Experiment 4: FET CHARACTERISTICS

Aim/Objective: To study Drain Characteristics and Transfer Characteristics of a FET.

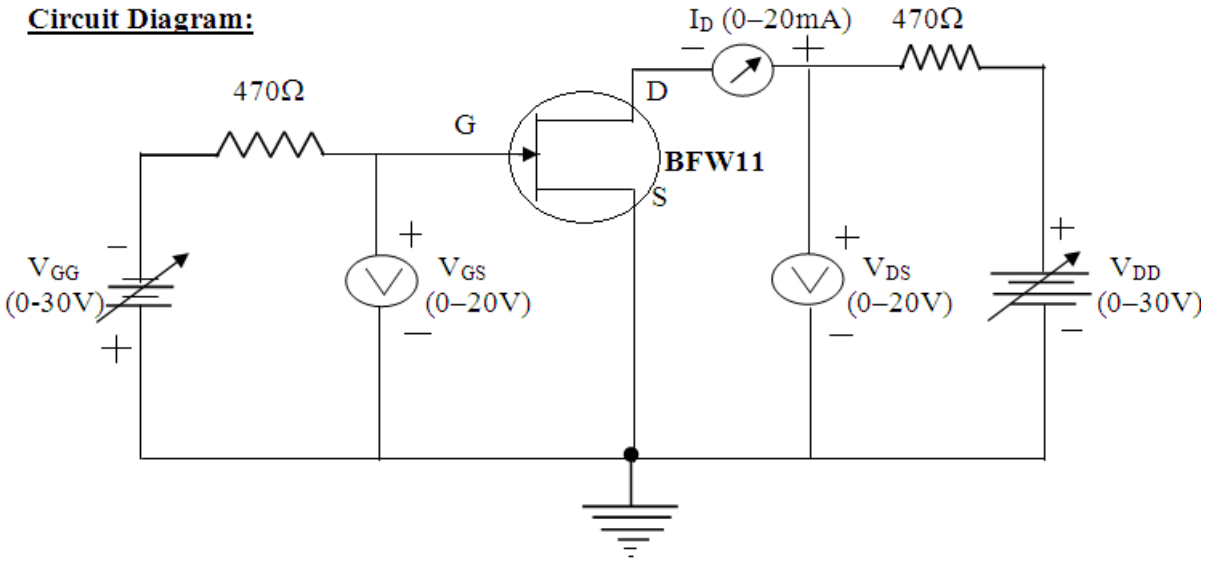
Description:

The basic circuit diagram for studying drain and transfer characteristics is shown in figure.

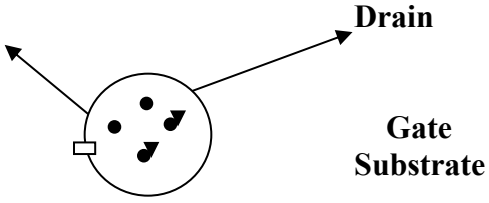
Drain characteristics are obtained between the drain to source voltage (V_{DS}) and drain current (I_D) taking gate to source voltage (V_{GS}) as the parameter.

Transfer characteristics are obtained between the gate to source voltage (V_{GS}) and Drain current (I_D) taking drain to source voltage (V_{DS}) as parameter.

Circuit Diagram:



Pin assignment of FET:



Pre lab session

1) **What is the basic structure and working principle of a JFET (Junction Field Effect Transistor)? How does it differ from a BJT?**

2) **Define pinch-off voltage in a JFET. What happens to the drain current beyond this voltage in the output characteristics?**

3) **How are the input and output characteristics of a JFET measured? Which terminals are involved in each case?**

4) **What is the significance of the high input impedance of a FET in analog applications?**

In-Lab Session

Procedure:

Drain Characteristics

1. Make the connections as per circuit diagram.
2. Keep V_{GS} = 0V by varying V_{GG}.
1. Varying V_{DD} gradually, note down both drain current I_D and drain to source voltage (V_{DS}).
2. Step Size is not fixed because of non linear curve and vary the X-axis variable (i.e. if output variation is more, decrease input step size and vice versa).
3. Repeat above procedure (step 3) for V_{GS} = -1V.

Transfer characteristics:

1. Keep V_{DS} = 2V by varying V_{DD}.
2. Varying V_{GG} gradually from 0 – 5V, note down both drain current (I_D) and gate to source voltage (V_{GS}).
3. Step Size is not fixed because of non linear curve and vary the X-axis variable (i.e. if output variation is more, decrease input step size and vice versa).
4. Repeat above procedure (step 2) for V_{DS} = 4V.

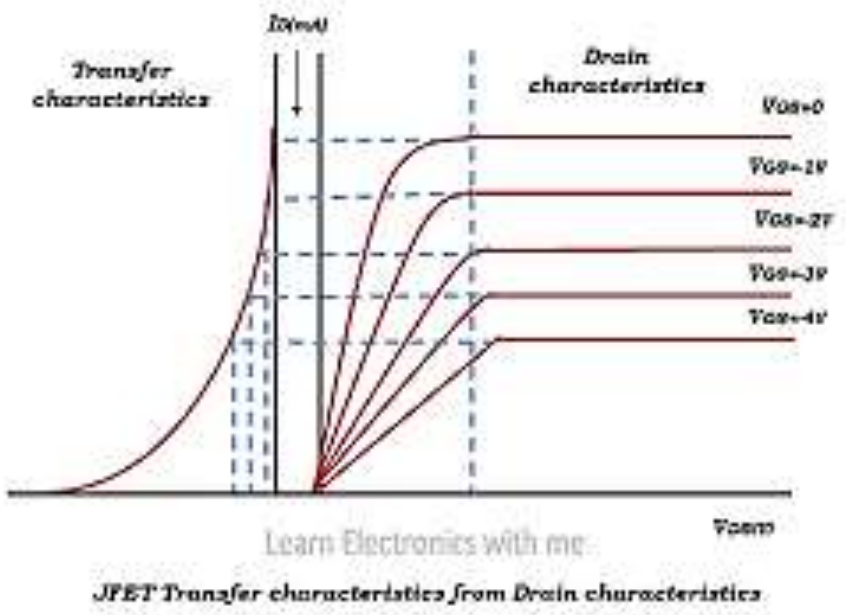
Tabular column:

Drain characteristics:

V_{GS} = -1V			V_{GS} = -2V	
S.No	**V_{DS} (V)**	**I_D (mA)**	**V_{DS} (V)**	**I_D (mA)**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Transfer characteristics:

V_{DS} = 2V			V_{DS} = 4V	
S.No	**V_{GS} (V)**	**I_D (mA)**	**V_{GS} (V)**	**I_D (mA)**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				



JFET Transfer characteristics from Drain characteristics

Calculations:

Drain Resistance (r_d): It is given by the ration of small change in drain to source voltage (ΔV_{DS}) to the corresponding change in Drain current (ΔI_D) for a constant gate to source voltage (V_{GS}), when the JFET is operating in pinch-off or saturation region.

Trans-Conductance (g_m) : Ratio of small change in drain current (ΔI_D) to the corresponding change in gate to source voltage (ΔV_{GS}) for a constant V_{DS}.
$g_m = \Delta I_D / \Delta V_{GS}$ at constant V_{DS} . (from transfer characteristics)
The value of g_m is expressed in mho's or siemens (s).

Amplification Factor (μ) : It is given by the ratio of small change in drain to source voltage (ΔV_{DS}) to the corresponding change in gate to source voltage (ΔV_{GS}) for a constant drain current.

$$\mu = \Delta V_{DS} / \Delta V_{GS.}$$
$$\mu = (\Delta V_{DS} / \Delta I_D) \text{ X } (\Delta I_D / \Delta V_{GS})$$
$$\mu = r_d \text{ X } g_m.$$

Result:

Viva-Voce

1. **Which of the following parameters defines the amplification capability of a FET?**
   A. Transconductance (gm)
   B. Input resistance
   C. Drain resistance
   D. Cut-off frequency

2. **In the output characteristics of an n-channel JFET, the region where drain current becomes constant is called the:**
   A. Ohmic region
   B. Saturation region
   C. Cut-off region
   D. Breakdown region

3. **The input impedance of a FET is typically:**
   A. Very low
   B. Low
   C. Moderate
   D. Very high

4. **Pinch-off voltage (Vp) in a JFET is the:**
   A. Maximum gate voltage for conduction
   B. Voltage at which gate current becomes maximum
   C. Drain-source voltage at which drain current saturates
   D. Gate-source voltage at which drain current becomes almost zero

5. **For a JFET operating in the active (saturation) region, the drain current is primarily controlled by:**
   A. VDS
   B. VGS
   C. Gate current
   D. Load resistance

Inference and Analysis:

Evaluator Remark (if Any):	**Marks Secured: _____out of 50**
	Signature of the Evaluator with Date