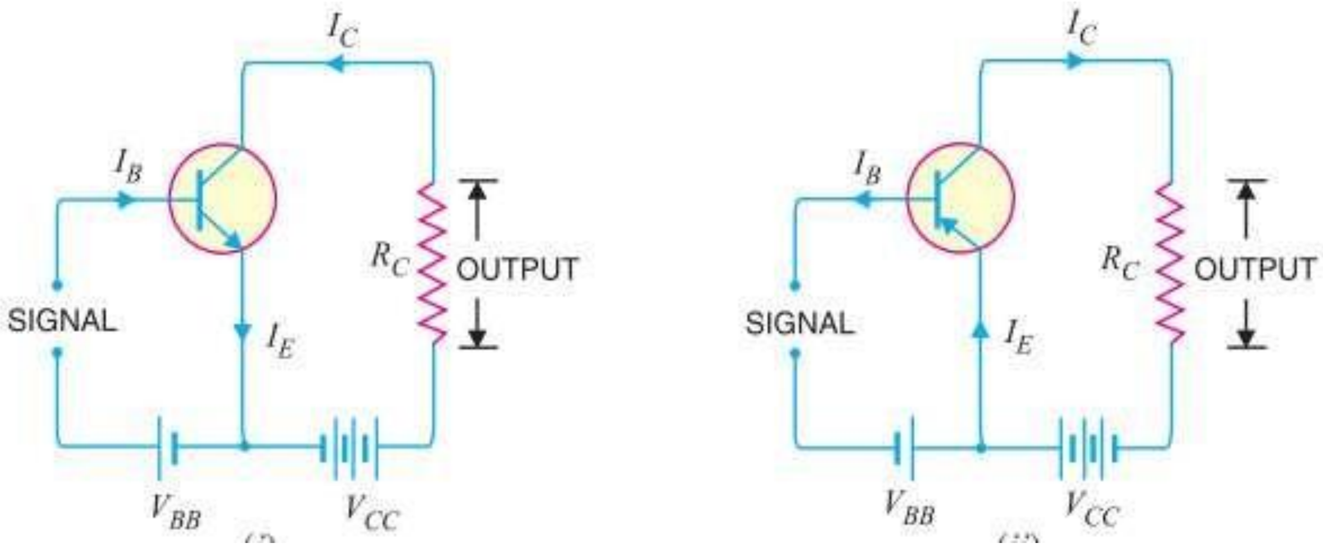
COMMON EMITTER CONNECTION

- The common-emitter terminology is derived from the fact that the emitter is common to both the input and output sides of the configuration.



- First Figure shows common emitter npn configuration and second figure shows common emitter pnp configuration.

COMMON EMITTER CONNECTION

- Base Current amplification factor (β) :
- In common emitter connection input current is base current and output current is collector current.
- The ratio of change in collector current to the change in base current is known as base current amplification factor, β.

$$\beta = \frac{\Delta I_C}{\Delta I_B}$$

- Normally only 5% of emitter current flows to base, so amplification factor is greater than 20. Usually this range varies from 20 to 500.

RELATION BETWEEN β AND α

$$\beta = \frac{\Delta I_C}{\Delta I_B}$$

$$\alpha = \frac{\Delta I_C}{\Delta I_E}$$

$$I_E = I_B + I_C$$

$$\Delta I_E = \Delta I_B + \Delta I_C$$

$$\Delta I_B = \Delta I_E - \Delta I_C$$

$$\beta = \frac{\Delta I_C}{\Delta I_E - \Delta I_C}$$

$$\beta = \frac{\Delta I_C / \Delta I_E}{\dfrac{\Delta I_E}{\Delta I_E} - \dfrac{\Delta I_C}{\Delta I_E}} = \frac{\alpha}{1-\alpha}$$

$$\beta = \frac{\alpha}{1-\alpha}$$

EXPRESSION FOR COLLECTOR CURRENT

$$I_C = \alpha I_E + I_{CBO}$$

$$I_E = I_B + I_C = I_B + (\alpha I_E + I_{CBO})$$

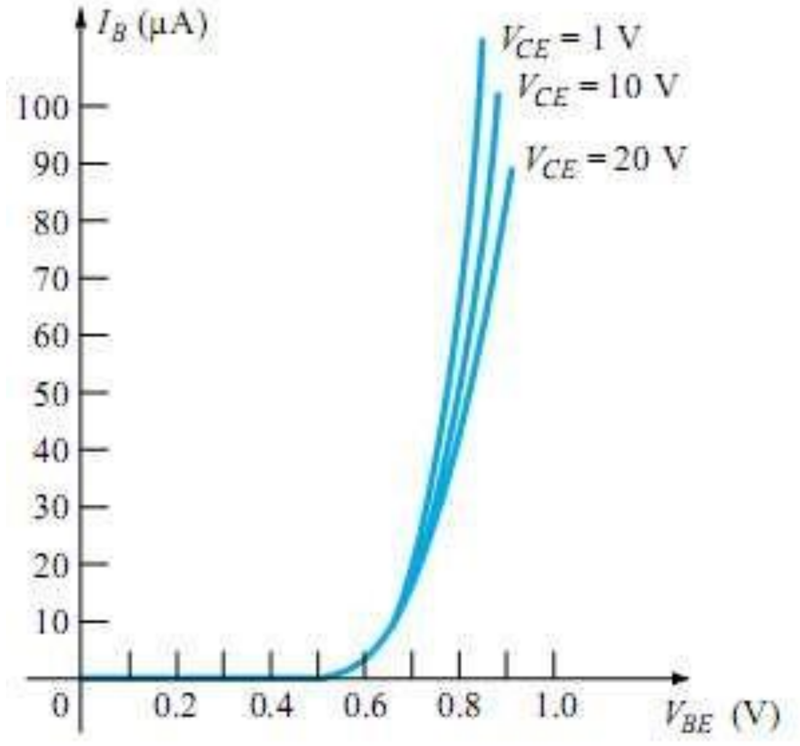
$$I_E (1 - \alpha) = I_B + I_{CBO}$$

$$I_E = \frac{I_B}{1-\alpha} + \frac{I_{CBO}}{1-\alpha}$$

$$I_C \;;\; I_E = *(\beta + 1) I_B + (\beta + 1) I_{CBO}$$

CHARACTERISTICS OF COMMON EMITTER CONFIGURATION

- <u>Input Characteristics:</u>



→V_{BE} vs I_B characteristics is called input characteristics.

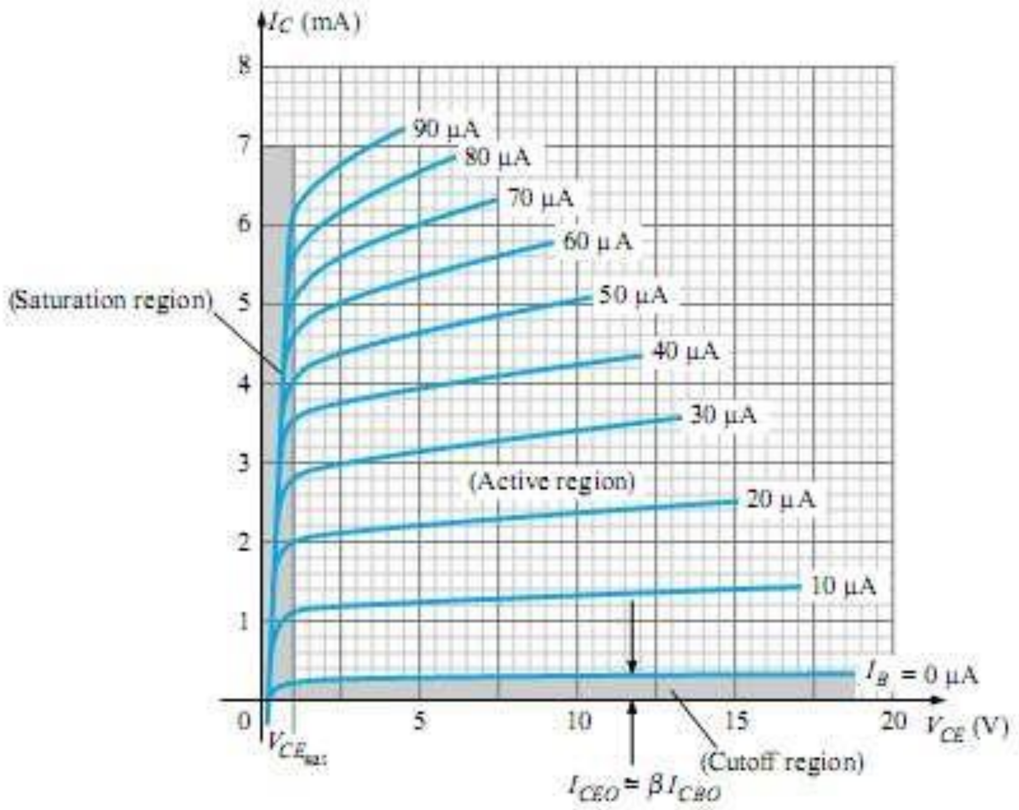
→ I_B increases rapidly with V_{BE} . It means input resistance is very small.

→ I_E almost independent of V_{CE}.

→I_B is of the range of micro amps.

CHARACTERISTICS OF COMMON EMITTER CONFIGURATION

- <u>Output Characteristics:</u>



- V_{CE} vs I_c characteristics is called output characteristics.
- I_C varies linearly with V_{CE} ,only when V_{CE} is very small.
- As, V_{CE} increases, I_C becomes constant.

EXPRESSION FOR COLLECTOR CURRENT

$$I_C = \alpha I_E + I_{CBO}$$

$$I_E = I_B + I_C = I_B + (\alpha I_E + I_{CBO})$$

$$I_E (1 - \alpha) = I_B + I_{CBO}$$

$$I_E = \frac{I_B}{1-\alpha} + \frac{I_{CBO}}{1-\alpha}$$

$$I_C \; ; \; I_E = *(\beta + 1)\, I_B + (\beta + 1)\, I_{CBO}$$

$$\beta = \frac{\alpha}{1-\alpha} \qquad \therefore \quad \beta + 1 = \frac{\alpha}{1-\alpha} + 1 = \frac{1}{1-\alpha}$$

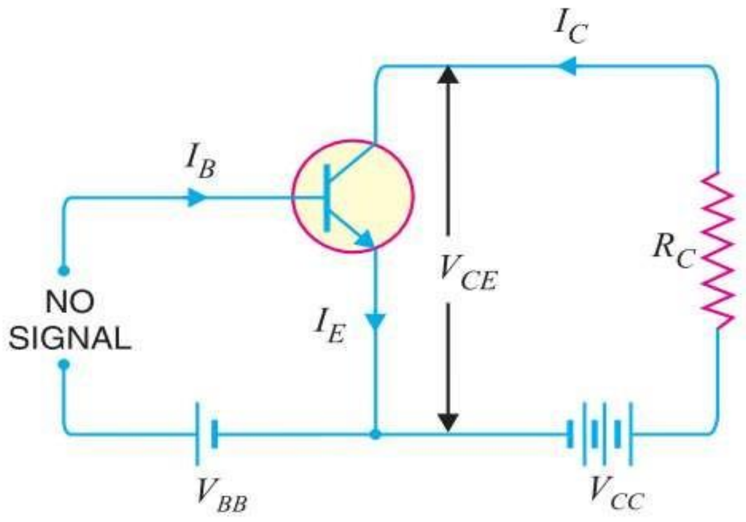
COMPARISON OF TRANSISTOR CONNECTION

S. No.	Characteristic	Common base	Common emitter	Common collector
1.	Input resistance	Low (about 100 Ω)	Low (about 750 Ω)	Very high (about 750 kΩ)
2.	Output resistance	Very high (about 450 kΩ)	High (about 45 kΩ)	Low (about 50 Ω)
3.	Voltage gain	about 150	about 500	less than 1
4.	Applications	For high frequency applications	For audio frequency applications	For impedance matching
5.	Current gain	No (less than 1)	High (β)	Appreciable

TRANSISTOR LOAD LINE ANALYSIS

- In transistor circuit analysis it is necessary to determine collector current for various V_{CE} voltage.
- One method is we can determine the collector current at any desired V_{CE} voltage, from the output characteristics.
- More conveniently we can use load line analysis to determine operating point.

TRANSISTOR LOAD LINE ANALYSIS



- Consider common emitter npn transistor ckt shown in figure.
- There is no input signal.
- Apply KVL in the output ckt-

$$V_{CE} = V_{CC} - I_C R_C$$

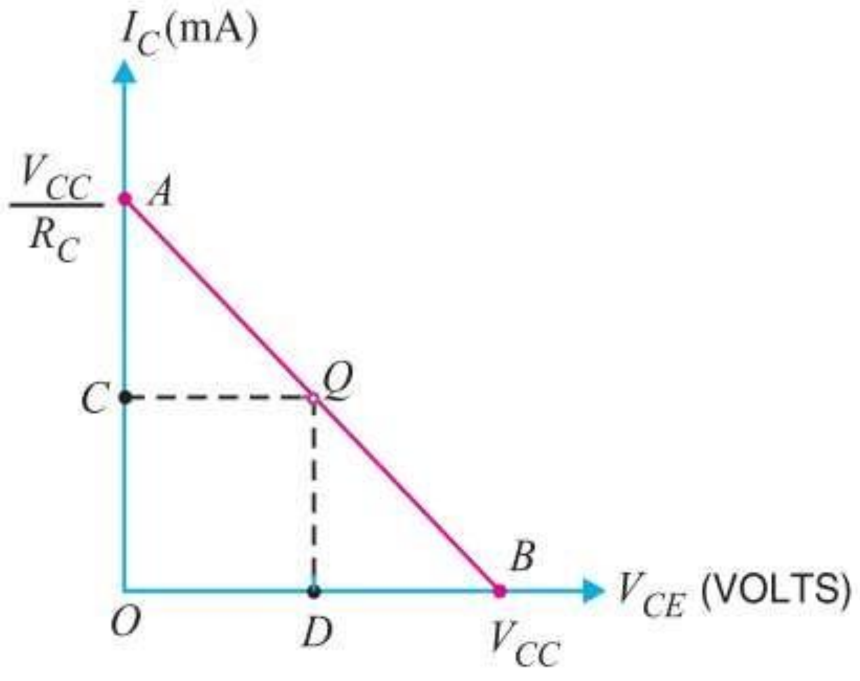
(*i*) When the collector current $I_C = 0$, then collector-emitter voltage is maximum and is equal to V_{CC} *i.e.*

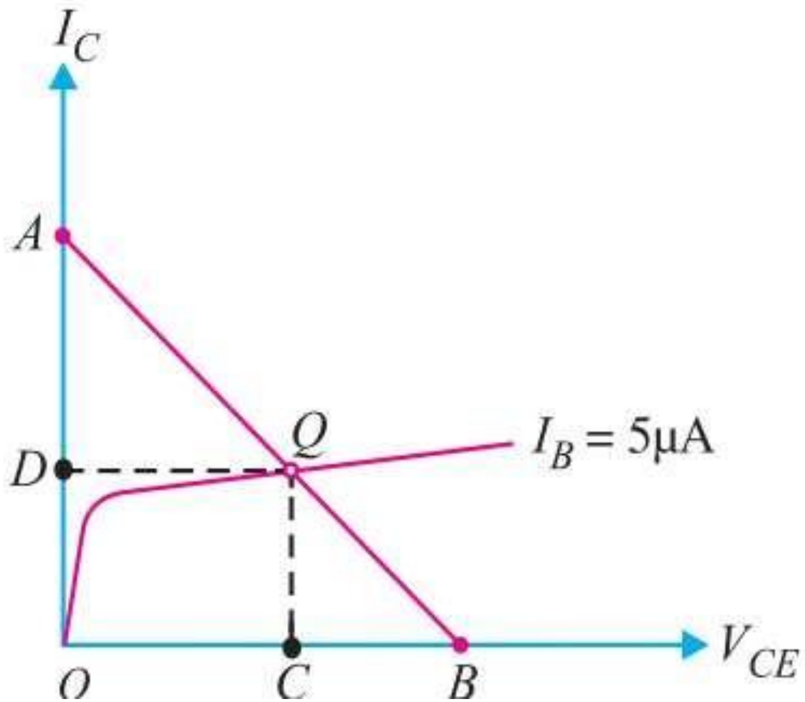
$$\text{Max. } V_{CE} = V_{CC} - I_C R_C$$
$$= V_{CC} \qquad (\because I_C = 0)$$

When collector-emitter voltage $V_{CE} = 0$,

$$V_{CE} = V_{CC} - I_C R_C$$
$$0 = V_{CC} - I_C R_C$$
$$\text{Max. } I_C = V_{CC}/R_C$$

TRANSISTOR LOAD LINE ANALYSIS





OPERATING POINT

The zero signal values of I_C and V_{CE} are known as the **operating point.**

- It is called operating point because variation of I_C takes place about this point.
- It is also called quiescent point or Q-point.