



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF COMPUTER SCIENCE AND DESIGN

COURSE NAME : 19EE01 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I YEAR /II SEMESTER - COMPUTER SCIENCE AND DESIGN

Unit 4 – ANALOG ELECTRONICS

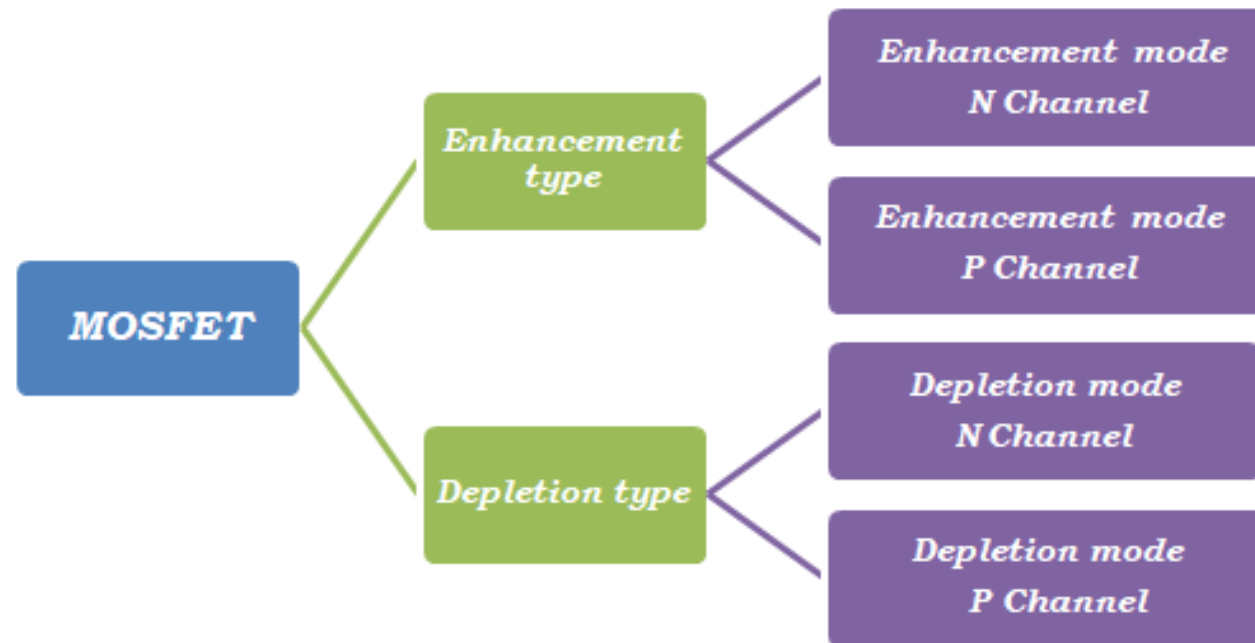
Topic 5 : MOSFET



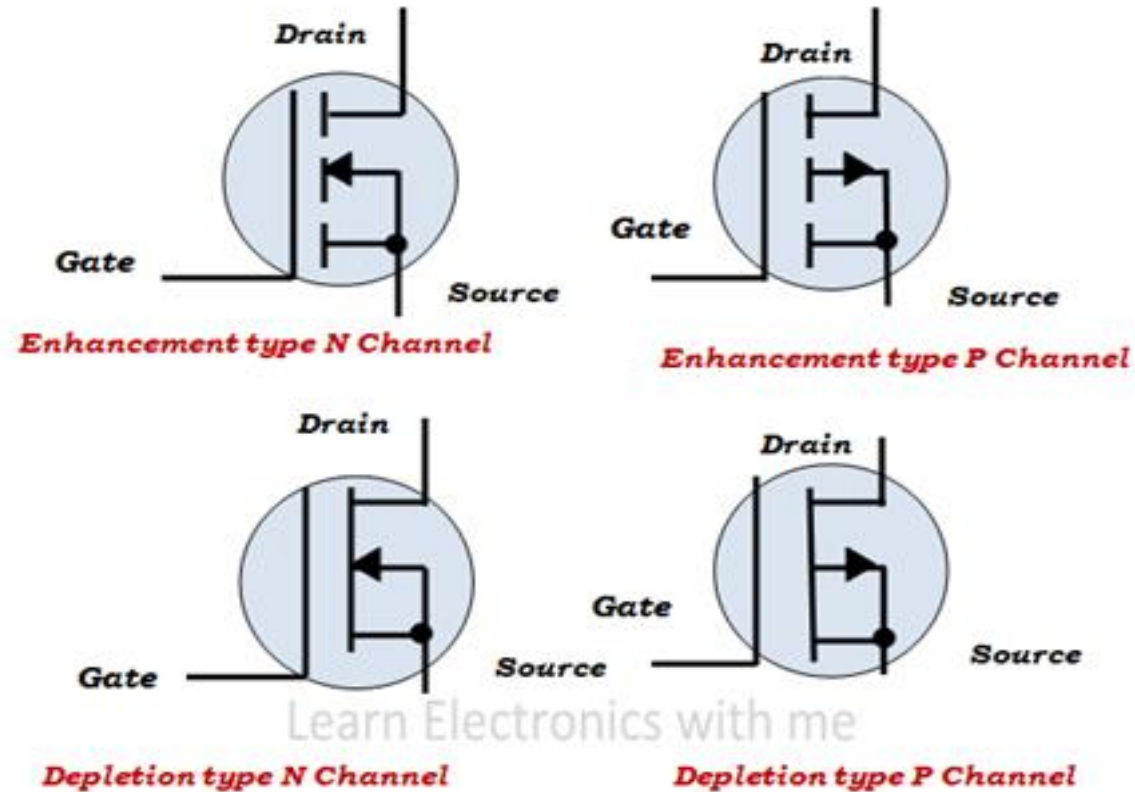
What is MOSFET?

MOSFET stands for Metal Oxide Semiconductor Field Effect Transistor. It is a type of Field Effect Transistor and it is voltage controlled device. It is also called as Insulated Gate Field Effect Transistor (IGFET). It is used for switching or amplifying electronic signals in the electronic devices. It is the most commonly used transistor and it can be used in both analog and digital circuits.

Types of MOSFET:



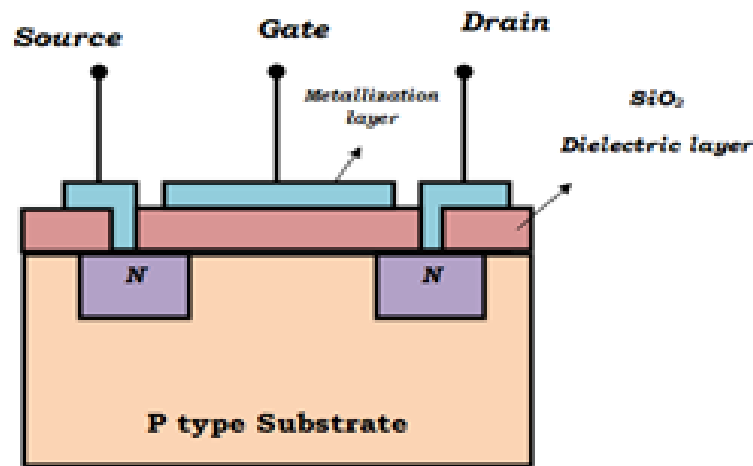
Symbol of MOSFET:



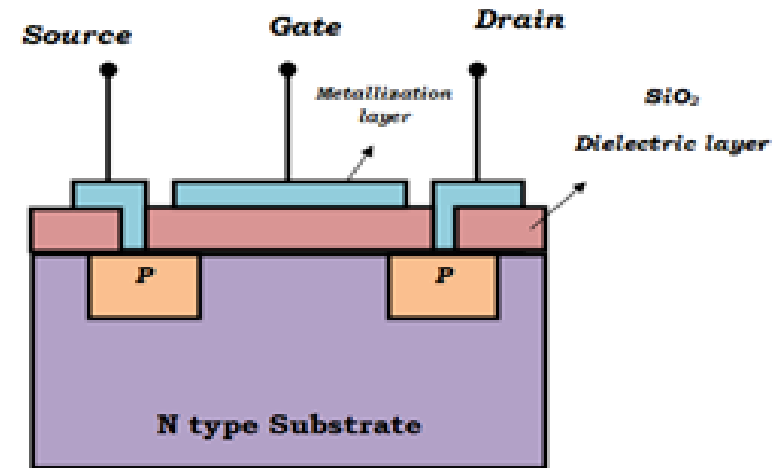
In the Enhancement MOSFET the source and the drain are not connected physically so in the symbol lines are broken and in the Depletion mode line is continuous. In the N type the arrow points inside and in the P type arrow points outside.

Construction of MOSFET:

The metallic gate terminal in the MOSFET is insulated from the semiconductor layer by a SiO_2 layer or dielectric layer. The MOSFET consists of three terminals, they are source(S), Gate (G), Drain (D) and the body which is called as substrate. The substrate is connected to the source internally.



N channel Enhancement MOSFET
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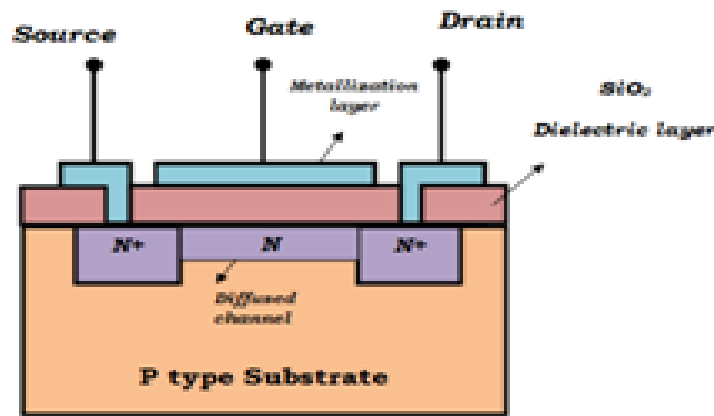


P channel Enhancement MOSFET
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Construction of N channel and P channel Enhancement MOSFET

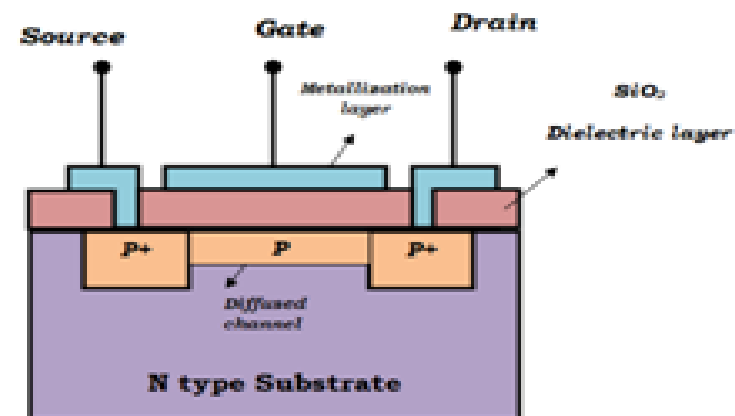
In N channel Enhancement MOSFET the source and drain are of N type semiconductor which is heavily doped and the Substrate is of P type semiconductor. Majority charge carriers are electrons. The source and drain terminals are physically separated in Enhancement mode.

In P channel Enhancement MOSFET the source and drain are of P type semiconductor which is heavily doped and the Substrate is of N type semiconductor. Majority charge carriers are holes.



N channel Depletion MOSFET

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P channel Depletion MOSFET

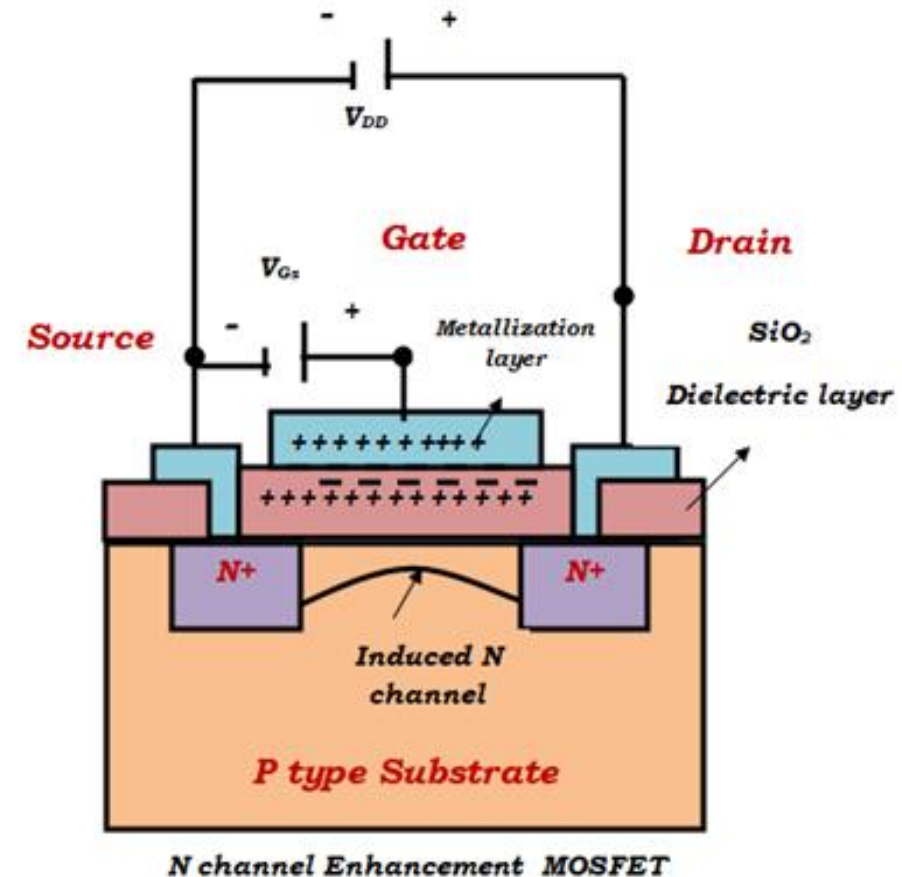
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Construction of N channel and P channel Depletion MOSFET

In the N Channel depletion MOSFET a small strip of semiconductor of N type connects the source and drain. The source and drain are of N type semiconductor and the Substrate is of P type semiconductor. Majority charge carriers are electrons. The source and drain are heavily doped.

In the P Channel depletion MOSFET a small strip of semiconductor of P type connects the source and drain. The source and drain are of P type semiconductor and the Substrate is of N type semiconductor. Majority charge carriers are holes.

Working of Enhancement MOSFET:



N channel Enhancement MOSFET

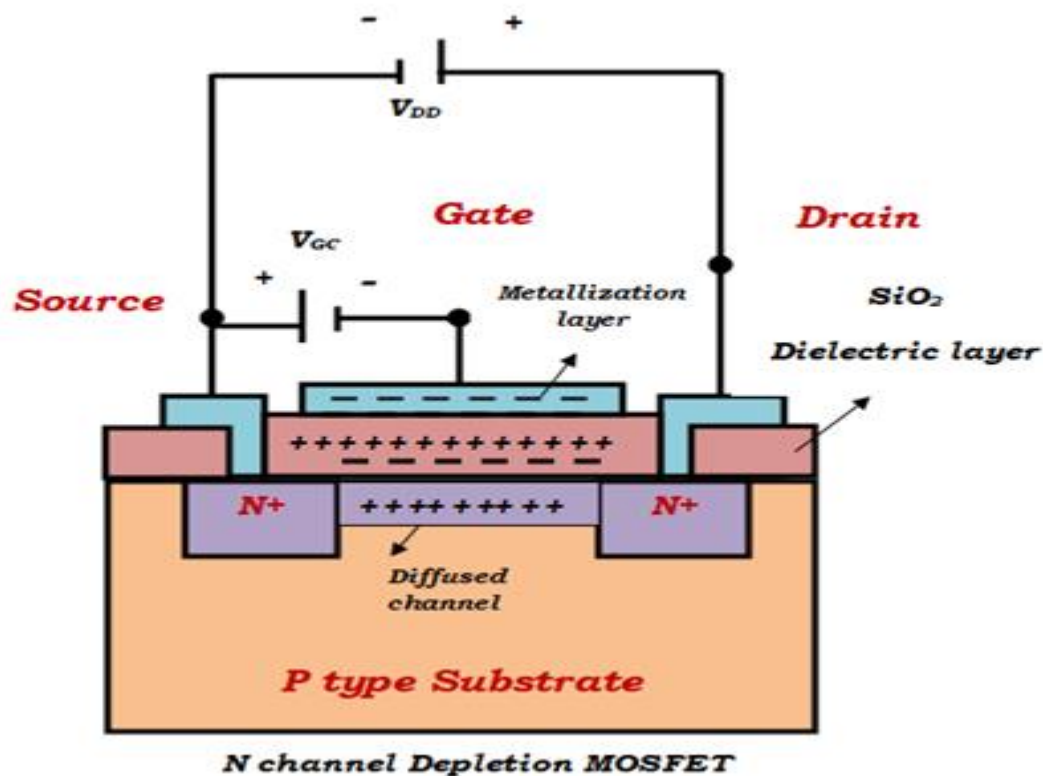
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In the enhancement mode the applied Gate voltage is always positive. When it crosses the threshold voltage it turns ON. The current is generated due to the movement of majority carriers. In N channel majority carriers are electrons and in P channel majority carriers are holes. The source is connected to the negative terminal. When the electrons move from source to drain the positive charges formed below the dielectric because of the repulsive force from gate combine with each other.

When the applied gate voltage is increased the number of majority carriers becomes more than the minority carriers below the dielectric medium. So the majority carriers overcomes the recombination of holes and electrons and the majority carrier move from source to drain in the channel, which forms the current. Thus the gate voltage controls the concentration of the majority carriers which is responsible for the formation of the channel.

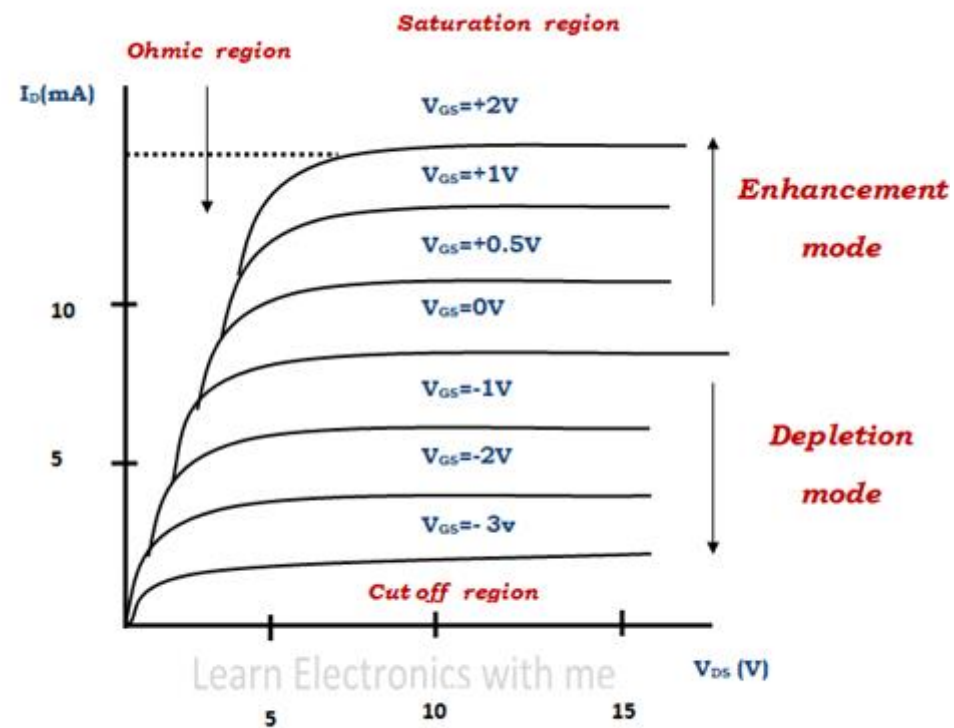
Working of Depletion MOSFET:



The depletion MOSFET is ON by default. The source and drain terminals are physically connected. When the gate terminal is connected to the negative terminal and source to the positive terminal, the electrons get repelled below the dielectric layer. The positive charged carrier from the source gets combined with the majority carrier the electrons in the N type and thus depletion layer is formed and the channel resistance increases and the current flow decreases. Thus the increase in gate voltage decreases the drain current. They are inversely proportional. When the negative voltage is further increased it reaches the pinch off mode.

When the gate is connected to the positive terminal and the source terminal it operates in the enhancement mode.

V-I Characteristics of MOSFET:



V-I Characteristics of MOSFET

**Cut off region:**

No current flows through it and the MOSFET is off.

Ohmic region:

Drain current increases when the drain source voltage increases. Used as amplifier in this region.

Saturation region:

Drain current is constant for drain source voltage. Used as switch in this region. This occurs when the drain source voltage reaches pinch off voltage.

Depletion mode:

The MOSFET is ON by default. When negative voltage is applied to the gate terminal it operates in the depletion mode and when positive voltage is applied, it operates in the enhancement mode.

Enhancement mode:

When positive voltage is applied to the gate terminal, it starts conducting and the current starts to flow.



REFERENCES

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THANK YOU