

Transistor As a Common-Emitter Amplifier:  
(Common emitter configuration)

In a common-emitter circuit, we have a forward biased base-emitter circuit and a reverse biased collector-emitter circuit. The emitter terminal is now common to both the input and output circuits. Using the n-p-n transistor, the current in the collector circuit is again 95% of the emitter current with the remaining flowing in the base circuit as shown in fig.

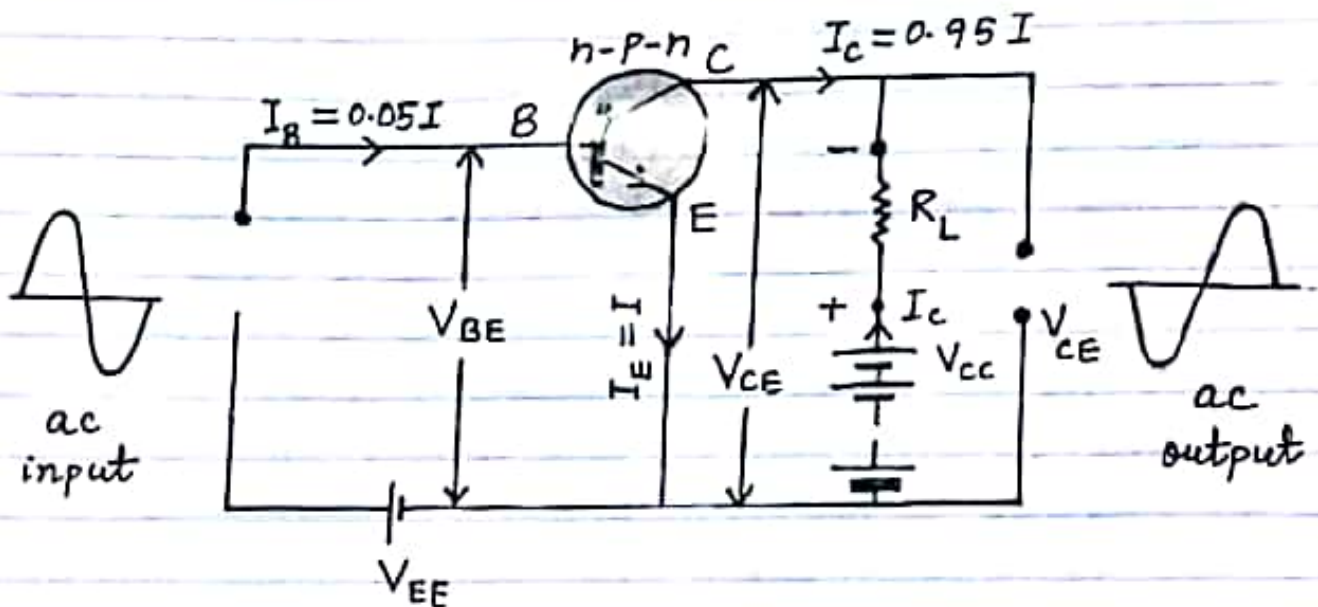


Fig.

### Operation

(a) With no signal input :  $V_{CE} = V_{CC} - I_C \times R_L$  (1)

(b) With a signal applied to the emitter base circuit : When the input signal is applied, its positive half-cycle increases the forward bias resulting in an increase in the collector current.

From eq<sup>n</sup> (1), with an increase in  $I_C$ ,  $V_{CE}$  decreases, i.e. the collector becomes less positive (i.e. more negative).

During the negative half-cycle, the input signal opposes the forward bias of the input circuit, thereby reducing the emitter and consequently the collector current. With a decrease in collector current,  $V_{CE}$  increases making the collector more positive. Thus, in a common-emitter amplifier, the input and output voltages are  $180^\circ$  out of phase with each other.

The dc current gain ( $\beta$ ): The input current in this case is the base current ( $I_B$ ) and the output current is the collector current ( $I_C$ ). Therefore, the current gains

3.

in the common-emitter amplifier and common-base amplifier are not the same. To distinguish one from the other, whereas the current gain in common-base is denoted by  $\alpha$ , the current gain in the common-emitter is denoted by  $\beta$ , where

$$\beta = \frac{\text{collector current } (I_c)}{\text{base current } (I_B)} \quad \text{--- (2)}$$

$$\text{or } \beta = \frac{0.951}{0.051} = 19$$

In case  $I_c = 0.98I$  and  $I_B = 0.02I$ ,

$$\beta = \frac{I_c}{I_B} = \frac{0.98I}{0.02I} = 49$$

Clearly, a good current gain is obtained here.

The ac current gain ( $\beta_{ac}$ ): The ratio of the change in collector current to the change in base current at constant emitter voltage is called ac current gain.

That is,

$$\beta_{ac} = \left[ \frac{\Delta I_c}{\Delta I_B} \right]_{V_{CE} = \text{constant}} \quad \text{--- (3)}$$