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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.

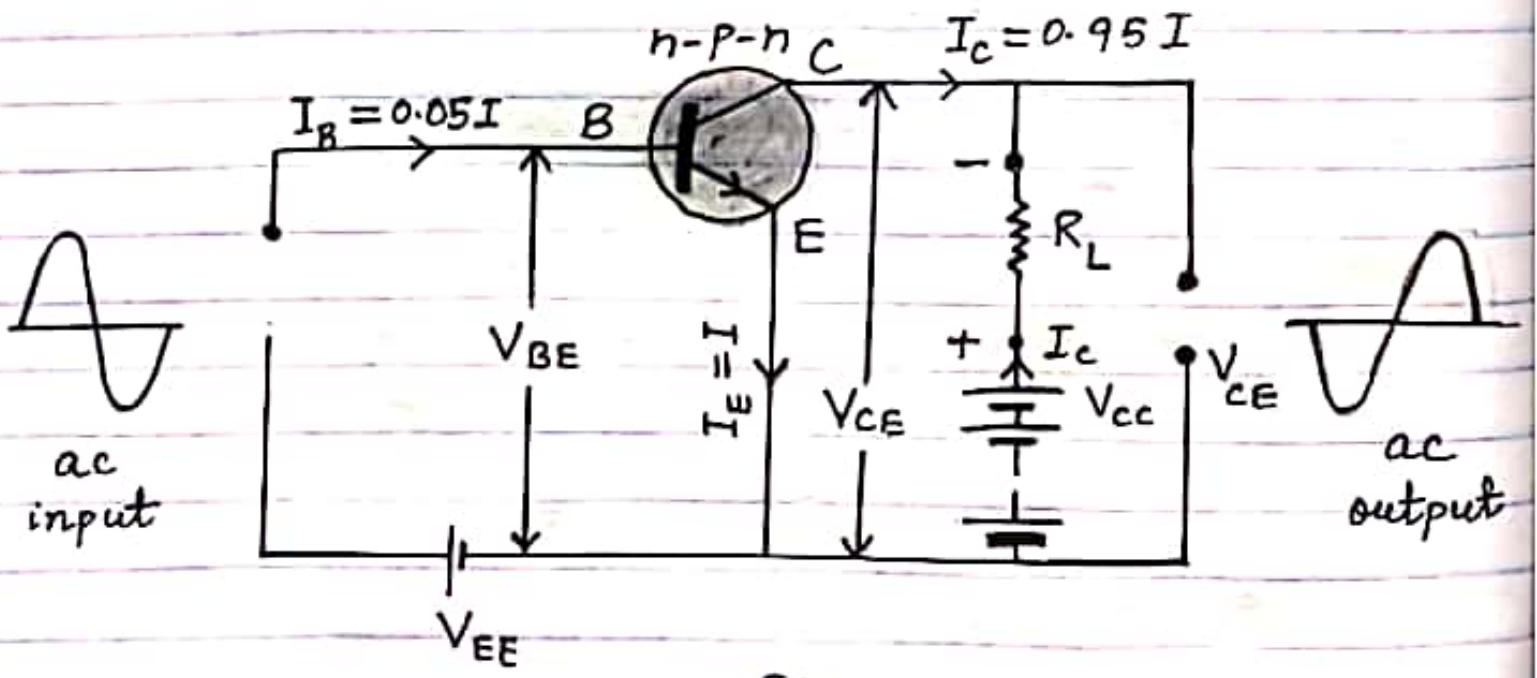

Fig.

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 eqⁿ (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° out of phase with each other.

The dc current gain (β): 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

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 α, the current gain in the common-emitter is denoted by β, where

$$\beta = \frac{\text{collector current } (I_C)}{\text{base current } (I_B)} \quad \text{— (2.)}$$

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 (β_{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,

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