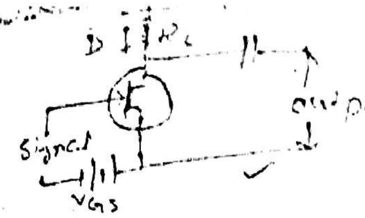


Ques:- Why FET Called voltage controlled device.

Answer: The small change in voltage at Gate V_{GS} produces a large change in drain current. This factor is used in amplification property of FET. So FET called voltage controlled device.

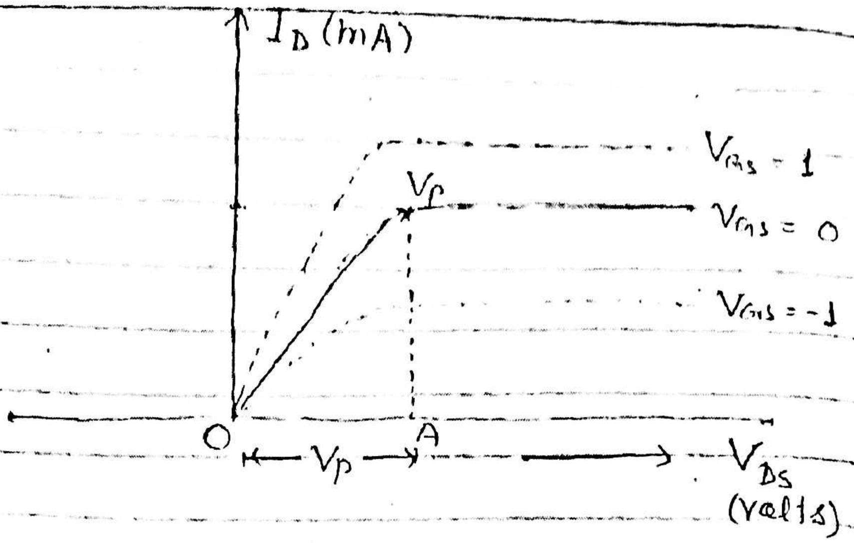
Output characteristics of FET:- (output characteristics of FET):-

The curve between drain current (I_D) and drain source voltage V_{DS} of a FET at constant gate source voltage V_{GS} called output characteristics of FET. Figure shows method for determining output characteristics of "JFET".

We keep V_{GS} fixed
at some value,
say 1 volt and
V_{DS} changed
in steps and
corresponding change
in I_D may be
noted.
following three terms are
used in output characteristic
of JFET.

1:- Shorted Gate drain Current. (I_{DSS})
2:- Pinch off voltage (V_P)
3:- Shorted gate cut off voltage $V_{GS(off)}$

Curve for output characteristics of JFET is shown in figure



* When JFET used after V_P in active reason. then FET is used as a constant source *

①: **Shorted Gate drain Current :- (I_{DSS})**:- It is the drain current with source shorted circuited to gate equal to pinch off voltage. It is some times called zero bias current."

② **Pinch off voltage (V_p)**: "It is minimum drain source voltage at which drain current essentially becomes constant."

③: **V_{GS} (off)** :- It is Gate source voltage where the channel is completely cut off and drain current becomes zero.

* **Expression for drain Current (I_D)**:- Expression for pinch off voltage

* Parameters of FET:- Like vacume tube s, there also three parameters of FET. The parameters of FET are given bellow -

1. a.c. drain resistance, (r_d)
2. Transconductance (g_{fs})
3. Amplification factor, (μ)

1. a.c. drain resistance (r_d) :- A.c. drain resistance is denoted by r_d. It is ratio of change in V_{DS} to change in I_d at constant V_{GS}.

$$r_d = \frac{\Delta V_{DS}}{\Delta I_D} \quad \text{at Constant } V_{GS}.$$

2. Transconductance :- (g_{fs}) :- Transconductance is denoted by g_{fs}. It is ratio of change in drain current I_d to change in V_{GS} at constant V_{DS}.

$$g_f = \frac{\Delta I_D}{\Delta V_{GS}} \quad \text{at Constant } V_{DS}$$

3. Amplification factor (μ) :- Amplification factor is denoted by μ. It is ratio of change in V_{DS} to change in V_{GS} at constant I_D.

$$\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}} \quad \text{at Constant } I_D$$

* **Relation between Parameters:-** The relation between r_d, g_{fs} and μ is given as bellow.

$$\boxed{\mu = g_{fs} \times r_d}$$

Amplification factor = a.c drain Resistance x trans Conductance

* **Problem:-** When reverse gate voltage of 15 volt is applied to a FET, the gate current is 10^{-3} µA. Find resistor between gate and source.

Solution:-

Given. $V_{GS} = 15$ volt

$I_G = 10^{-3}$ µA

$= 10^{-9}$ A

Gate source resistance $= \dfrac{V_{GS}}{I_G}$

$= \dfrac{15}{10^{-9}} = 15 \times 10^{9}\,\Omega$

* **Problem:-** Following readings are obtained from a FET. Find all parameters of FET.

V_{GS}	0V	0V	0.2V
V_{DS}	7V.	15V	15V
I_D	10 mA	10.25 mA	9.65 mA.

* **Solution:-**

(i):- $r_d = \dfrac{\Delta V_{DS}}{\Delta I_D}$ When V_{GS} is constant

$\Delta V_{DS} = (15V - 7V) = 8V$ at. $V_{GS} = 0V$

$\Delta I_D = (10.25 - 10) = .25$ mA

Hence.

$$r_d = \frac{\Delta V}{.125\,mA} = \frac{16 \times 10^{4}}{.25}$$

$$= 3.2 \times 10^{4}\,\Omega$$

$$= 32 \times 10^{3}\,\Omega$$

$$= 32\,k\Omega$$

(ii):- $g_{fs} = \frac{\Delta I_d}{\Delta V_{GS}}$ at Constant ΔV_{DS}

$\Delta I_d = (10.25 - 9.65) = 0.6\,mA$ at $V_{DS} = 15V$

$\Delta V_{GS} = (.2V - 0V) = 0.2V$ at $V_{DS} = 15V$

$$\therefore g_{fs} = \frac{.2\,V}{.6\,mA} = \frac{2}{6} \times 10^{3}$$

$$= \frac{.6\,mA}{.2\,V} = 3\,mA/volt = 3\,m\,mho.$$

(iii):- and amplification factor.

$$\mu = r_d \times g_{fs}$$

$$= 32 \times 10^{3}\,\Omega \times 3\,mA/volt$$

$$= 96.$$

$r_d = 32\,k\Omega = 3.2 \times 10^{4}\,\Omega$

$g_{fs} = 3$ milimho.

$\mu = 96$

} Ans