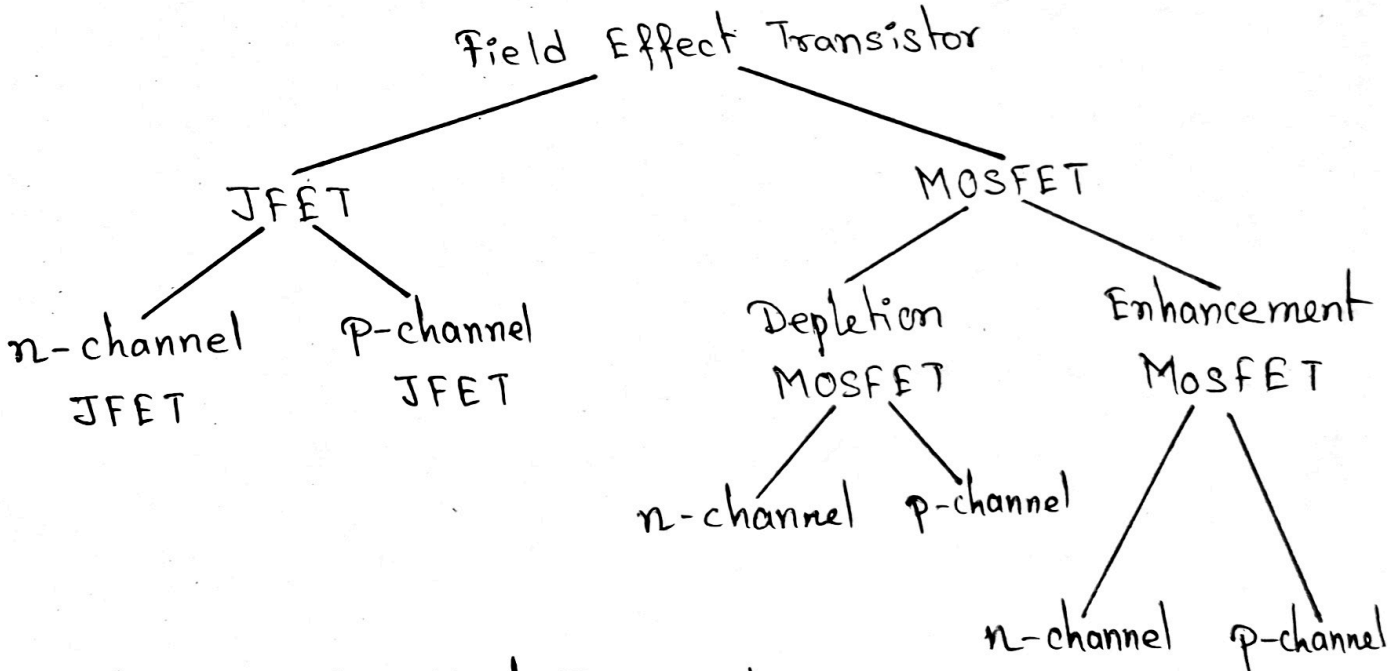
## • Field Effect Transistors (FET):

• The field-effect transistor (FET) is a semiconductor device with the output current controlled by an electric field.

• In FET the current is carried predominantly by one type of carriers, thus the FET is known as unipolar transistor.

• The FET is thus different from the bipolar junction transistor (BJT) which involves two types of carriers (electrons and holes) for current conduction.

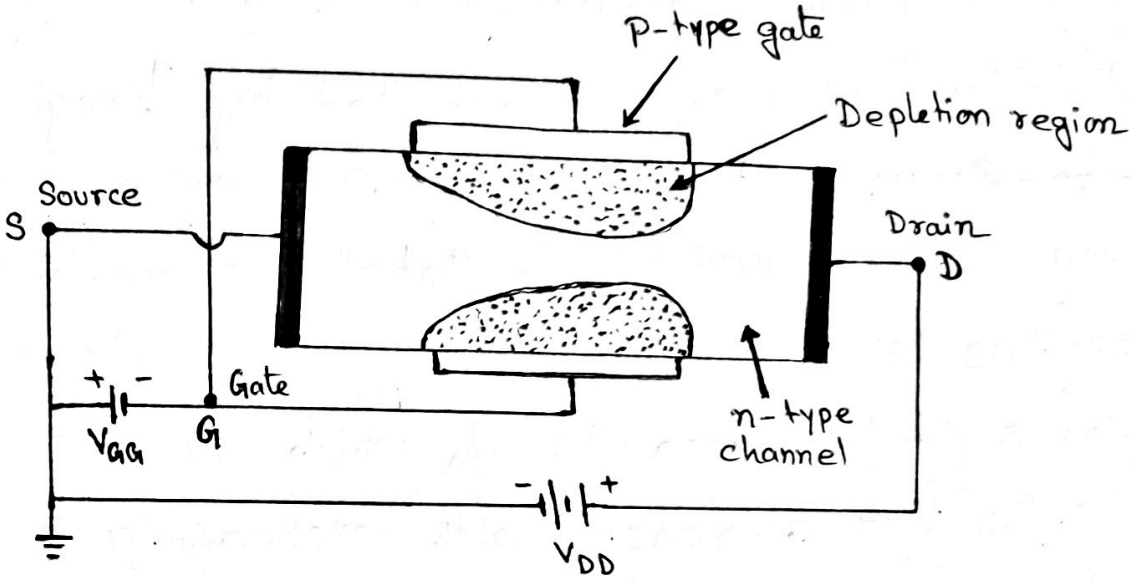
• FET are used in controlled switching between conducting and non conducting states in a digital circuits. FETs are also thermally stable.




## Junction Field-Effect Transistor (JFET):

The JFET consists of a uniformly doped Semiconductor bar usually of Silicon (Si) or Gallium

arsenide (GaAs). If the semiconductor bar is n-type, the JFET is called n-channel JFET, on the other hand if the bar is p-type, the device is termed a p-channel JFET.




Basic structure of JFET

Two sides of the bar are heavily doped with impurities opposite to that of the bar. (i.e. p-type impurities for an n-type bar and n-type impurities for an p-type bar). By applying a voltage $V_{DD}$ between the two ends of the bar a current is allowed to flow along the length of the bar.

Source (S): The terminal through which the majority carriers enter the bar is known as source.

Drain (D): The terminal through which the majority carriers leave the bar is known as drain.

Gate (G): The region on the two sides of the bar heavily doped with impurities opposite to the bar is called Gate.

## Principle of JFET Operation :

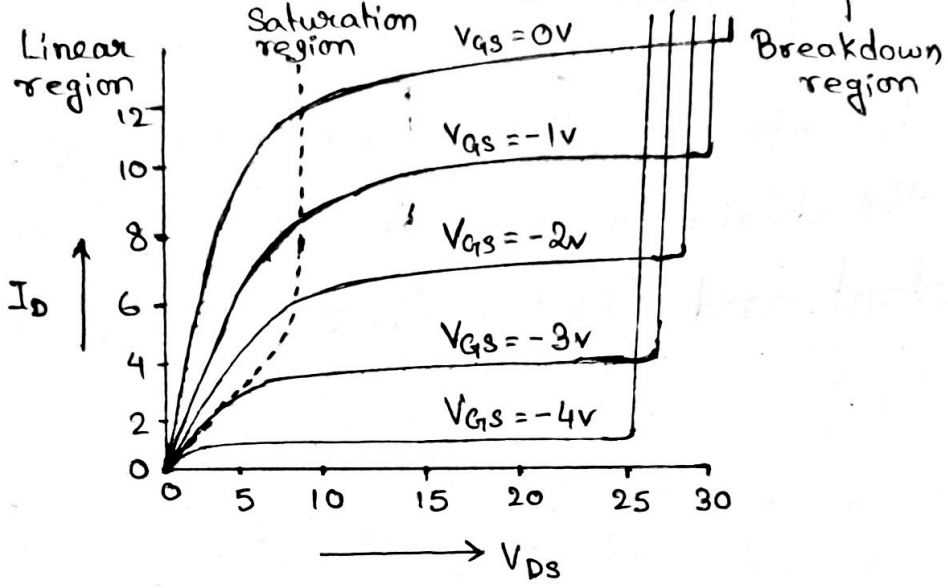
The junction between the bar and the gate is reverse biased by applying a voltage $V_{GG}$. The resulting depletion regions extends into the bar. The width of the depletion region can be controlled by changing the gate-to-Source voltage. The depletion region does not have any current carriers, so that the conductivity of these regions is nominally zero. Therefore, the effective cross sectional area through which the current flows in the bar decreases with increasing reverse bias. For a given drain-to-Source voltage, the drain current is a function of the gate-to-Source voltage.

The JFET is basically a voltage-controlled resistor, the resistance being controlled by the gate voltage.

The portion of the Semiconductor bar between the depletion region through which the majority carriers move from Source to drain is called the channel.

## Static Characteristics of JFET:

The graphical plots of the drain current ($I_D$) against the drain-to-source voltage ($V_{DS}$) with the gate-to-source voltage ($V_{GS}$) as a parameter are known as static characteristics of JFET.




The drain characteristics are found to consist of three regions,

i) The linear region, where the voltage $V_{DS}$ is small and $I_D$ is nearly proportional to $V_{DS}$.

ii) The saturation region where $I_D$ is fairly constant and is independent of $V_{DS}$

iii) The breakdown region where $I_D$ increases rapidly with a small increase of $V_{DS}$.

The constant drain current in the saturation region of the characteristics is called the saturation current ($I_{DSat}$). The minimum value of $V_{DS}$ at which

the drain current saturates for a given $V_{GS}$ is called the Saturation voltage $V_{Dsat}$. The points of intersection of the dashed curve with the characteristics give the values of $I_{Dsat}$ and $V_{Dsat}$ for different $V_{GS}$.

## Pinch off voltage :

Pinch off voltage is the drain to source voltage after which the drain to source current becomes almost constant. and JFET enters into saturation region.