MINISTRY OF HIGHER EDUCATION AND SIENTIFIC RESEARCh - SAWA UNIVERSITY - ENGINEERING COLLEGE -PHYSICS DEPT. SECOND STAGE 2.nd COURSE

جامعة ساوة الاهلية

كلية التقنيات الهندسية

القسم: الفيزياء الطبية والعلاج

الاشعاعيالمرحلة الثانية /الفصل الثاني

عنوان المحاضرة:

MOSFET TRANSISTORS & PRAPORATORY WEEK BEFORE FINAL EXAM

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رقم المحاضرة (٨)

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

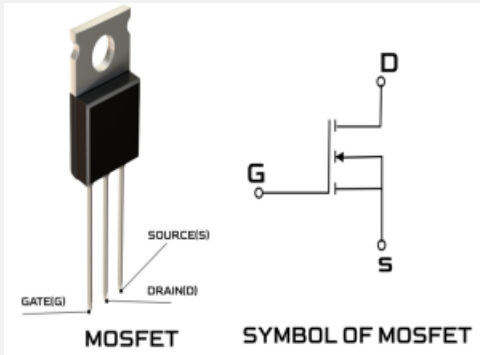
IN THE NAME OF GOD, THE MOST GRACIOUS, THE MOST MERCIFUL

Department of Physics and Radiotherapy

MOSFET (METAL-OXIDE-SEMICONDUCTOR FIELD-EFFECT TRANSISTOR)

- A MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) is a type of transistor that controls the flow of electrical current by applying a voltage to a control terminal called the gate. It's a fundamental component in modern electronics, widely used in integrated circuits, digital logic, and power switching applications

Fig. (36) Mosfet Symbol

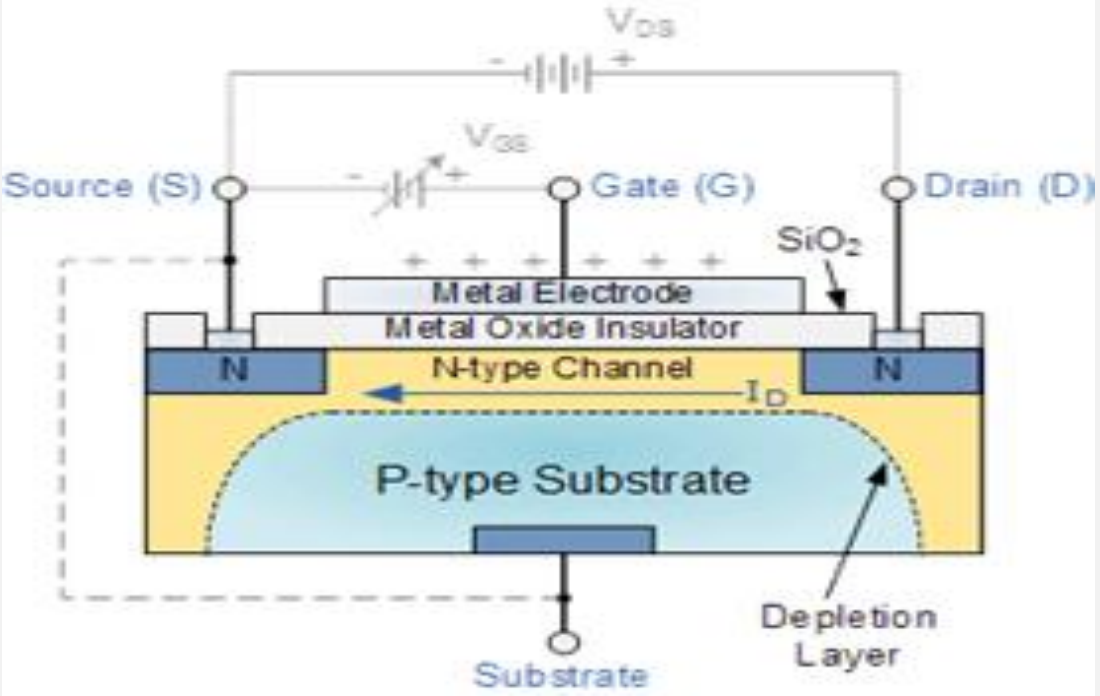


VOLTAGE-CONTROLLED

- Unlike bipolar junction transistors (BJTs), MOSFETs are controlled by voltage rather than current.
- So, VMOSFETs are voltage-controlled devices. This means that the voltage applied to the gate terminal controls the current flow between the source and drain terminals. It requires very little or no current flow into the gate, relying instead on the electric field created by the gate voltage to modulate the channel conductivity

THE MOSFET

METAL OXIDE FET'S OPERATE THE SAME AS JFET'S BUT HAVE A GATE TERMINAL THAT IS ELECTRICALLY ISOLATED FROM THE CONDUCTIVE CHANNEL



MOSFET _TERMINALS

- It is a four-terminal device with
- (A) Source (S),
- (B) Drain (D)
- (C) , Gate (G), and
- (D) body (B) terminals. The body (B) is frequently connected to the source terminal, reducing the terminals to three. It works by varying the width of a channel along which charge carriers flow (electrons or holes).
- As Shown in Fig. (36)

MOSFET _TERMINALS

- The charge carriers enter the channel at the source and exit via the drain. The width of the channel is controlled by the voltage on an electrode called Gate which is located between the source and the drain. It is insulated from the channel near an extremely thin layer of metal oxide.

DIFFERENT TYPES OF MOSFET

- 1. Depletion Mode: The transistor requires the Gate-Source voltage (VGS) to switch the device "OFF". The depletion-mode MOSFET is equivalent to a "Normally Closed" switch.

- 2. Enhancement Mode: The transistor requires a Gate-Source voltage (VGS) to switch the device "ON". The enhancement mode MOSFET is equivalent to a "Normally Open" switch.

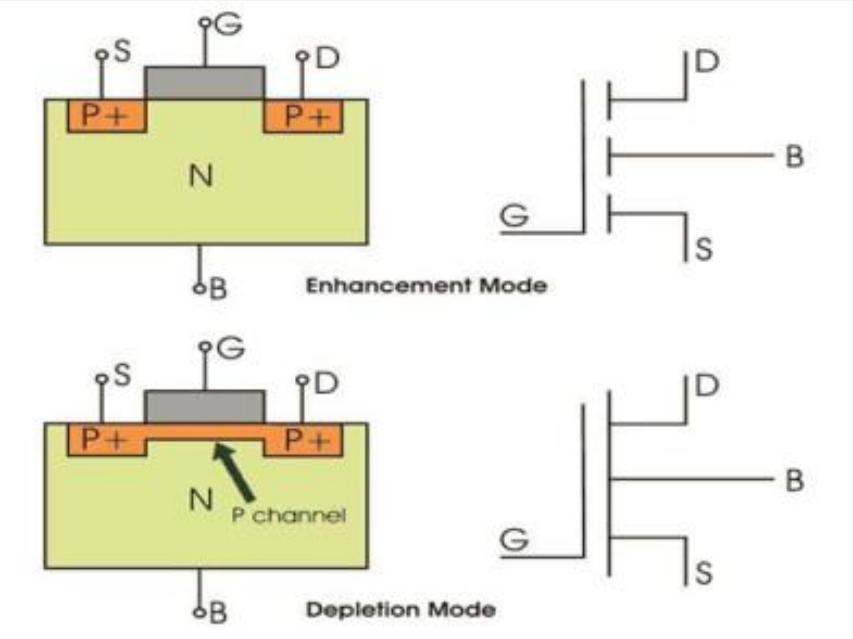
CLASSIFICATION ACCORDING WORKING PRINCIPLE

- Typically , with respect to the working principle, MOSFET is classified as follows:

- P-Channel Depletion MOSFET
- P-Channel Enhancement MOSFET
- N-Channel Depletion MOSFET
- N-Channel Enhancement MOSFET

P-CHANNEL MOSFET

Fig. (37) P-CHENNEL

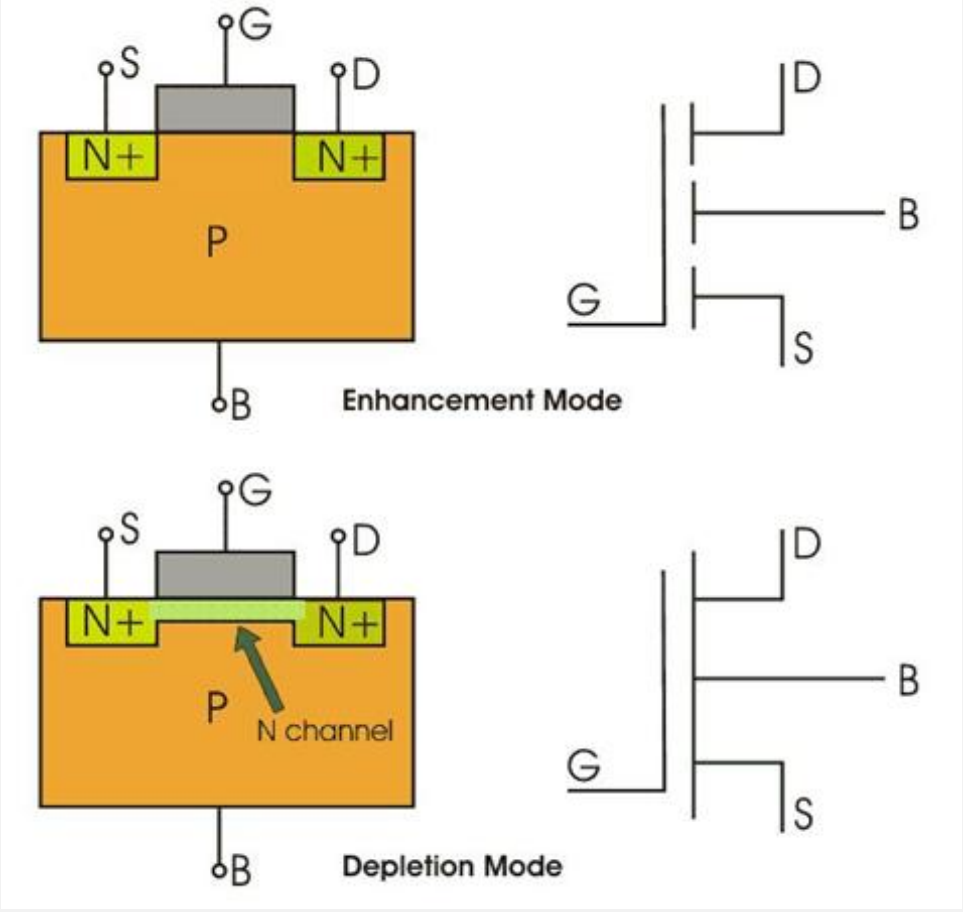


The drain and source are heavily doped p+ region and the substrate is in n-type. The current flows due to the flow of positively charged holes, and that's why known as p-channel MOSFET .

When we apply negative gate voltage, the electrons present beneath the oxide layer experience repulsive force and are pushed downward into the substrate, the depletion region is populated by the bound positive charges which are associated with the donor atoms .

The negative gate voltage also attracts holes from the P+ source and drain region into the channel region.

N-CHANNEL MOSFET



(Fig. 37) **N-Channel MOSFET**

The drain and source are heavily doped N+ region and the substrate is p-type. The current flows due to the flow of negatively charged electrons and that’s why known as n-channel MOSFET .

When we apply the positive gate voltage, the holes present beneath the oxide layer experience repulsive force, and the holes are pushed downwards into the bound negative charges which are associated with the acceptor atoms .

The positive gate voltage also attracts electrons from the N+ source and drain region into the channel thus an electron-rich channel is formed.

MOSFET WORKING OPERATION

- The working principle of a MOSFET depends upon the MOS capacitor. The MOS capacitor is the main part of MOS-FET. The semiconductor surface at the below oxide layer is located between the source and drain terminals. It can be inverted from p-type to n-type by applying positive or negative gate voltages.

- When we apply positive gate voltage, the holes present under the oxide layer experience a repulsive force, and holes are pushed downward with the substrate.

- The depletion region is populated by the bound negative charges that are associated with the acceptor atoms. The electrons reach, and the channel is formed. The positive voltage also attracts electrons from the n+ source and drain regions into the channel.

- Now, if a voltage is applied between the drain and source, the current flows freely between the source and drain and the gate voltage controls the electrons in the channel. If we apply negative voltage, a hole channel will be formed under the oxide layer.

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