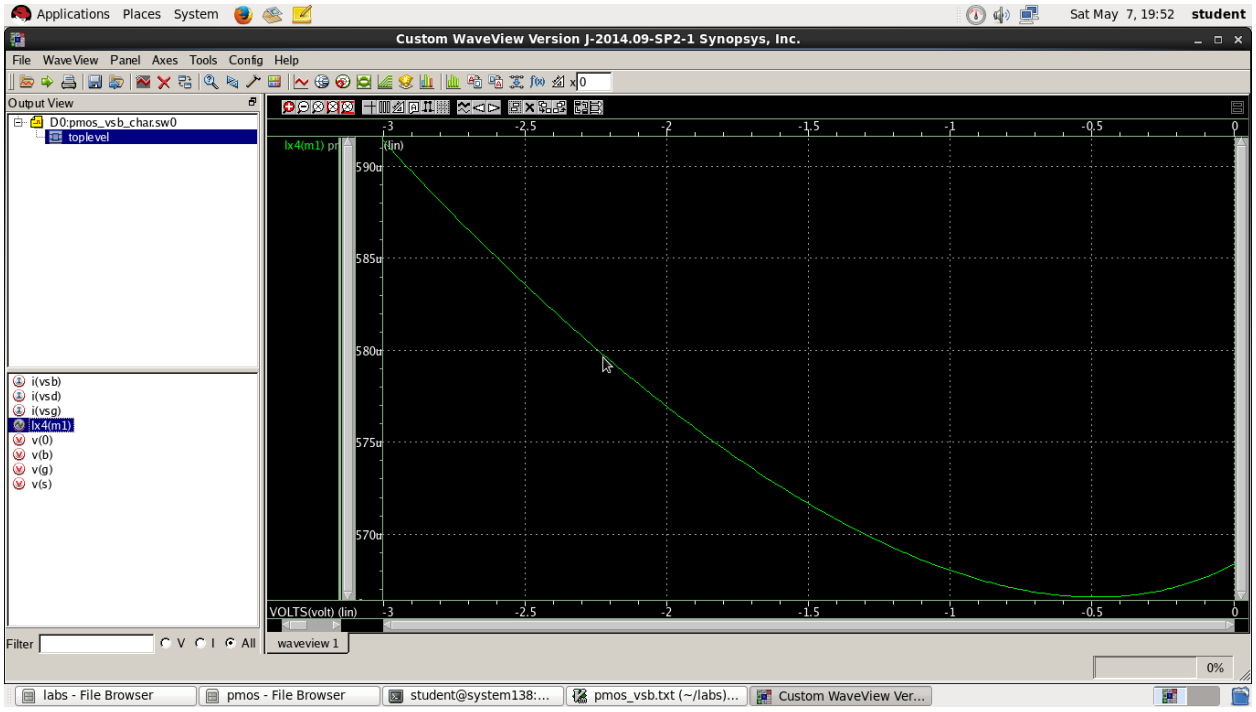
PMOS Vsg:



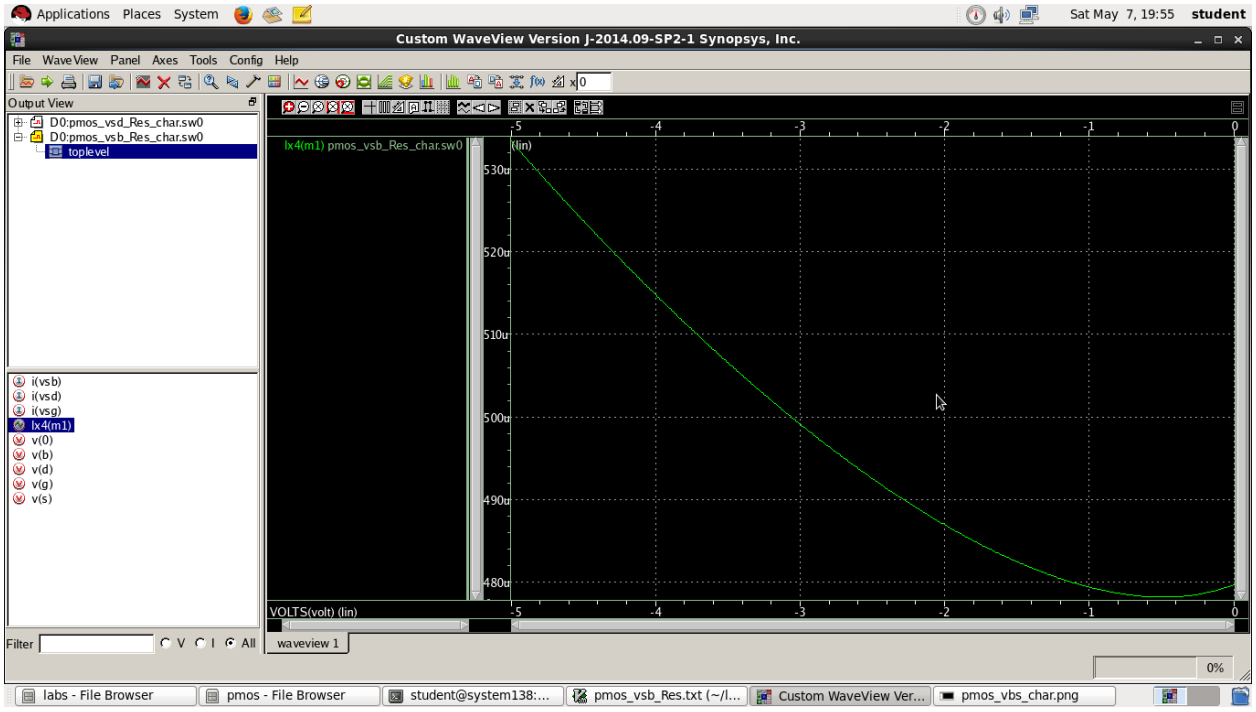
PMOS Vsg with resistance:



PMOS Vbs:



PMOS Vbs with resistance:



INFERENCE:

- Analyzed the characteristics of enhancement p- and n- type type MOSFET
- Modeled the devices only by designing netlist for the operation
- Assigned node names for the MOSFETs and provided the input
- Manually written the netlist for the devices, so schematic is not required
- Since node names were assigned, connections can be easily monitored