FIELD EFFECT TRANSISTOR (FET)

In the previous Chapters, we have discussed about the Bipolar Junction Transistor (BJT). They are controlled by both electrons and holes and called current operated devices. BJT has two main disadvantages; first, it has low input impedance because of forward biased emitter junction. Secondly, it has considerable noise level.

To overcome the above problems, FET can be developed and become important electronic device in the integrated circuit (IC) technology.

The FET is a device in which the flow of current through the conducting region is controlled by an electric field (voltage).

There are two types of field effect transistor,

1. Junction Field Effect Transistor (JFET)
2. Metal Oxide Semiconductor Field Effect Transistor(MOSFET)

Junction Field Effect Transistor (JFET)

JFET is a three terminal semiconductor device in which current conduction is by one type of carrier (i.e.) electrons or holes. It is a unipolar device. It has high input impedance and low noise level.

There are two types of JFET.

They are,

1. N-Channel JFET
2. P-Channel JFET

Advantages

1. The JFET has higher input impedance.

2. It is a low power consumption device.

3. It can be fabricated in small size area.

4. It has negative temperature coefficient of resistance, so they possess higher temperature stability.

5. It has less noise.

Disadvantages

1. The JFET is relatively low gain bandwidth product.

2. Its voltage gain is low.

3. It requires special handling during installation.

Table 6.2 Comparison of BJT and JFET

S.No	BJT	JFET
1.	Bipolar device (current conduction by both type of carriers i.e. majority and minority -electrons and holes)	Unipolar device (current conduction is only due to one type of majority carrier either electron or hole)
2.	Current driven device	Voltage driven device
3.	Low Input impedance	High Input impedance
4.	High noise level	Low noise level
5.	Low Power gain	High Power gain
6.	Low switching speed	High switching speed
7.	Less thermal stability	Better thermal stability
8.	Emitter and collector terminals are not interchangeable	Source and drain terminals are interchangeable

Application for JFET

1. The JFET is used as a constant current source.

2. It is used as buffer amplifier.

3. It is used as electronic switch.

4. It is used as phase shift oscillator.
5. JFET is used as a voltage variable resistor (VVR).
6. It is used as high impedance wide band amplifier.

MOSFET

The MOSFET is an abbreviation of Metal Oxide Semiconductor Field Effect Transistor. In MOSFET, the gate is insulated from the channel by using SiO_2 layer. The input impedance of MOSFET is high, because the gate current is extremely small. It is also called as Insulated Gate FET (IGFET).

There are two types of MOSFET.

They are,
1. Enhancement MOSFET (E-MOSFET).
2. Depletion MOSFET (DE-MOSFET).

Enhancement MOSFET (E-MOSFET)

The enhancement MOSFET works only in enhancement mode. It does not conduct when gate to source voltage (VGS) is equal to zero, therefore it is called as 'normally OFF MOSFET'. It is widely used in digital circuits. There are two types of enhancement MOSFET. They are

1. N-channel E-MOSFET
2. P-channel E-MOSFET

Depletion MOSFET (DE-MOSFET)

The depletion MOSFET can be operated in either depletion mode or enhancement mode. Therefore, it is called as DE-MOSFET. There are two types of depletion MOSFET. They are,

1. N channel depletion MOSFET

2. P-channel depletion MOSFET

Application for MOSFET

1. MOSFET is widely used for switching and amplifying the signals.
2. It is used in FM radio and TV receivers (for mixer operation).
3. It is used in computer memories.
4. It is used as auto intensity control of street lights.

Table 6.3 Comparison of JFET and MOSFET

S.No	JFET	MOSFET
1.	JFET stands for Junction Field Effect Transistor	MOSFET stands for Metal Oxide Semiconductor Field Effect Transistor
2.	It can be operated only in the depletion mode	It can be operated either depletion or in enhancement mode
3.	It has high input impedance (10^8 Ω)	It has very high input impedance (from 10^{10} Ω to 10^{15} Ω)
4.	It is difficult to fabricate	It is easier to fabricate
5.	Gate current (Ig) is high	Gate current (Ig) is low
6.	It is mainly used in low noise application	It is widely used in VLSI circuits