# Rugved Task 2

## 1. BJT (Bi-Polar Junction Transistor)

### *Definition: -*

A Bipolar Junction Transistor (also known as a BJT or BJT Transistor) is a three-terminal semiconductor device consisting of two p-n junctions which can amplify or magnify a signal. It is a current controlled device. The three terminals of the BJT are the base, the collector, and the emitter. A BJT is a type of transistor that uses both electrons and holes as charge carriers.

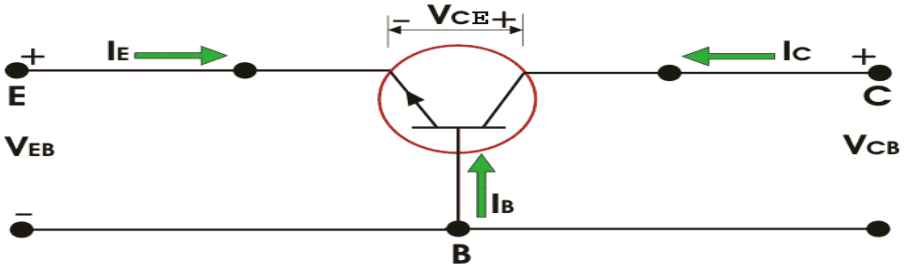
### *Types of BJTs:-*

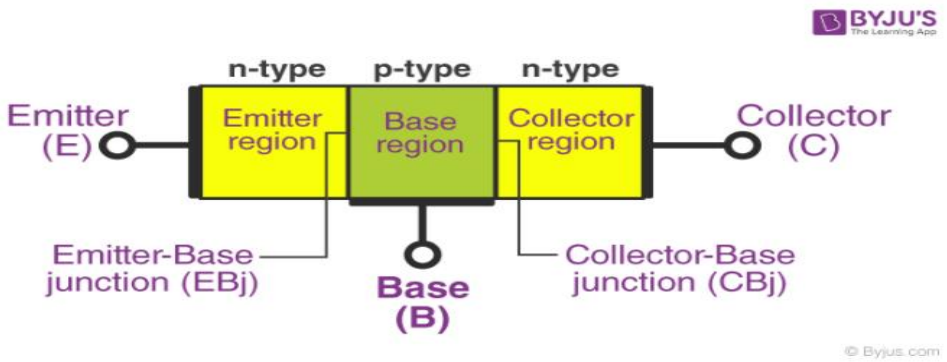
There are two types of BJTs:-

I. NPN Bi-Polar Junction Transistor
II. PNP Bi-Polar Junction Transistor

#### (a) NPN Bi-Polar Junction Diode

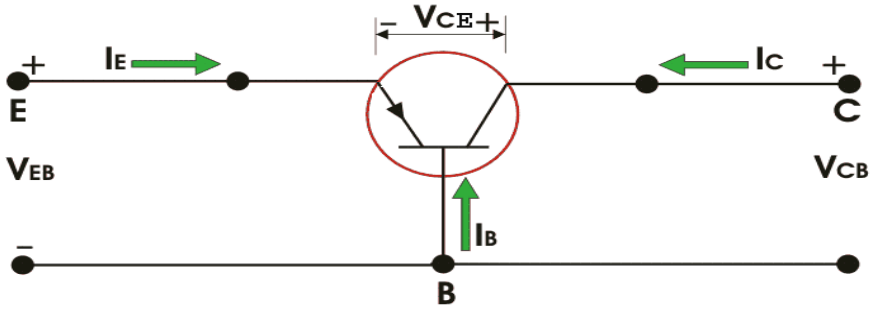
In an n-p-n bipolar transistor (or npn transistor) one p-type semiconductor resides between two n-type semiconductors.
The NPN transistor is made of semiconductor materials like silicon or germanium. The NPN transistor features three terminals: emitter, base and collector. The emitter is moderately doped, the base is lightly doped, and the collector is comparatively more doped. This transistor features two diodes that are connected back to back. The diode seen between the emitter-base terminal is referred to as the emitter-base diode. The diode between collector and base terminal is known as collector-base diodes.

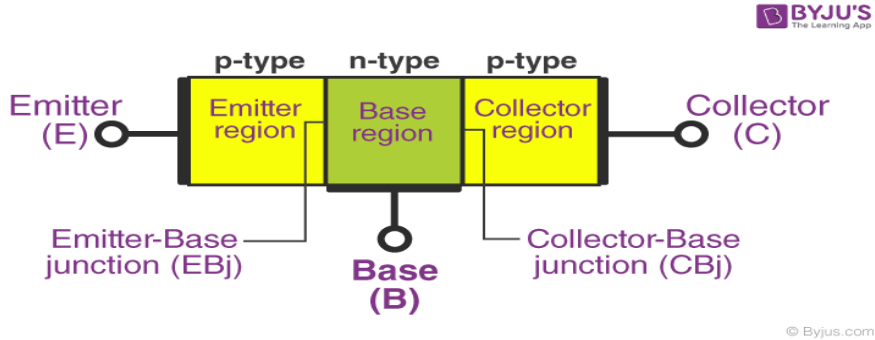





## (b) PNP Bi-Diode Junction Diode

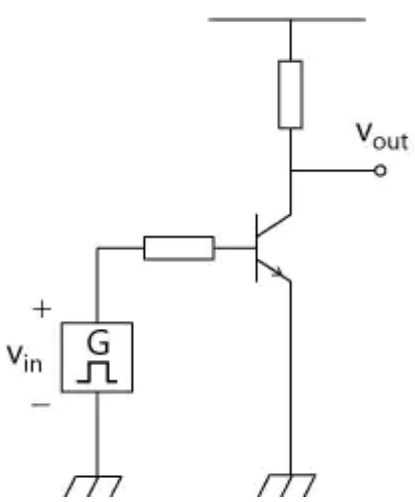
This bipolar PNP junction transistor is formed with three layers of semiconductor material, with two P-type regions and one N-type region. Like NPN they also have three terminals. In PNP transistors, in this type of transistor, majority charge carriers are holes, and minority charge carriers are electrons. For p-n-p transistors, current enters into the transistor through the emitter terminal. Like any bipolar junction transistor, the emitter-base junction is forward biased and the collector-base junction is reverse biased. We can tabulate the emitter, base and collector current, as well as the emitter-base, collector base and collector-emitter voltage for p-n-p transistors also.



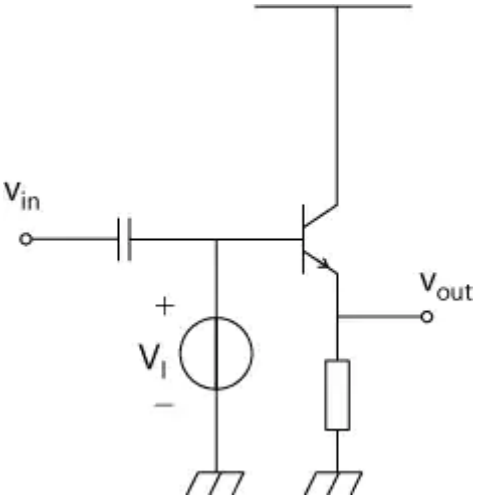



## *Applications of BJT:-*

BJT's are used in a discrete circuit designed due to availability of many types, and obviously because of its high transconductance and output resistance which is better than MOSFET. BJT's are suitable for the high-frequency application also.
That is why they are used in radio frequency for wireless systems. Another application of BJT can be stated as a small-signal amplifier, metal proximity photocell, etc.
Bipolar transistors can control the collector current via the current applied to the base, hence, they are also utilized as switches using their characteristics in the saturation and cut-off regions.




Switching circuit

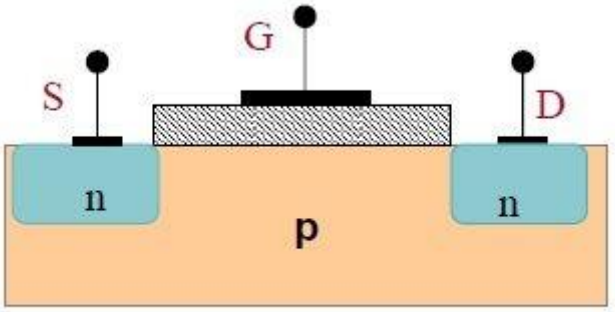



Common-collector amplifier (emitter follower)

# 2. MOSFET

## *Definition: -*

A metal–oxide–semiconductor field-effect transistor (MOSFET, MOS-FET, or MOS FET) is a field-effect transistor (FET with an insulated gate) where the voltage determines the conductivity of the device.
It is used for switching or amplifying signals. The ability to change conductivity with the amount of applied voltage can be used for amplifying or switching electronic signals.
MOSFETs are now even more common than BJTs (bipolar junction transistors) in digital and analog circuits.



MOSFET Structure

## *Types of MOSFETs:-*

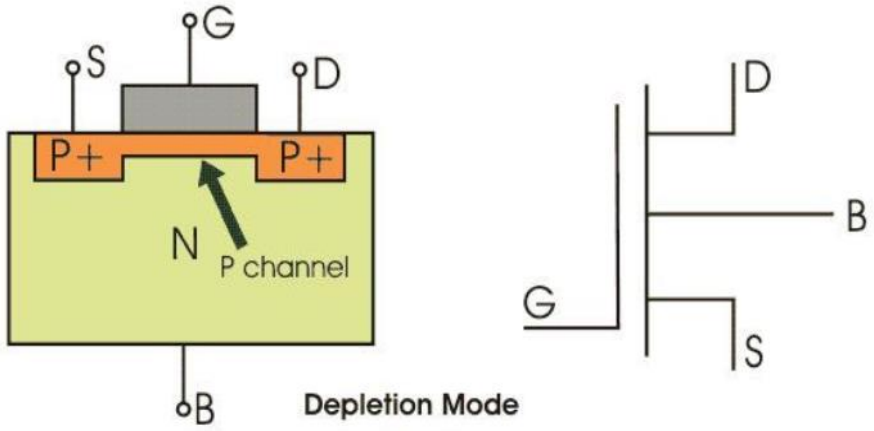
There are two modes of a MOSFET:-

I. Depletion Mode
II. Enhancement Mode

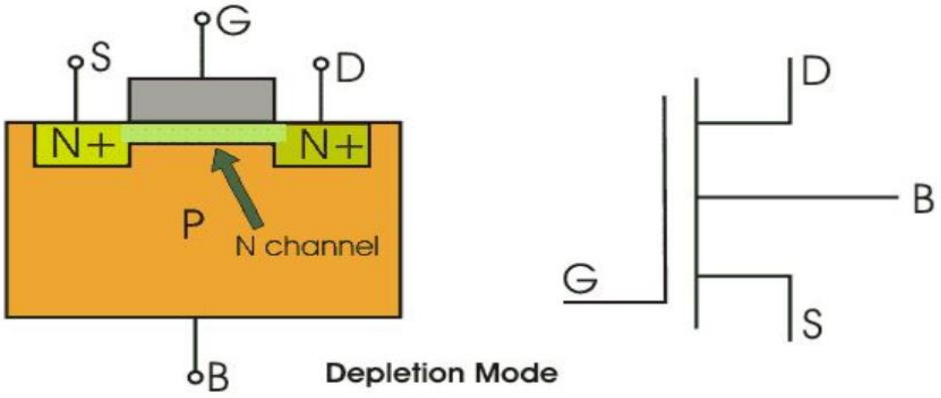
### (a) Depletion Mode

The transistor requires the Gate-Source voltage (VGS) to switch the device “OFF”. The depletion-mode MOSFET is equivalent to a “Normally Closed” switch. A voltage placed across the source and drain would induce current flow. We put a voltage in between the source and drain, we would have current flow. The channel acts like a resistor. Negative voltage will reduce current. We put a negative voltage here, it will tend to increase the resistance of the n-type channel and that would reduce current. A more positive voltage would cause the channel to reduce and resistance and conduct lots of current.

P-Channel MOSFET



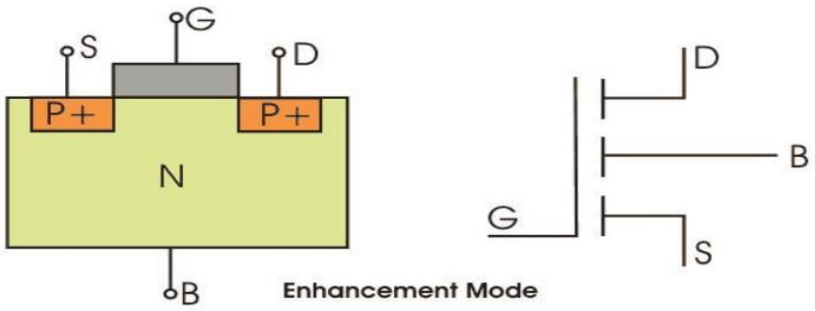

N-Channel MOSFET



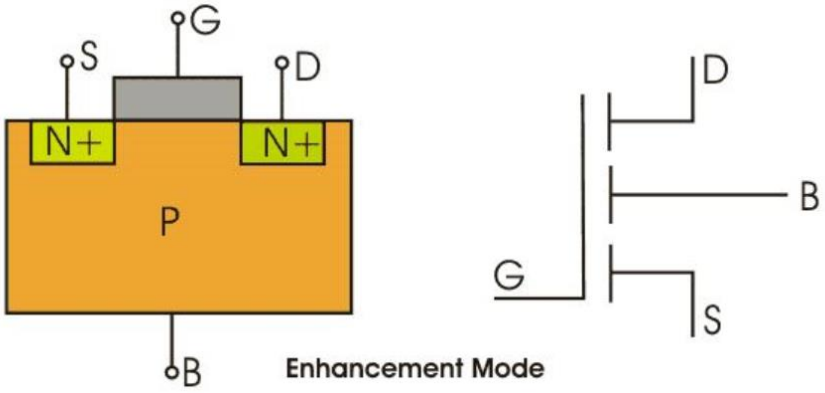

## (b) Enhancement Mode

The transistor requires a Gate-Source voltage(VGS) to switch the device “ON”. The enhancement-mode MOSFET is equivalent to a “Normally Open” switch. the source, and drain terminals connect to heavily doped n-type silicon in an n-channel enhancement-mode MOSFET. The source and the drain are connected to heavily doped n-type material with no continuous channel between the source and the drain. The area between the source and the drain is lightly doped p-type material.

P-Channel MOSFET



N-Channel MOSFET



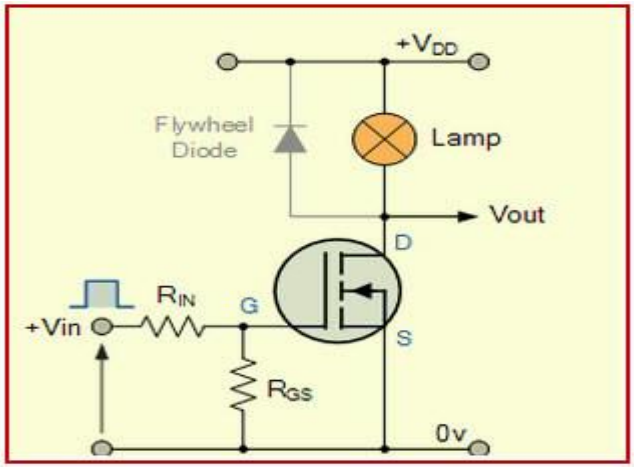

## *Application of MOSFETs:-*

MOSFET is a voltage controlled device and has some decent applications. There are some advantages of using MOSFET in electronics circuits. Some important applications of MOSFET are given below :

1. It is used for some switching applications an in electronics device.
2. It is used in some amplifying circuits.
3. It is used in chopper circuits
4. It is used in voltage regulator circuits

### (a) MOSFET application as a Switch

We use enhancement mode, an N-channel MOSFET is being used to switch the LED or LAMP for ON and OFF. The voltage is applied at the gate of the MOSFET at that condition the lamp is ON. When the zero voltage level is applied at the gate then the device and lamp is turned off (VGS=0. So by this way, we can use MOSFET for switching operation. And MOSFET has a very high switching device.



## (b) MOSFET as an amplifier

Here we take basic enhancement type MOSFET for operation. The simple amplifying circuit using MOSFET is shown in the figure. For a good amplifying signal, we must require to get an operating point for that circuit. Here input signal is applied between gate (G) and source (S) to generate require gate signal for getting an operating point. An output is taken between the drain (D) and source (S). Simple MOSFET amplifier is shown in the figure

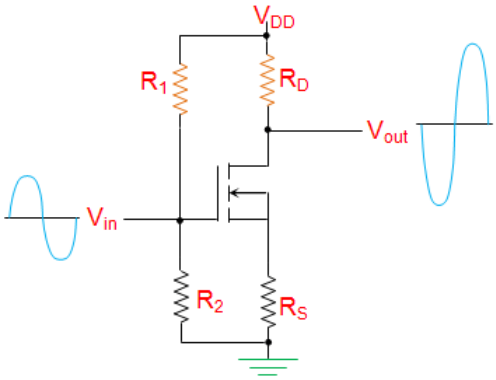



Figure 3 MOSFET as an Amplifier

## (c) MOSFET used in voltage regulator circuits

In Depletion type MOSFETs in source-follower connection are used in voltage regulator circuits. Here linear voltage regulator circuit is shown in the figure. In this regulating circuit, V(load) follows the gate voltage, V(gate) minus the gate-to-source voltage (Vgs). Further with gate-source voltage, V(gs) increases with an increase in the drain current (Id). So that the gate voltage is fixed, then the source voltage will reduce as the load current increases.

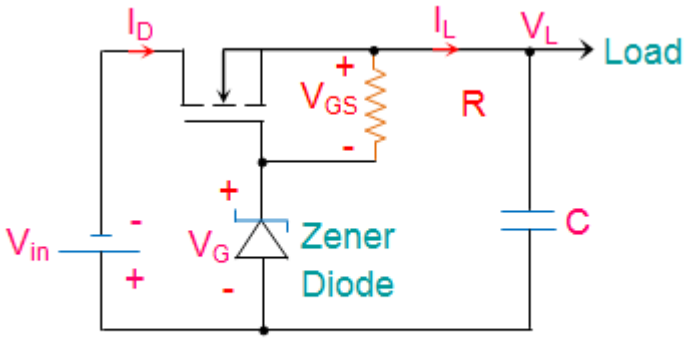



Figure 5 MOSFET as a Linear Voltage Regulator

### (d) MOSFET used as the chopper

MOSFET is also used in the chopper circuit. Hereby chopper D.C signal is converted into an A.C signal. MOSFET chopper circuit is shown in the figure. Vdc is converted into Vac at the same amplitude. Vdc is applied between gate and source terminal. Output Vac is taken at the drain terminal.

## 3. Earthing and Grounding

### *Definition: -*

Earthing: - The process of transferring the immediate discharge of the electrical energy directly to the earth by the help of the low resistance wire is known as the electrical earthing. The electrical earthing is done by connecting the non-current carrying part of the equipment or neutral of supply system to the ground.

Grounding:- The process of removing the excess charge on an object by means of the transfer of electrons between it and another object of substantial size. When a charged object is grounded, the excess charge is balanced by the transfer of electrons between the charged object and a ground.

## *Difference between Grounding and Earthing: -*

| *Earthing* | *Grounding* |
|---|---|
| This method protects human beings from electric shocks. | This method protects the entire power system from malfunctioning. |
| Earthing is done between the Earth and the electrical appliance or equipment. | It is connected between the ground and the used neutral of the equipment. |
| Earthing is achieved through the connection of a metallic system to earth. It is achieved by inserting ground rods or other electrodes deep inside the earth. | Grounding ensures a safe, alternate path around the electrical system of your house or commercial building by protecting it from high voltage. |
| Earthing is a preventive measure. | Grounding is a backup pathway. |

## *Application of Earthing:-*

The applications of Earthing are:-

I. The low voltage system consumption appliances are available at the domestic users where proper electrical earthing is done to protect the electrical appliances and also protect ourselves against electric shocks.

II. For domestic users, the common fault that occurs is due to voltage fluctuations. During voltage fluctuations proper electrical earthing plays a key role.

III. In high voltage system (>1kv) the focus of the earthing system is less on safety but it is more important to look after the reliability of power supply, protection of equipment. The most common type of fault is the L-G fault in the high voltage system. During the L-G fault, the fault current path is closed through the earth.