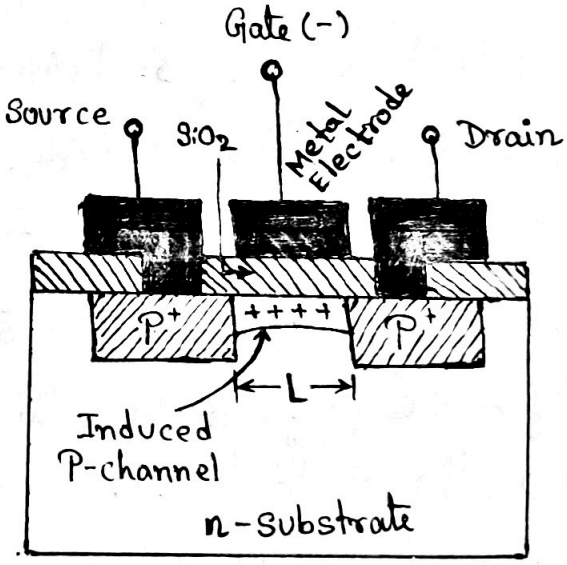
Metal - Oxide - Semiconductor FET (MOSFET):

The MOSFET is also referred to as the IGFET (Insulated - Gate Field effect transistor). MOSFET is Commercially more important than the JFET Since MOS devices are Suitable for very large scale integration

MOSFET can be of n-channel and p-channel type. MOSFET have been constructed with various Semiconductors Such as Silicon and gallium arseride, and with different insulators like Silicon dioxide (SiO_2), Aluminum oxide (Al_2O_3). The $Si - SiO_2$ Combination is the most common system.



P-channel MOSFET

A p-channel MOSFET Consists of a lightly doped n-type Semiconductor Substrate into which two heavily doped p-region are formed. These heavily doped p-regions act as the Source and drain. A thin layer of Silicon dioxide SiO_2 is grown on the Surface of the Structure.

The distance between the two metallurgical p^+ junctions is reffered to as the channel length 'L'.

The area of the gate metal together with the insulating oxide layer and the semiconductor channel produces a parallel plate capacitor, the SiO_2 layer acts as a dielectric.

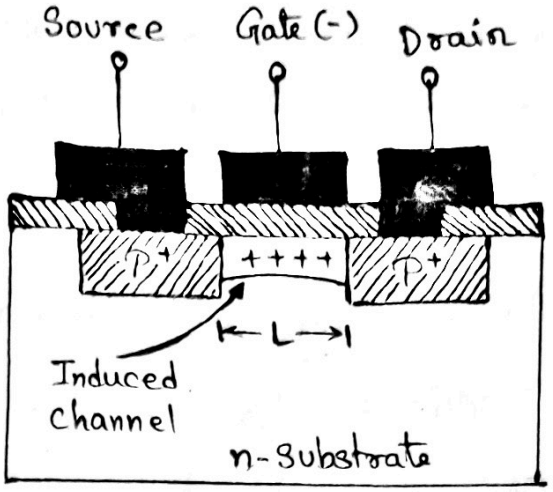
Enhancement and Depletion type MOSFET :

• Enhancement MOSFET :

If the n-type substrate of is grounded and a negative voltage is applied to the gate, positive charges will be induced on the semi-conductor due to capacitor action. These positive charges, being the minority carriers in the n-type substrate, produce an inversion layer.

An increase in the negative gate voltage enhances the induced positive charge in the semiconductor. These positive charges are confined to a thin region called the channel, below the oxide layer.

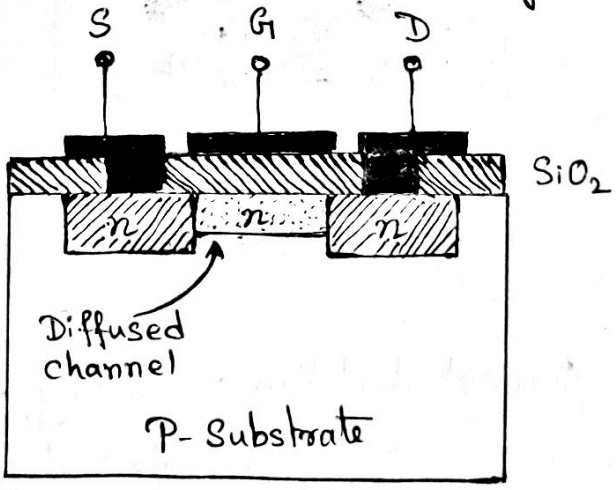
If a positive voltage is applied to the source with respect to the drain, the induced channel carries the current from source to drain. The conductivity of the induced channel and the drain current is enhanced by the negative gate voltage. Hence the device is known as enhancement MOSFET.



Enhancement MOSFET

- **Depletion MOSFET:**

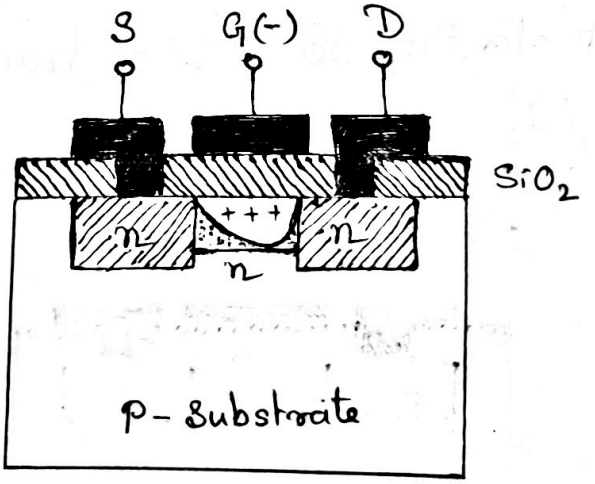
If a portion of the semi-conductor substrate between the source and the drain is diffused with same type of impurities as that used for the formation of the source and the drain, the depletion MOSFET is formed. When a positive voltage is applied to the drain with respect to the source a drain current flows for zero gate-to-source voltage (i.e. $V_{GS} = 0$).



n-channel depletion MOSFET

When the gate voltage is negative, positive charges are induced in the diffused n-channel due to the capacitor action. The induced positive charges reduce the channel conductivity as a portion of the channel is depleted of carriers. The effective depletion of the majority carriers in the channel justifies the name depletion MOSFET. Clearly the drain current falls as V_{GS} is made more negative.

Since the drain-to-source voltage is positive, the voltage drop between the channel and the gate is greater near the drain than near the source. Hence the channel region near the drain is depleted more than that near the source.

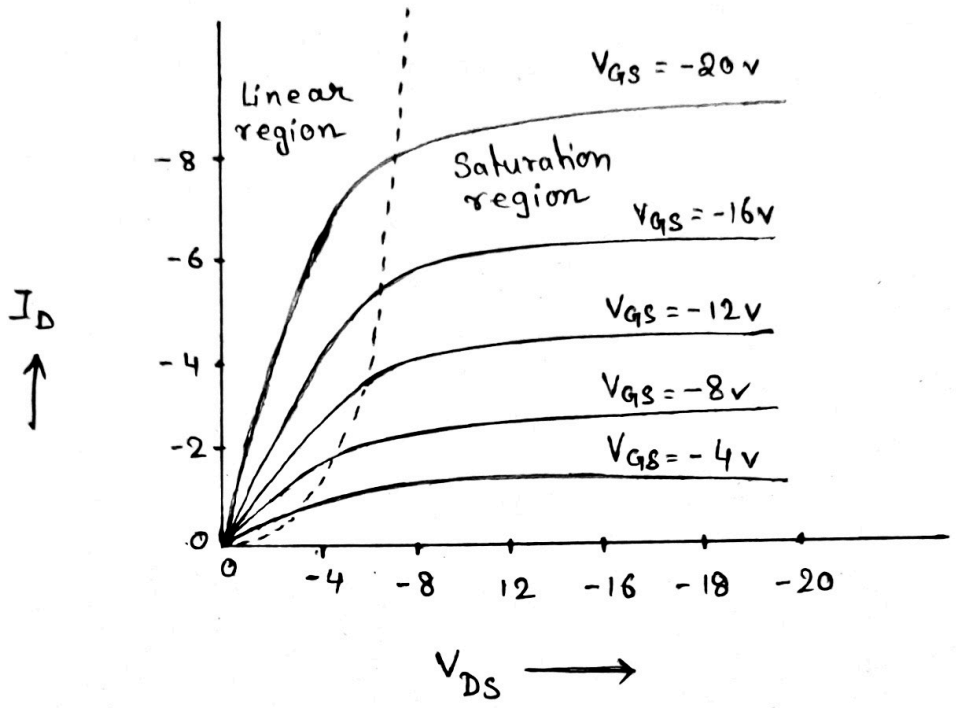


Channel depletion resulting from a negative gate voltage

** A depletion MOSFET can be operated in enhancement mode by applying a positive gate voltage to induce

negative charges in the n-type channel.

Static Characteristics of MOSFET :



The drain characteristics of a p-channel enhancement type MOSFET is illustrated above.

Each characteristic curve displays the variation of the drain current I_D with the drain-to-source voltage V_{DS} for a fixed gate to source voltage. V_{GS}.

Suppose that for a given negative gate voltage, the drain voltage is made slightly negative with respect to source. A current flows from the source to the drain. The drain current I_D is proportional to the drain-to-source voltage V_{DS}. This gives the linear region.