BJT,s (Bipolar Junction)

FET (Field effect Transistor)

BJT uses both electron and hole as a carrier.

FET uses only one type of carrier that,s why it is called unipolar devices.

Main two types of FET.

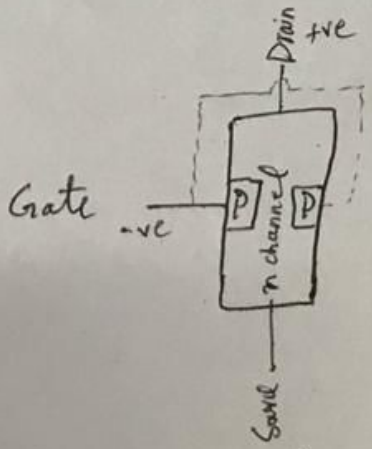
JFET (Junction field effect transistor).

MOSFET (Metal oxide semiconductor field effect transistor).

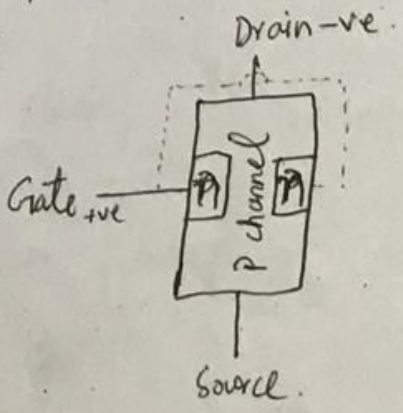
BJT is a current controlled device.

FET is a voltage controlled device.

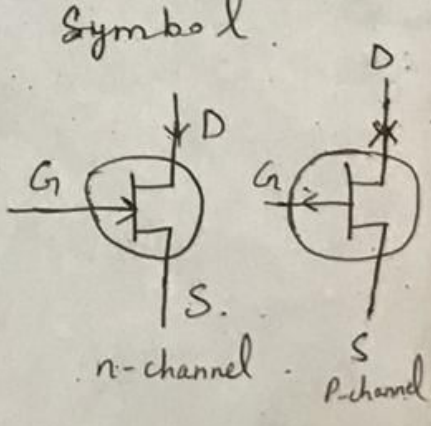
Basic structures of JFET :-



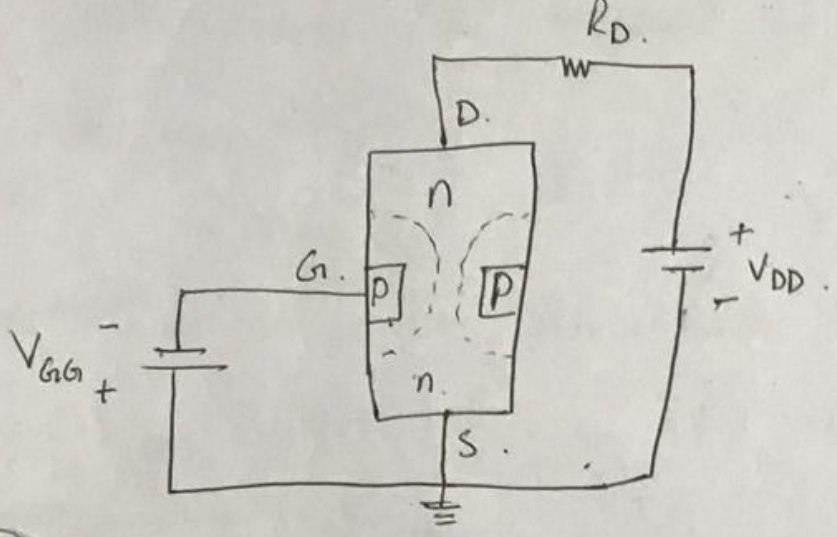
n-channel.



P-channel



Basic Operation :-



There is a reverse bias pn junction region between Grate Sourd and gate drain.

Drain current can be controlled by gate voltage.

Depletion region is wider towards drain end because diffevence b/w Grate and drain voltage is greater.

V_{GS} increases than I_D decreases.

V_{GS} and I_D are inversely proportional.

Reason :- V_{GG} narrows the channel (increases white area) which increases the resistance of the channel and decreases I_D.

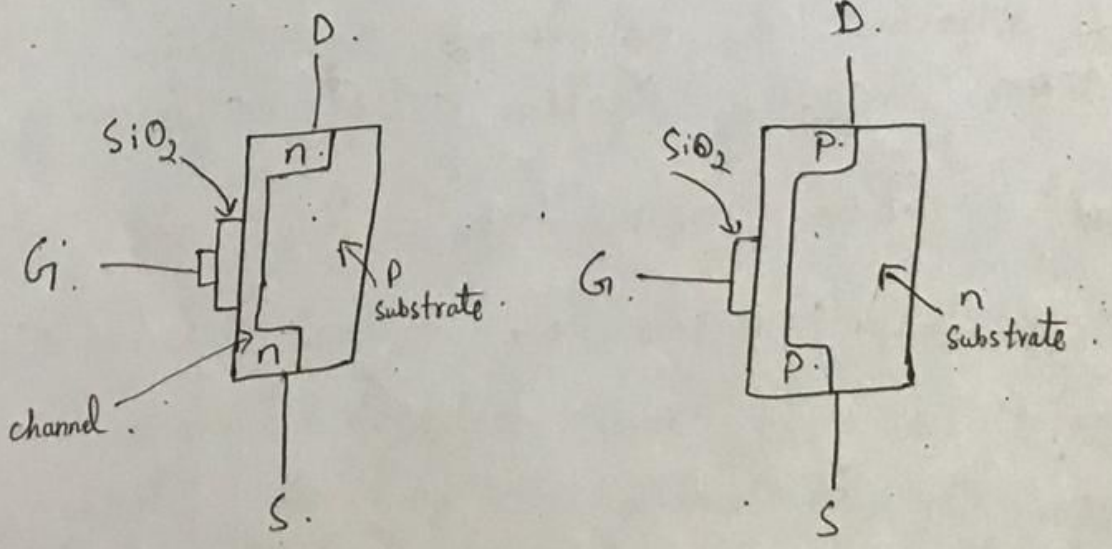
MOSFET (metal oxide semiconductor field effect transistor):-

It differs from FET that it has no pn junction structure.

Gate of MOSFET is insulated from the channel by a silicon dioxide (SiO_2) layer.

Two basic type of MOSFET are depletion (D) and enhancement (E).

Depletion MOSFET :-

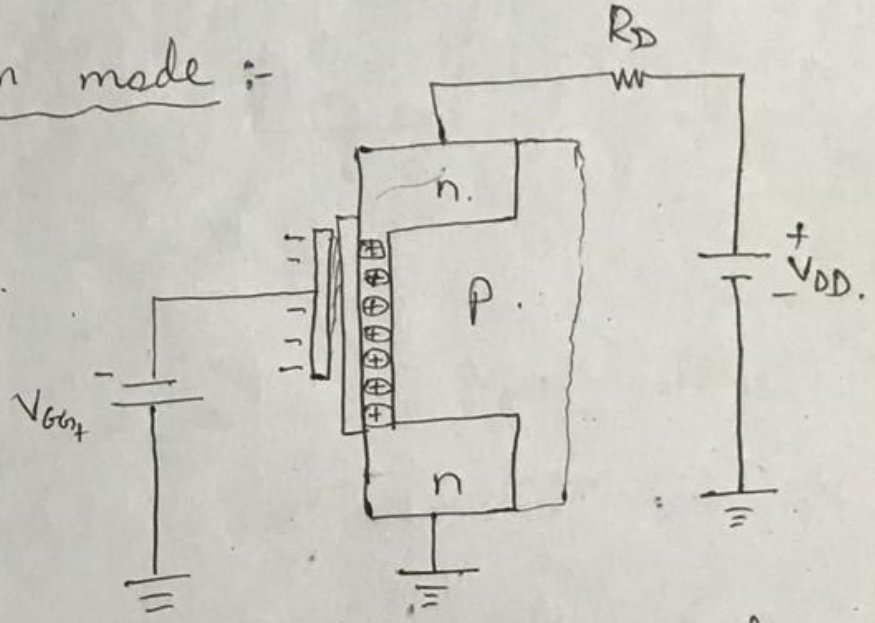


D-MOSFET can be operated in depletion mode or enhancement mode. 2(a)

n-channel MOSFET operates in the depletion mode when a negative gate to source voltage is applied.

Enhancement mode when positive gate to source voltage is applied.

Depletion mode :-



Gate and channel can be visualize as capacitor plates. Negative gate voltage contains negative charges on the gate which repel electrons from the channel leaving +ve ions in their places.

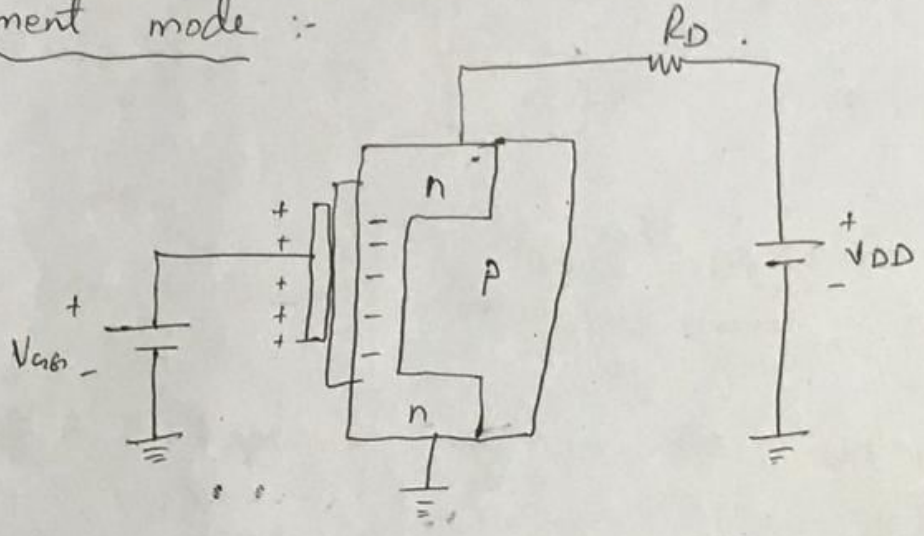
n-channel depleted some of its electrons.

Greater the negative voltage at gate the greater the depletion channel of n-channel electrons.

At a sufficiently negative gate to source voltage $V_{GS(off)}$, the channel is totally depleted and the drain current is zero.

Gate -ve voltage $\alpha \frac{1}{I_D}$.

Enhancement mode :-

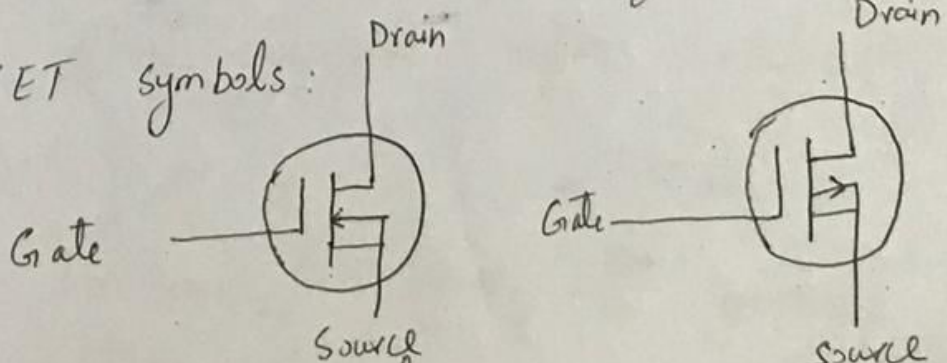


Enhancement mode :

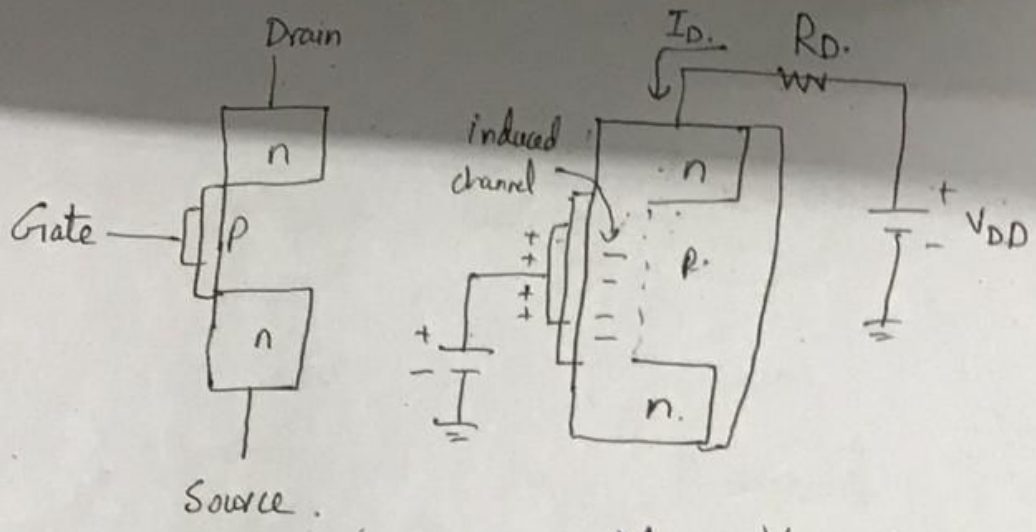
With a positive gate voltage more conduction electrons are attracted into the channel, thus increasing the channel capacity.

Gate +ve voltage α I_D.

D-MOSFET symbols :



Enhancement MOSFET :-



(a) Basic construction

$V_{GS} > V_{GS(th)}$

(b) Induced channel.

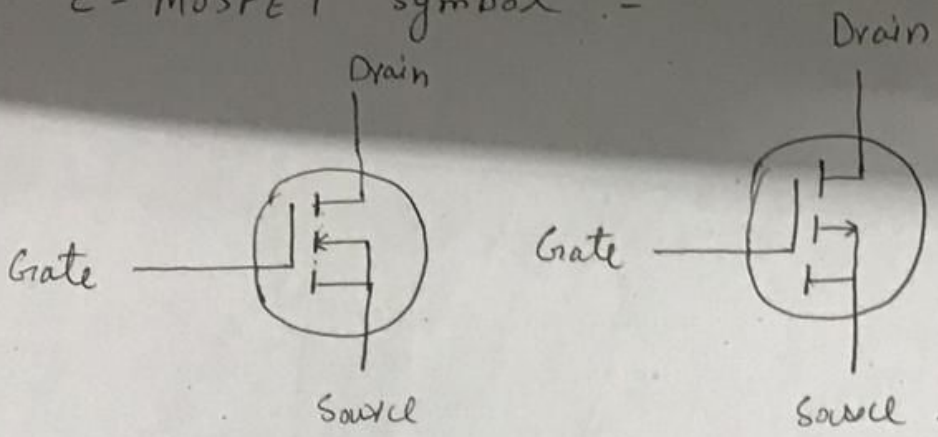
E-MOSFET operates only in the enhancement mode and has no depletion mode.

Substrate extended to SiO_2 layer.

For an n-channel device a positive gate voltage above a threshold value induces a channel by creating a thin layer of negative charges in the substrate region adjacent to the SiO_2 layer.

I_D can be increase by increasing gate to source voltage.

E- MOSFET symbol :-

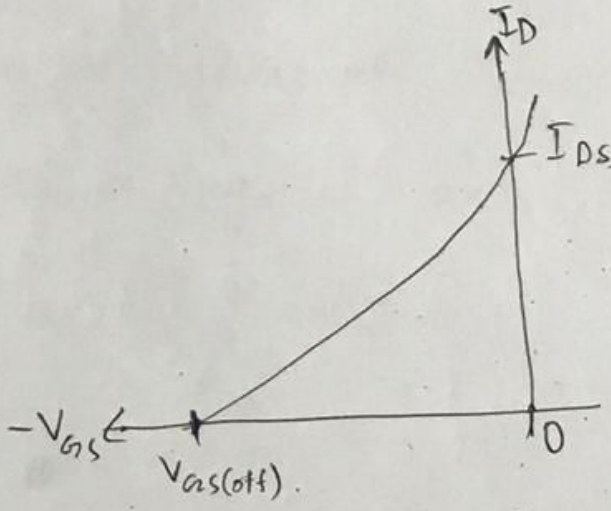


n-channel.

P-channel.

D- MOSFET Transfer characteristic :-

D- MOSFET depletion mode. with n-channel.



nchannel.

As we know for $V_{GS} = 0$ $I_D = I_{DSS}$ (maximum drain current)

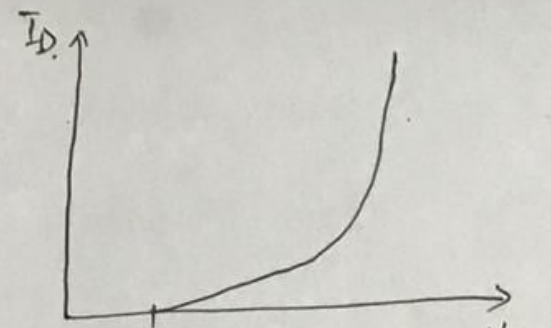
Repeal ~~to much~~ very few electrons from channel.

$V_{GS} = V_{GS(off)}$ $I_D = 0$.

Repeal to much electrons from channel.

E - MOSFET Transfer characteristic :-

Enhancemode only in E-MOSFET with n-channel



n-channel

E - MOSFET differs from D - MOSFET because the curves starts at $V_{GS(th)}$ rather than $V_{GS(off)}$ on the horizontal axis and never intersects the vertical axis.