SNS COLLEGE OF ENGINEERING
Coimbatore-35
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 CSE (IoT)

23ECT102- ELECTRONIC DEVICES AND CIRCUITS
I YEAR/ II SEMESTER

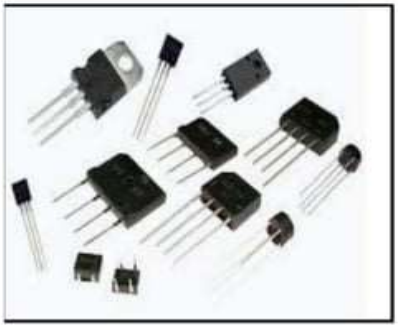
UNIT 4 – **Field Effect Transistor & FET Amplifier**

Transistor & Type

A **transistor** is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit.

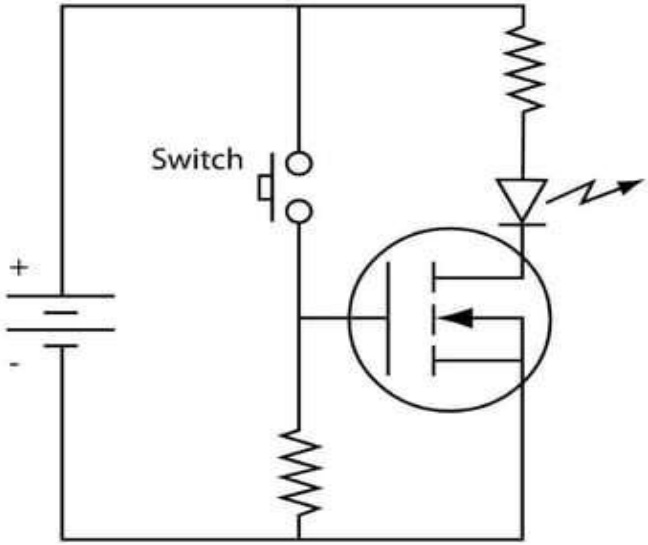
- **BJT**
- **FET**

1.JFET
2.MOSFET

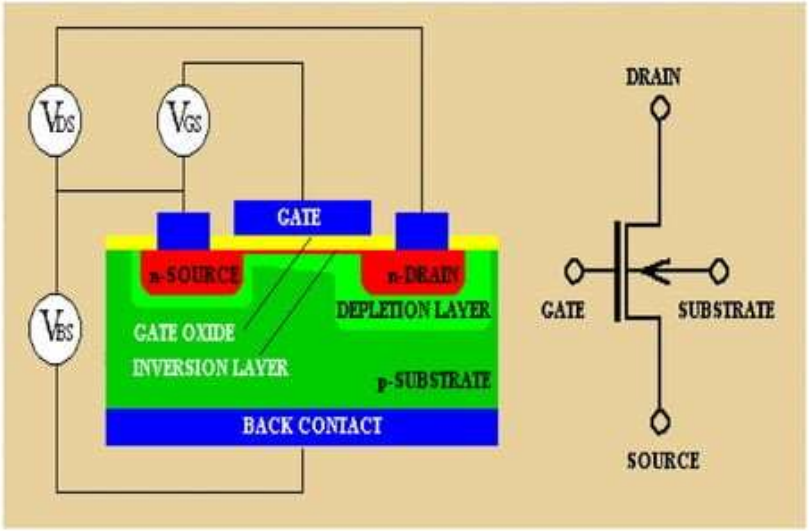


MOSFET Circuit

The **metal–oxide–semiconductor field-effect transistor** (**MOSFET**, **MOS-FET**, or **MOS FET**) **is a type of transistor used for amplifying or switching electronic signals.**



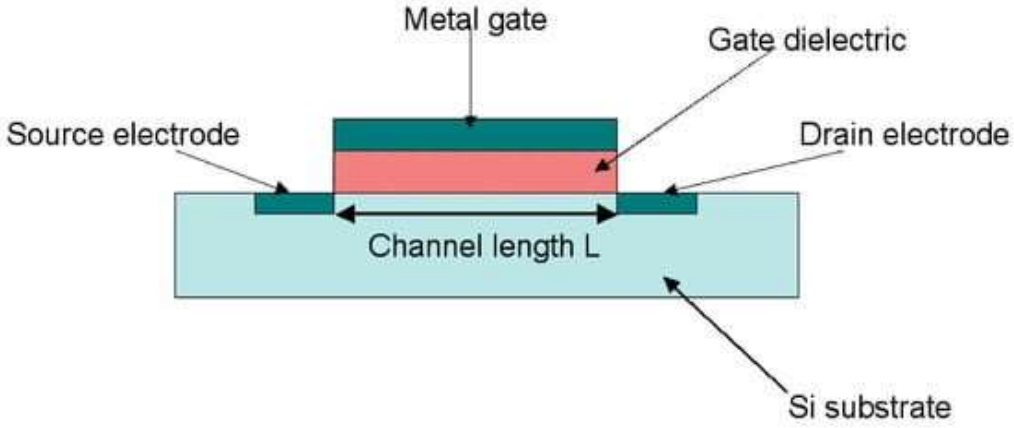
MOSFET Symbol Circuit



MOSFET

- A MOSFET (**Metal Oxide Semiconductor Field Effect Transistor**) is a semiconductor device.
- A MOSFET is most commonly used in the field of power electronics.
- A semiconductor is made of manufactured material that acts neither like a insulator nor a conductor.
- Types
  - **n - MOS FET**
  - **p – MOS FET**
  - **CMOS FET**

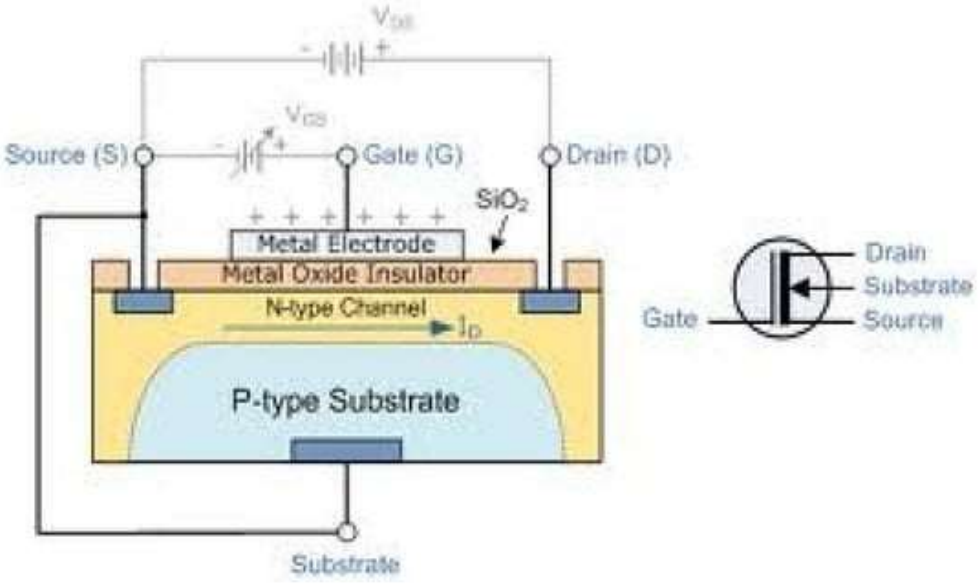
Schematic structure of MOSFET



Working principle of MOSFET

- The working principle of MOSFET depends up on the MOS capacitor.
- The MOS capacitor is the main part.
- The semiconductor surface at below the oxide layer and between the drain and source terminal can be inverted from p-type to n-type by applying a positive or negative gate voltages respectively.
- When we apply positive gate voltage the holes present beneath the oxide layer experience repulsive force and the holes are pushed downward with the substrate

Working principle of MOSFET



Working principle of MOSFET

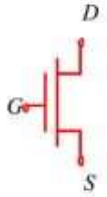
The depletion region is populated by the bound negative charges, which are associated with the acceptor atoms.

The positive voltage also attracts electrons from the n+ source and drain regions in to the channel.

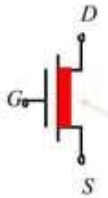
The electron reach channel is formed. Now, if a voltage is applied between the source and the drain, current flows freely between the source and drain gate voltage controls the electrons concentration the channel.

Instead of positive if apply negative voltage a hole channel will be formed beneath the oxide layer.

MOS transistors Symbols

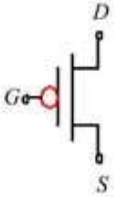


NMOS Enhancement

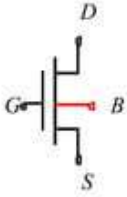


NMOS Depletion

Channel

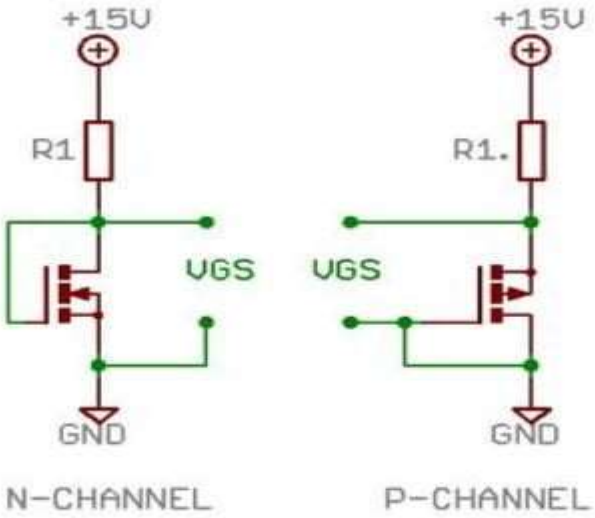


PMOS Enhancement



NMOS with Bulk Contact

N and P channel of MOSFET



N and P channel of MOSFET

- If the MOSFET is an **n-channel** or **nMOS FET**, then the source and drain are 'n+' regions and the body is a **'p'** region.

- If the MOSFET is a **p-channel** or **pMOS FET**, then the source and drain are 'p+' regions and the body is a **'n'** region.

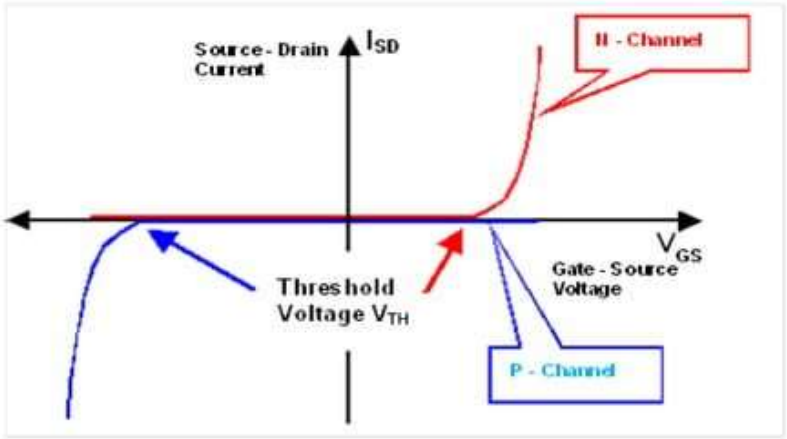
MOSFET Applications:

- MOSFETs are used in digital integrated circuits, such as microprocessors.
- Used in calculators.
- Used in memories and in logic CMOS gates.
- Used as analog switches.
- MOSFET devices are also applied in audio-frequency power amplifiers for public address systems

MOSFET Applications

- Used as amplifiers.
- Used in the applications of power electronics and switch mode power supplies.
- MOSFETs are used as oscillators in radio systems.
- Used in automobile sound systems and in sound reinforcement systems

Application



NMOS and PMOS turn on characteristics

Limitations of the MOSFET

Overheating is very much a concern when considering today's integrated circuits contain millions of transistors in a relatively small space.

- Recently, the small size of MOSFETs has created operational problems as producing such tiny transistors is an enormous challenge,