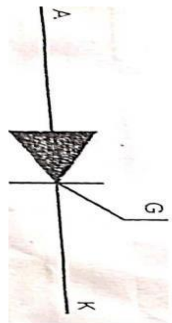
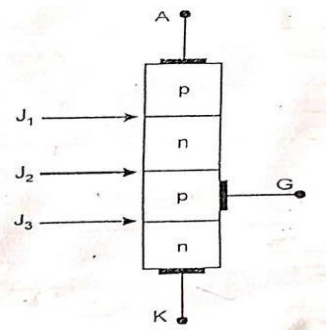
Briefly explain the construction working and operation of SCR.

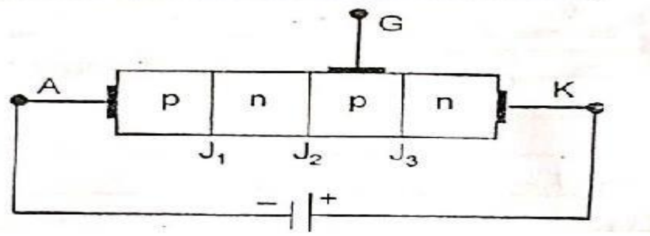
- It is a unidirectional semi conductor device.
- * made by silicon.
- SCR is a Three terminal, four layer Semi conductor device.
- It consists of P type and N type material.
- It has three PN junctions. J_1, J_2 and J_3.
- Device has terminals Anode (A) cathode (K) and Gate (G)
- Gate is attached to the P Layer.





- Single SCR is the combination of one pnp transistor (Q_1) and one npn transistor (Q_2)
- Emitter of Q_1 is anode
- Emitter of Q_2 is cathode.

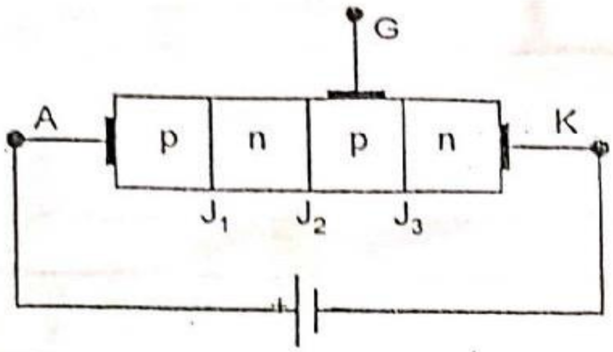
Reverse blocking Mode of SCR :-



- In this mode SCR is reverse biased.
- Anode terminal (A) to ~~positive~~ nega
- Cathode terminal (K) to positive end of Battery.
- Reverse biasing in Junction J_1 and J_3.
- J_2 remains forward biased condition.
- This State SCR act as a diode.
- Reverse bias condition reverse current flow through a device.

FORWARD BLOCKING MODE OF SCR:-

- Positive voltage applied to SCR
- Anode is connected to positive and cathode is connected to negative terminal of Battery.
- J_1, J_3 forward biased. • J_2 reverse biased.

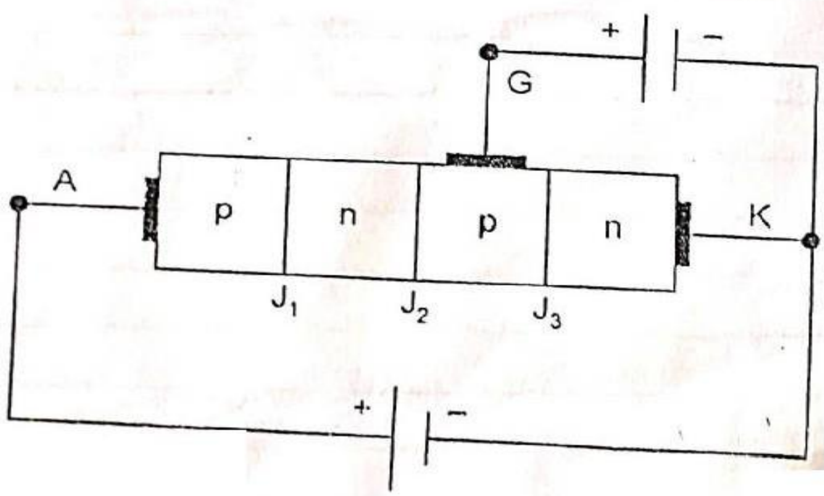


Forward conduction Mode of SCR :-

• SCR can be made to conduct.

1) increasing positive voltage applied to anode beyond break over voltage.

2) Applying positive voltage to Gate terminal.



• In the first case increase in voltage. cause reverse bias at Junction J_2.

• SCR can also be turned on by apply small voltage to gate terminal.

• Applying positive voltage ~~at the gate~~
Q_2 switches on. Collector current flows in base of transistor Q_1.

• It causes transistor saturated at very rapid rate.
• It cannot be stopped even removing the applied Gate voltage.
• providing current through SCR is greater than Latching current.
• Latching current is defined as minimum current required to maintain SCR in conduction state.

• Different techniques used to switch off a SCR, they are Natural commutation and Forced commutation.

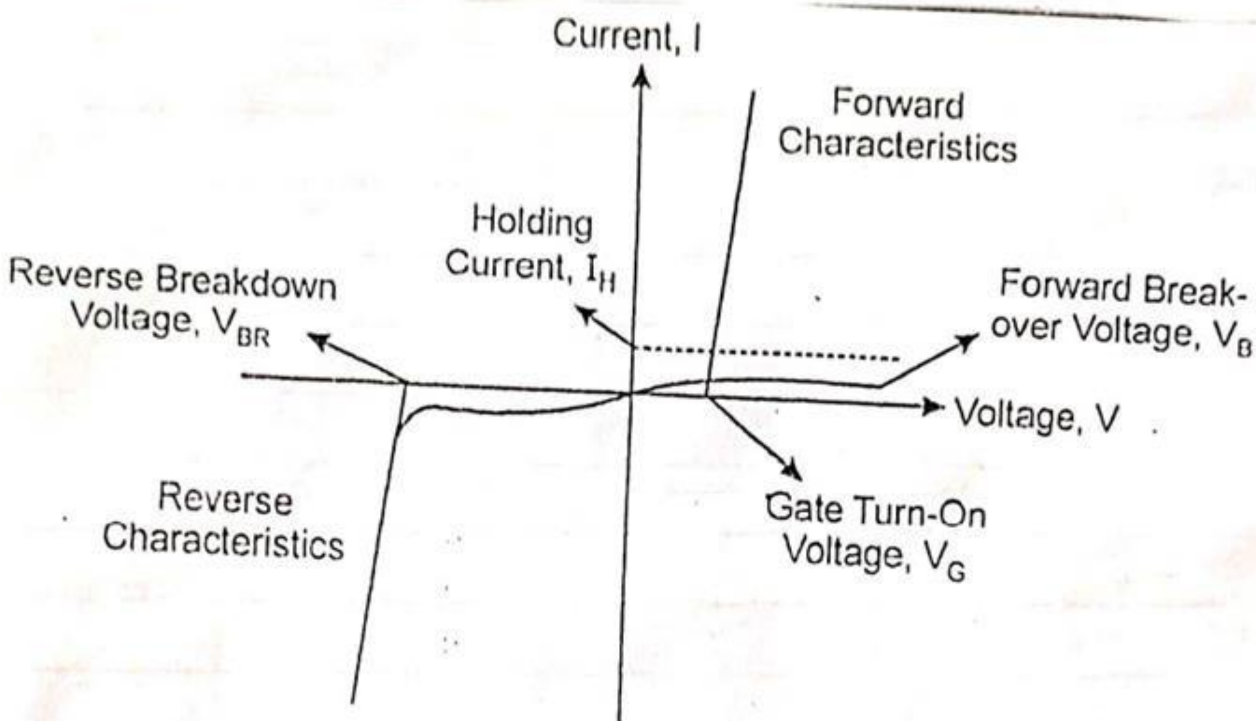
• These Techniques Anode current is below the holding current.

• Holding current is a minimum current to maintain SCR in conduction Mode.

Different methods used for triggering SCR is voltage triggering, Gate trigering, dv/dt trigering.

Application:-
1. Power switching circuit
2. Inverter.
3. Controlled Rectifier.
4. Over voltage protection.
5. Pulse circuits.

6. Computer logic circuit.
7. Timing circuit.
8. Temperature control system.
9. Remote switching unit.



CONFIGURATION OF TRANSISTER

COMMON BASE CONFIGURATION

In common base configuration circuit is shown in figure. Here base is grounded and it is used as the common terminal for both input and output. It is also called as grounded base configuration. Emitter is used as a input terminal whereas collector is the output terminal.

To describe the behavior of common-base amplifiers requires two set of characteristics:

1. Input or driving point characteristics.
2. Output or collector characteristics s

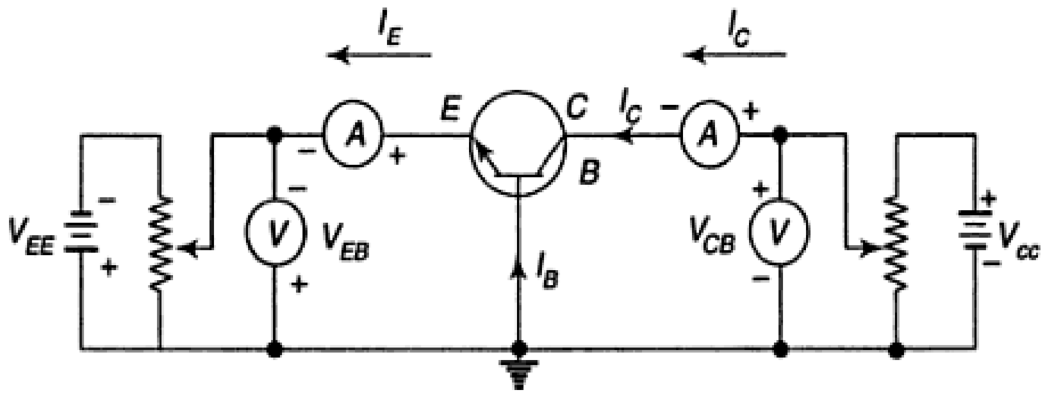
The output characteristics has 3 basic regions:

- Active region –defined by the biasing arrangements
- Cutoff region – region where the collector current is 0A
- Saturation region- region of the characteristics to the left of V_{CB} =0V

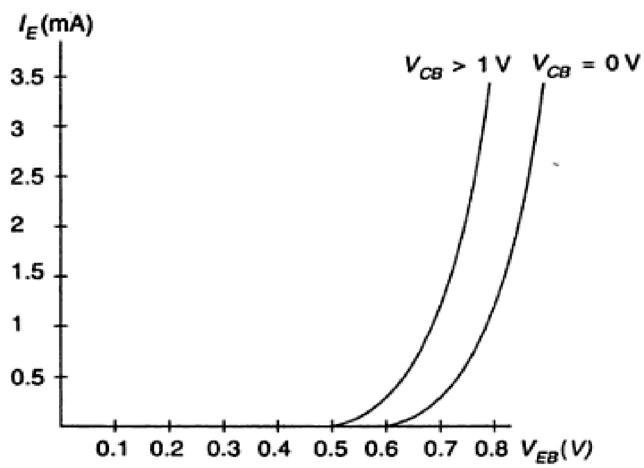
Input Characteristics

It is defined as the characteristic curve drawn between input voltage to input current whereas output voltage is constant.

To determine input characteristics, the collector base voltage V_{CB} is kept constant at zero and emitter current I_E is increased from zero by increasing V_{EB}.
This is repeated for higher fixed values of V_{CB}.



A curve is drawn between emitter current and emitter base voltage at constant collector base voltage is shown in figure.



CB input characteristics

When V_{CB} is zero EB junction is forward biased. So it behaves as a diode so that emitter current

Increases rapidly.

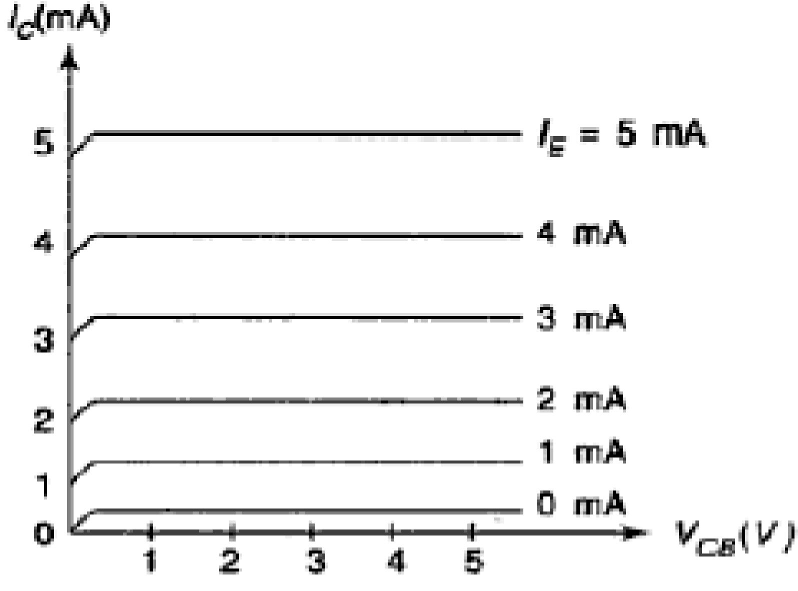
Output Characteristics

It is defined as the characteristic curve drawn between output voltage to output current whereas input current is constant.

To determine output characteristics, the emitter current I_E is kept constant at zero and collector current Ic is increased from zero by increasing V_{CB}.This is repeated for higher fixed values of I_E.

From the characteristic it is seen that for a constant value of I_E, Ic is independent of V_{CB} and the curves are parallel to the axis of V_{CB}.

As the emitter base junction is forward biased the majority carriers that is electrons from the emitter region are injected into the base region.



CB output characteristics

In CB configuration a variation of the base-collector voltage results in a variation of the quasi-neutral width in the base. The gradient of the minority-carrier density in the base therefore changes, yielding an increased collector current as the collector-base current is increased. This effect is referred to as the Early effect.

Transistor parameters in CB configuration

The slope of CB characteristics will give the following four transistor parameters. It is known as base hybrid parameters.

I. Input impedance (h_{ib}): It is defined as the ratio of change in input voltage (emitter voltage) to change in input current (emitter current) with the output voltage (collector voltage) is kept constant.

$$h_{ib} = \frac{\Delta V_{EB}}{\Delta I_E},\ V_{CB} \text{ constant}$$

This ranges from 20ohms to 50ohms.

II. Output admittance (h_{ob}): It is defined as the ratio of change in output current (collector current) to change in output voltage (collector voltage) with the input current (emitter current) is kept constant. This ranges from 0.1 to 10µ mhos

$$h_{ob} = \frac{\Delta I_C}{\Delta V_{CB}},\ I_E \text{ constant}$$

III. Forward current gain (h_{fb}): It is defined as the ratio of change in output current (collector current) to change in input current (emitter current) with the output voltage (collector voltage) is kept constant.

$$h_{fb} = \frac{\Delta I_C}{\Delta I_E}, \; V_{CB} \text{ constant.}$$

This ranges from 0.9 to 1.0.

IV. Reverse voltage gain (h_{rb}): It is defined as the ratio of change in input voltage (emitter voltage) to change in output voltage (collector voltage) with the input

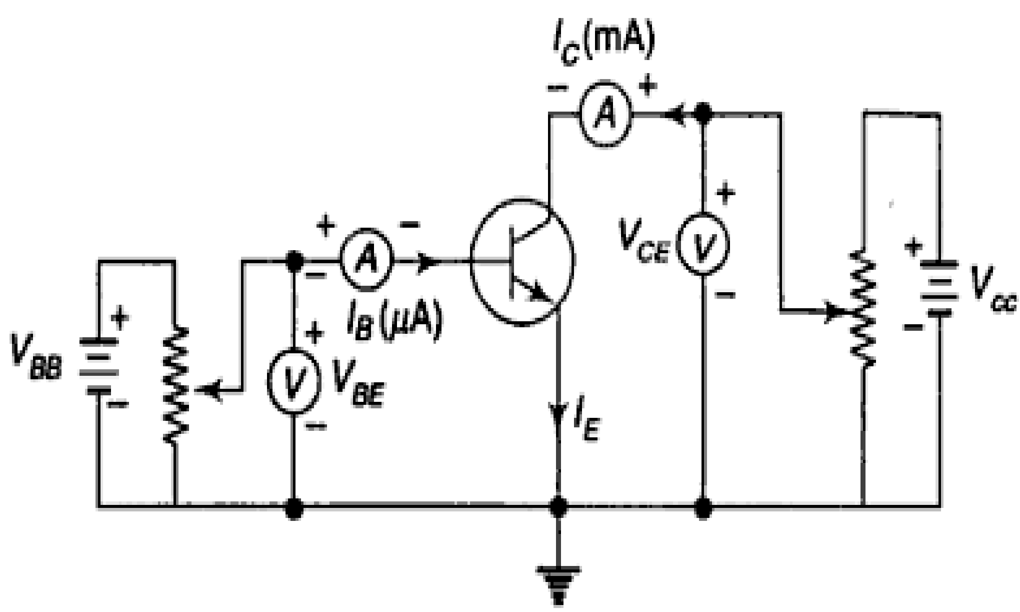
$$h_{rb} = \frac{\Delta V_{EB}}{\Delta V_{CB}}, \; I_E \text{ constant}$$

current (emitter current) is kept constant.

This ranges from 10^{-5} to 10^{-4}.

COMMON EMITTER CONFIGURATION

- In common emitter configuration circuit is shown in figure. Here emitter is grounded and it is used as the common terminal for both input and output.
- It is also called as grounded emitter configuration.
- Base is used as a input terminal whereas collector is the output terminal.
- Two set of characteristics are necessary to describe the behavior for CE ; input (base terminal) and output (collector terminal) parameters.



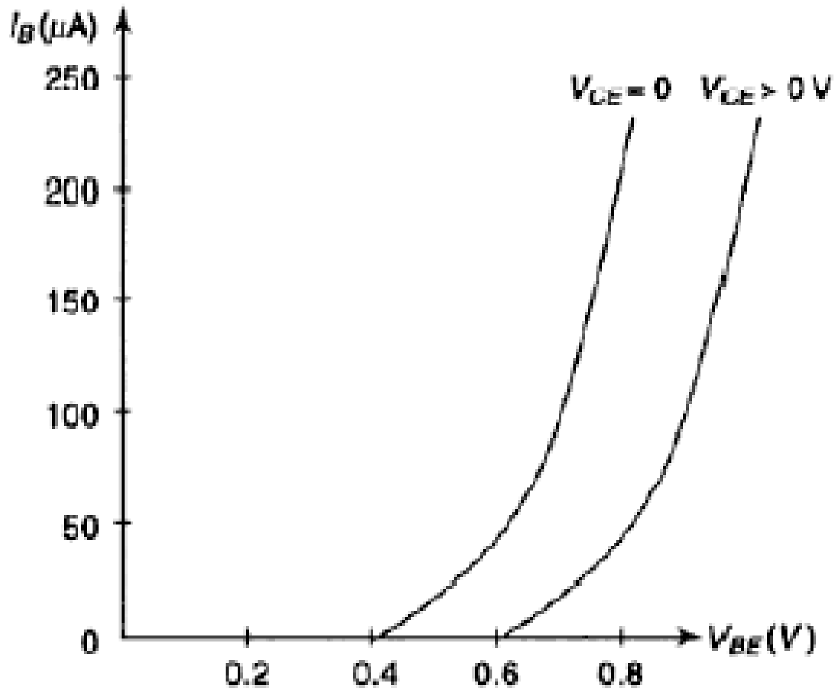
Input Characteristics

It is defined as the characteristic curve drawn between input voltage to input current whereas output voltage is constant.

To determine input characteristics, the collector base voltage V_{CB} is kept constant at zero and base current I_B is increased from zero by increasing V_{BE}.

This is repeated for higher fixed values of V_{CE}.

A curve is drawn between base current and base emitter voltage at constant collector base voltage is shown in figure.
Here the base width decreases. So curve moves right as V_{CE} increases.



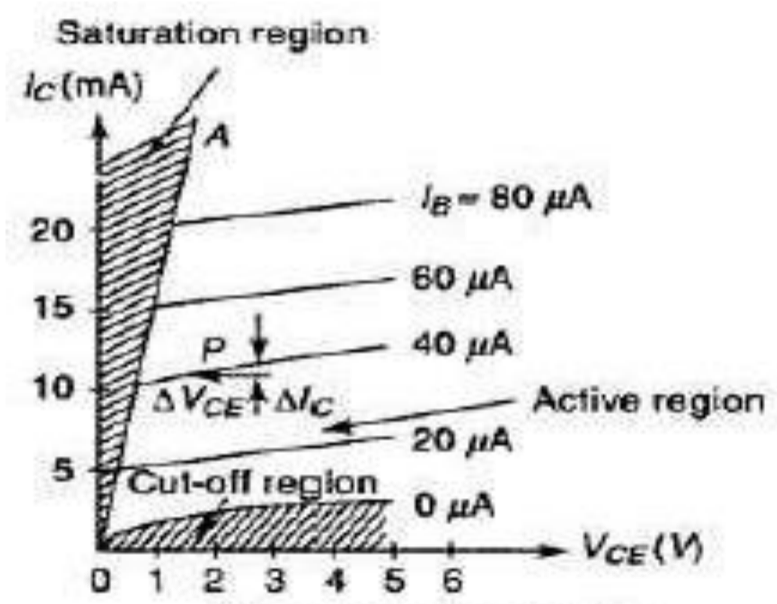
CE input characteristics

Output Characteristics

It is defined as the characteristic curve drawn between output voltage to output current whereas input current is constant.

To determine output characteristics, the base current I_B is kept constant at zero and collector current Ic is increased from zero by increasing V_{CE}.

This is repeated for higher fixed values of I_B..
From the characteristic it is seen that for a constant value of I_B, Ic is independent of V_{CB} and the curves are parallel to the axis of V_{CE}.



CE output characteristics

The output characteristic has 3 basic regions:

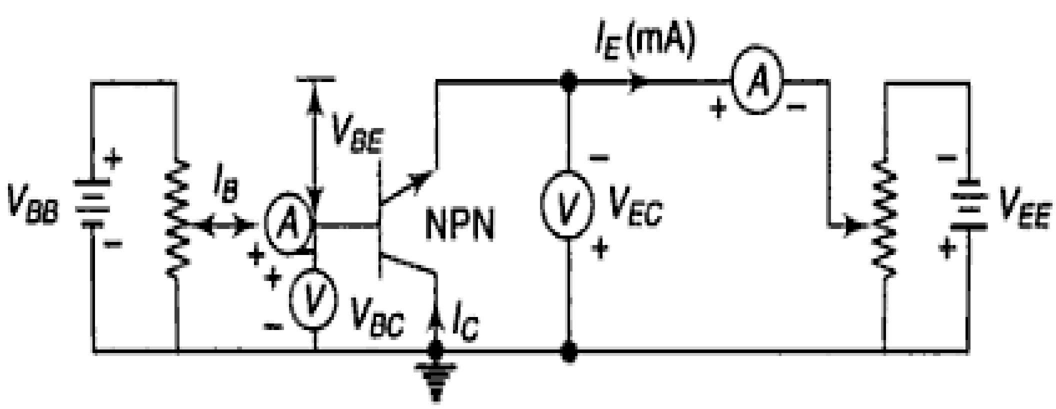
- Active region –defined by the biasing arrangements

- Cutoff region – region where the collector current is 0A

- Saturation region- region of the characteristics to the left of VCB = 0V

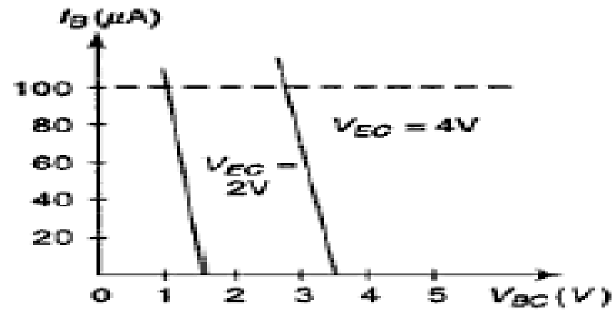
COMMON COLLECTOR CONFIGURATION

In common collector configuration circuit is shown in figure. Here collector is grounded and it is used as the common terminal for both input and output. It is also called as grounded collector configuration. Base is used as a input terminal whereas emitter is the output terminal.



Input Characteristics

It is defined as the characteristic curve drawn between input voltage to input current whereas output voltage is constant.



CC input characteristics

To determine input characteristics, the emitter base voltage V_{EB} is kept constant at zero and base current I_B is increased from zero by increasing V_{BC}.

This is repeated for higher fixed values of V_{CE}.

A curve is drawn between base current and base emitter voltage at constant collector base voltage is shown in above figure.

Output Characteristics

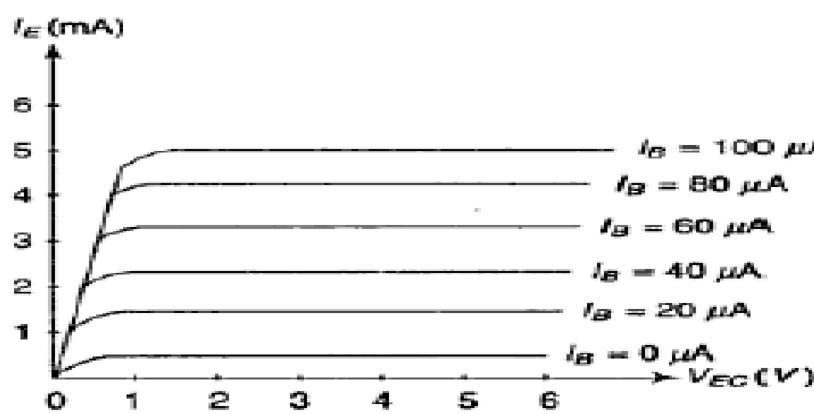
It is defined as the characteristic curve drawn between output voltage to output current whereas input current is constant.

To determine output characteristics, the base current I_B is kept constant at zero and emitter current I_E is increased from zero by increasing V_{EC}.

This is repeated for higher fixed values of I_B.

From the characteristic it is seen that for a constant value of I_B, I_E is independent of

$_{EB}$ and the curves are parallel to the axis of V_{EC}.



CC output characteristics