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BRANCH: BTECH - CSE AND SPEC IN AI/ML – VITCHENNAI

BECE101P_SLOT-L5+L6_EXPERIMENT – 09

FACULTY: PROF. SASITHRADEVI MA'AM

Characteristics of MOSFET

AIM: To study, understand and simulate the characteristics of MOSFET by using LT Spice.

SOFTWARE REQUIRED: LT-Spice

Apparatus required: NMOS Transistor-1, Resistor-2, Voltage source-2, wires and grounding.

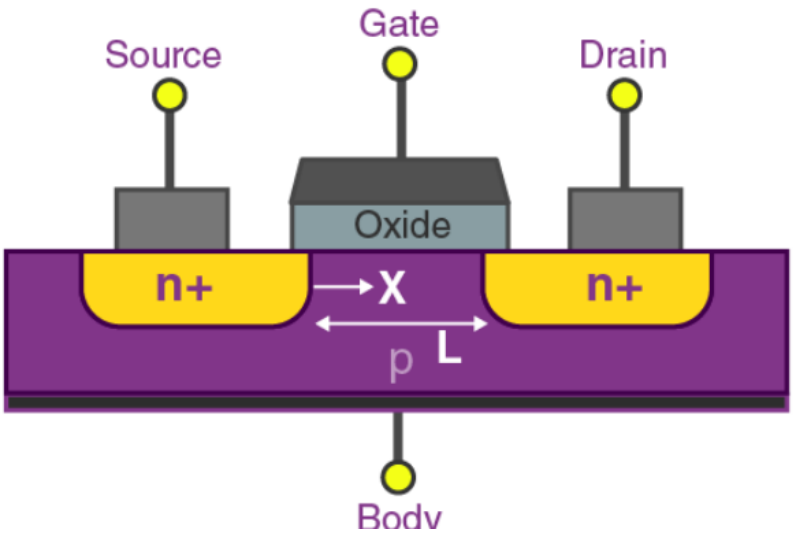
THEORY:

NPN Transistor

The NPN transistor consists of two n-type semiconductors that sandwich a p-type semiconductor. Here, electrons are the majority charge carriers, while holes are the minority charge carriers.

MOSFET

Metal Oxide Silicon Field Effect Transistors commonly known as MOSFETs are electronic devices that are used to switch or amplify voltages in circuits. MOSFET is a type of FET. It is a current controlled device and is constructed by three terminals. It is the transistor that operates under the applied electric field. The presence of an insulating oxide layer in MOSFET makes it different from other types of transistors.



MOSFET CONSTRUCTION

- The p-type semiconductor forms the base of the MOSFET.
- The two types of the base are highly doped with an n-type impurity which is marked as n+ in the diagram.
- From the heavily doped regions of the base, the terminals source and drain originate.
- The layer of the substrate is coated with a layer of silicon dioxide for insulation.
- A thin insulated metallic plate is kept on top of the silicon dioxide and it acts as a capacitor.
- The gate terminal is brought out from the thin metallic plate.
- A DC circuit is then formed by connecting a voltage source between these two n-type regions.

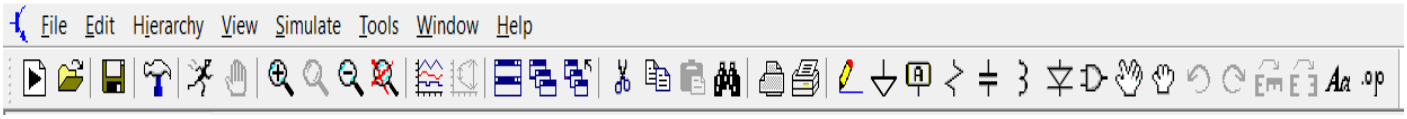
WORKING OF MOSFET

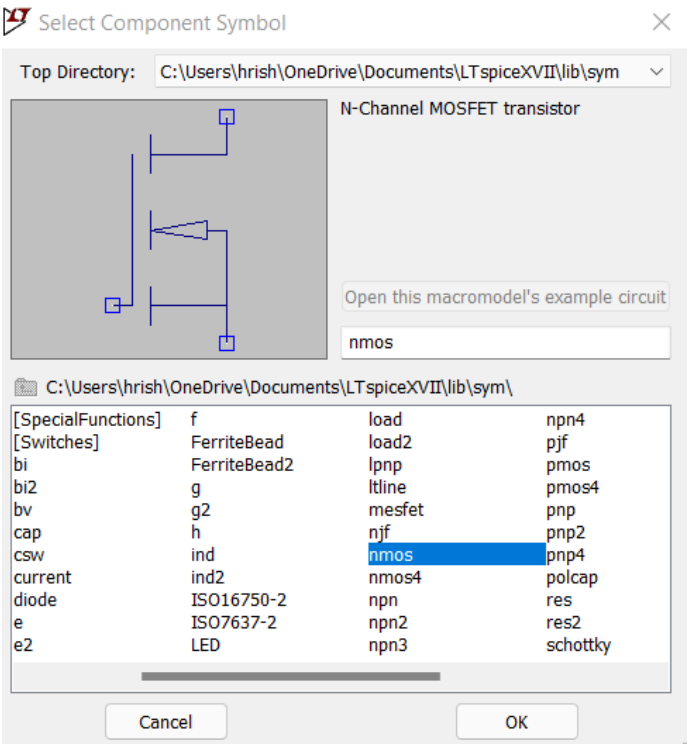
When voltage is applied to the gate, an electrical field is generated that changes the width of the channel region, where the electrons flow. The wider the channel region, the better conductivity of a device will be.

PROCEDURE

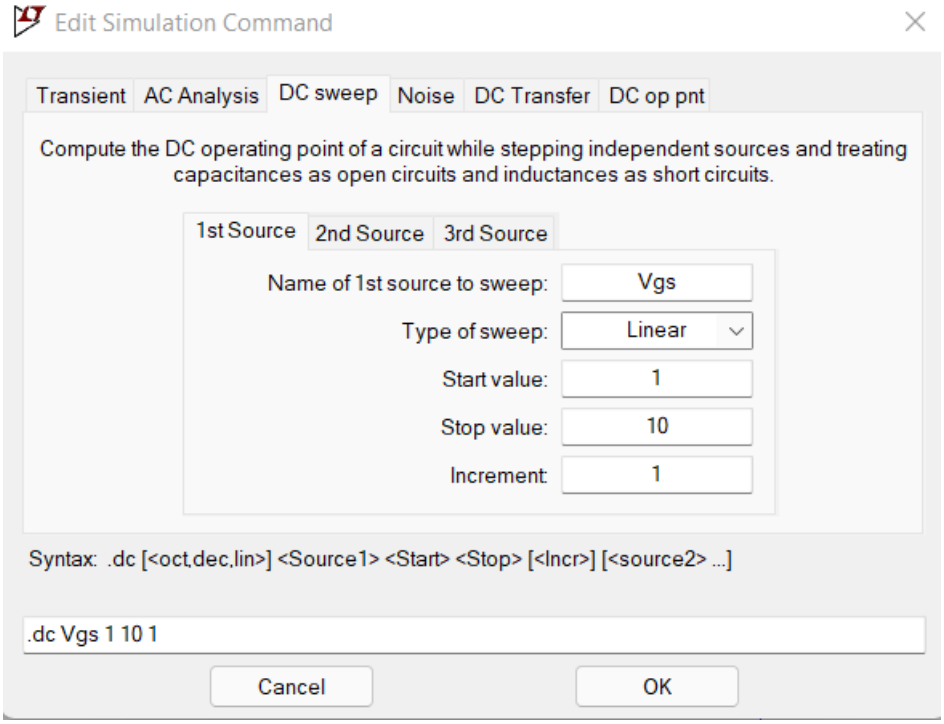
PART1

1. Click the component library symbol from the toolbar and select the NMOS from the component library.





2. Now, add 2 voltage sources and 2 resistors as in the circuit diagram shown later.
3. Right click on the 2 voltage sources and rename them as Vgs and Vds as shown in the circuit diagram.
4. Give values to all the components. R1 (20 ohms) and R2 (220 ohms) for resistors, Vgs (10V) and Vds (30V) for voltage sources.
5. Now, under simulation tab click on 'edit simulation command' and then click on DC sweep and give the values as shown below.



6. Now, under simulation tab click on 'Run'.
7. Next, Click on R1 resistor to get the 1ST V-I characteristics graph for the MOSFET.
8. Now, after we get the graph right click on the graph area and add text "Vds vs Vgs" and then place it on the graph.

PART2

1. We will use the same circuit as for the previous one but we will be making some changes.
2. Firstly, Right-click on Vds voltage source and then change its value to V volts.
3. Next, go under the simulation tab and click on 'Edit simulation command' and now go under DC sweep tab, click on 1st source and give the settings as shown below and then click on second source and then give the settings as shown below.

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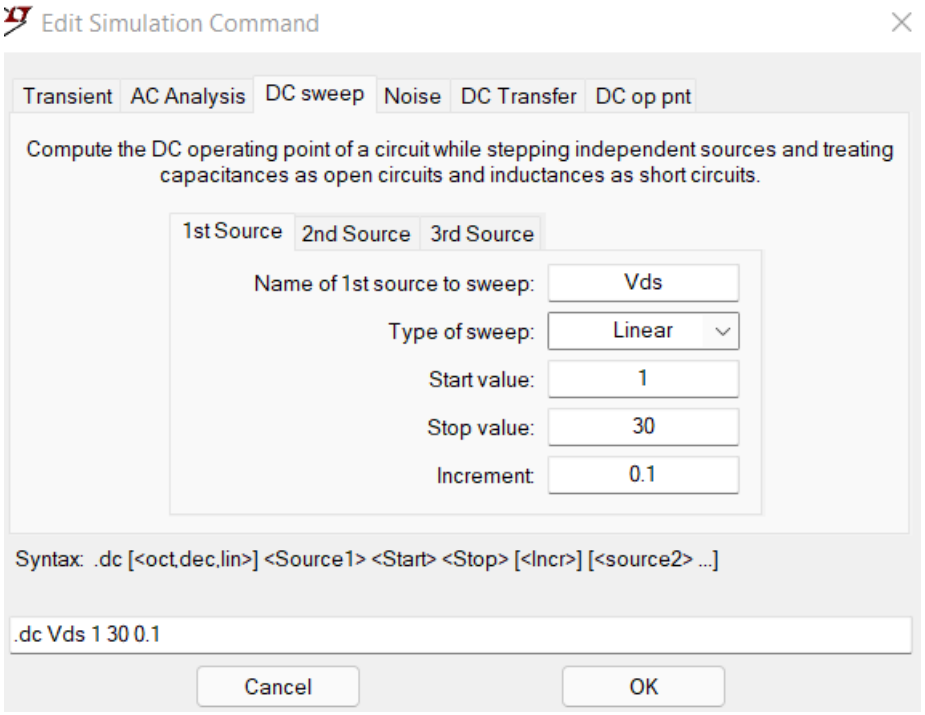
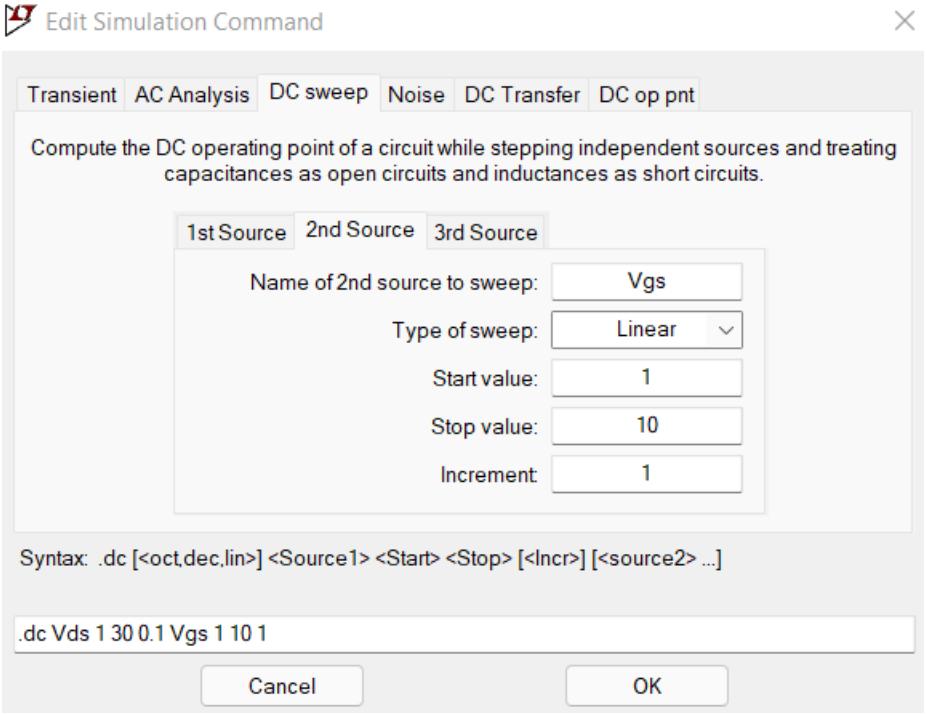
V





4. Now, under simulation tab click on ‘Run’.
5. Click on the R1 resistor to get the 2ND V-I Characteristics graph of MOSFET.
6. Now, when the graph appears right click on the graph and add text as Vgs=10V and place it on the top most curve. Then, add another text as Vgs=9V and place it on the second top most curve.

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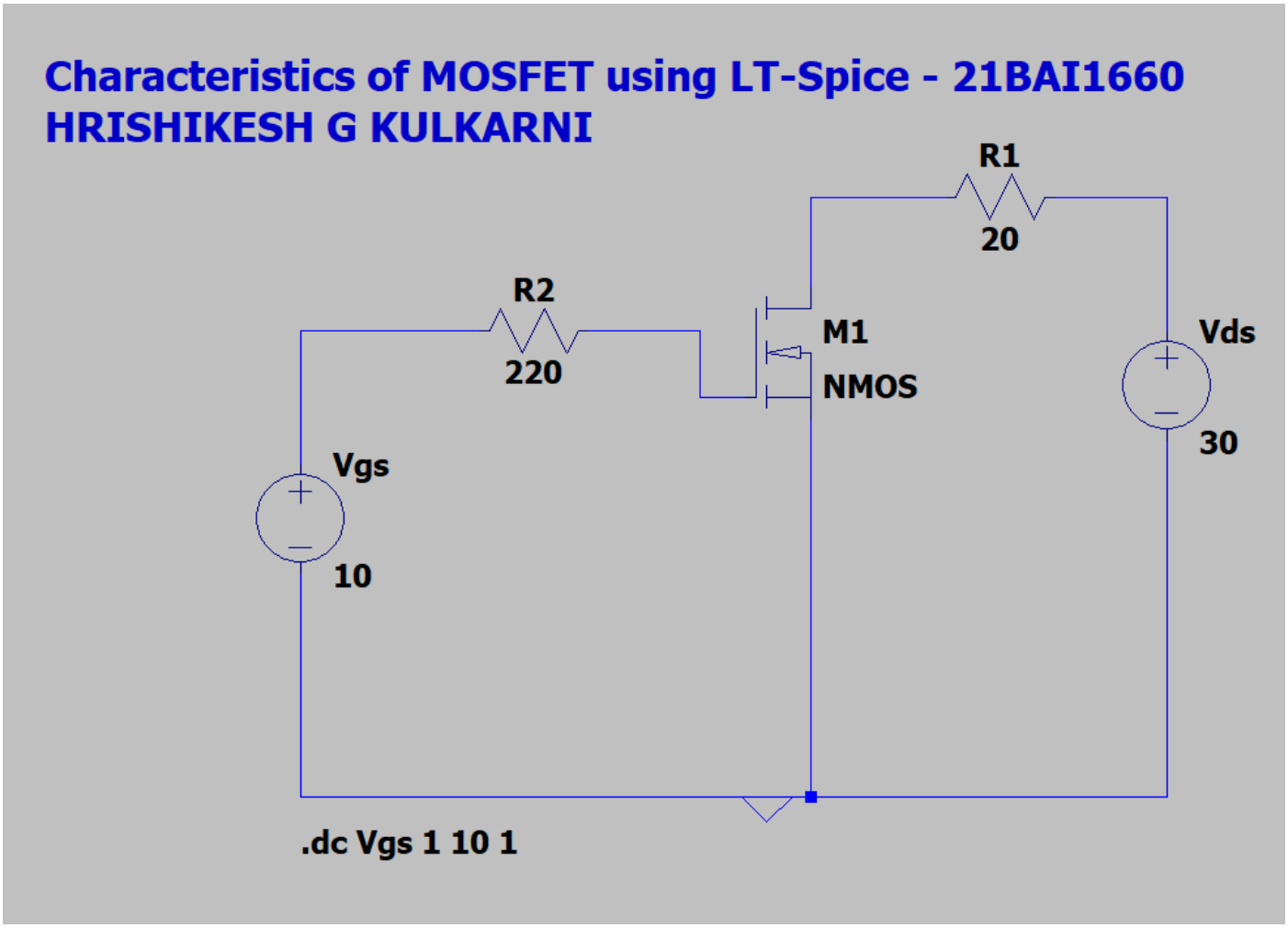
CIRCUIT DIAGRAMS

MOSFET 1ST V-I Characteristics



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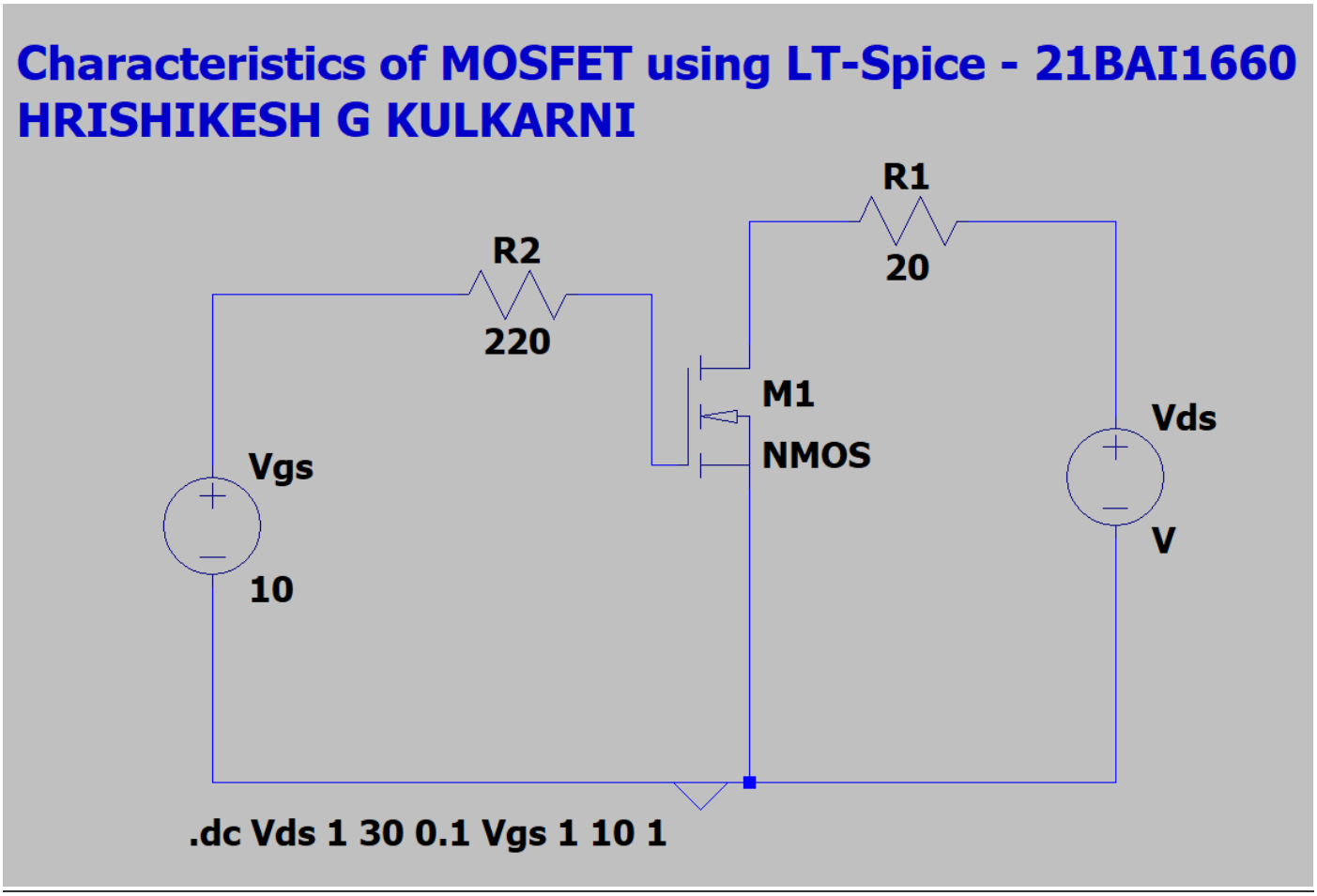
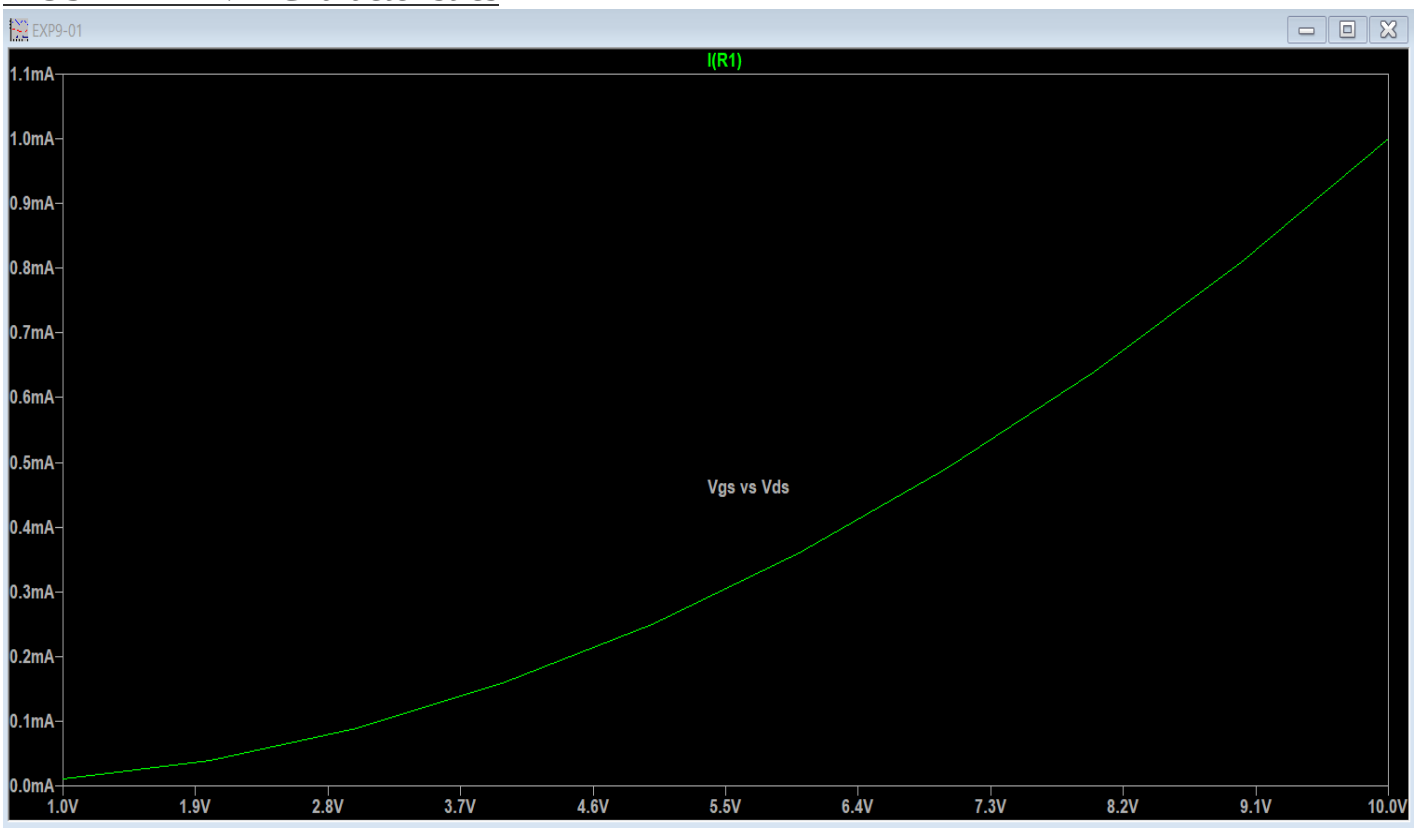
MOSFET 2ND V-I Characteristics

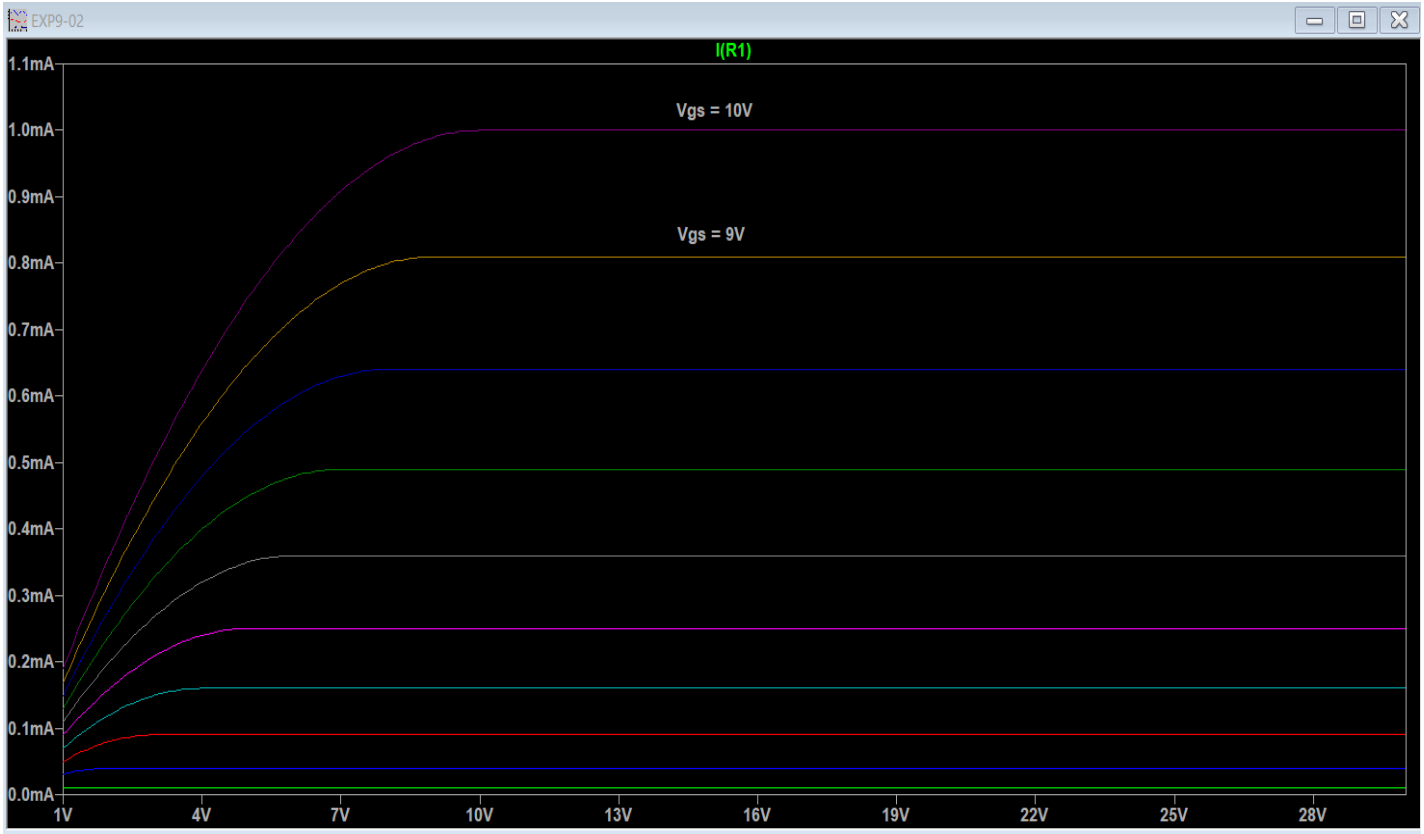


OUTPUTS

MOSFET 1ST V-I Characteristics



MOSFET 2ND V-I Characteristics



RESULT AND INFERENCE

- We were able to study and understand about the MOSFET and about its working principle.
- With the help of the LT-spice simulation we were able to study, understand and observer the V-I characteristics and V-I characteristic graphs of the MOSFET.

=====THE END=====