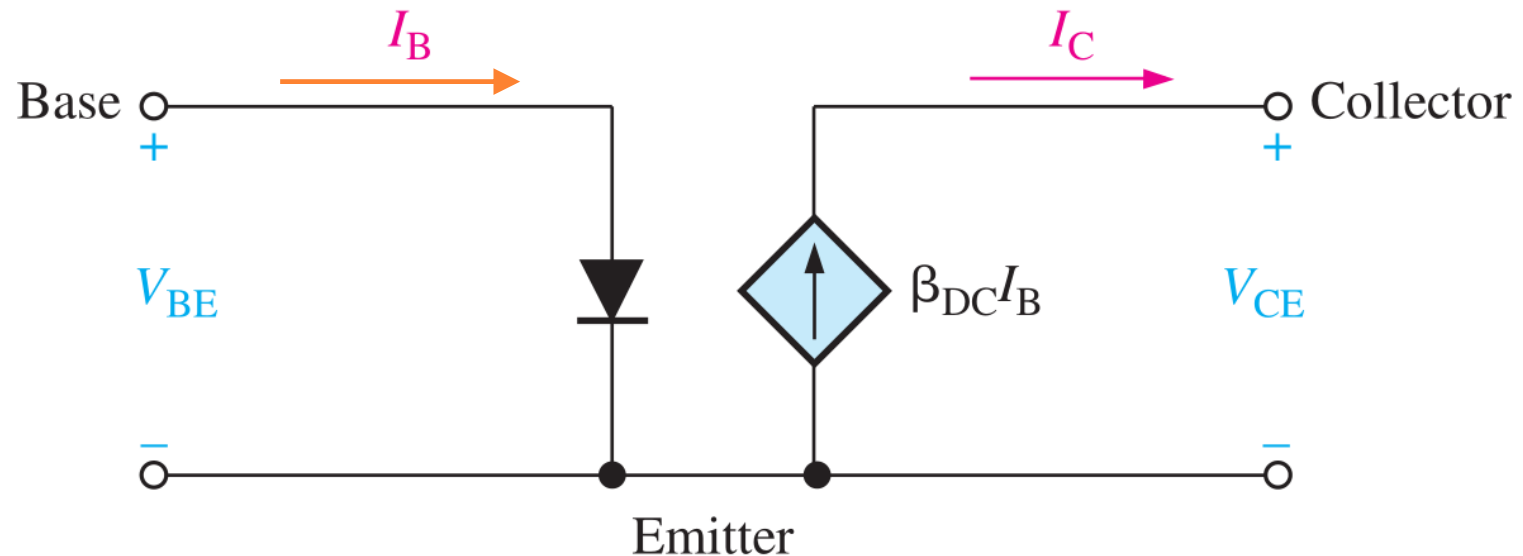# Basic Electronic Circuits (IEC-103)
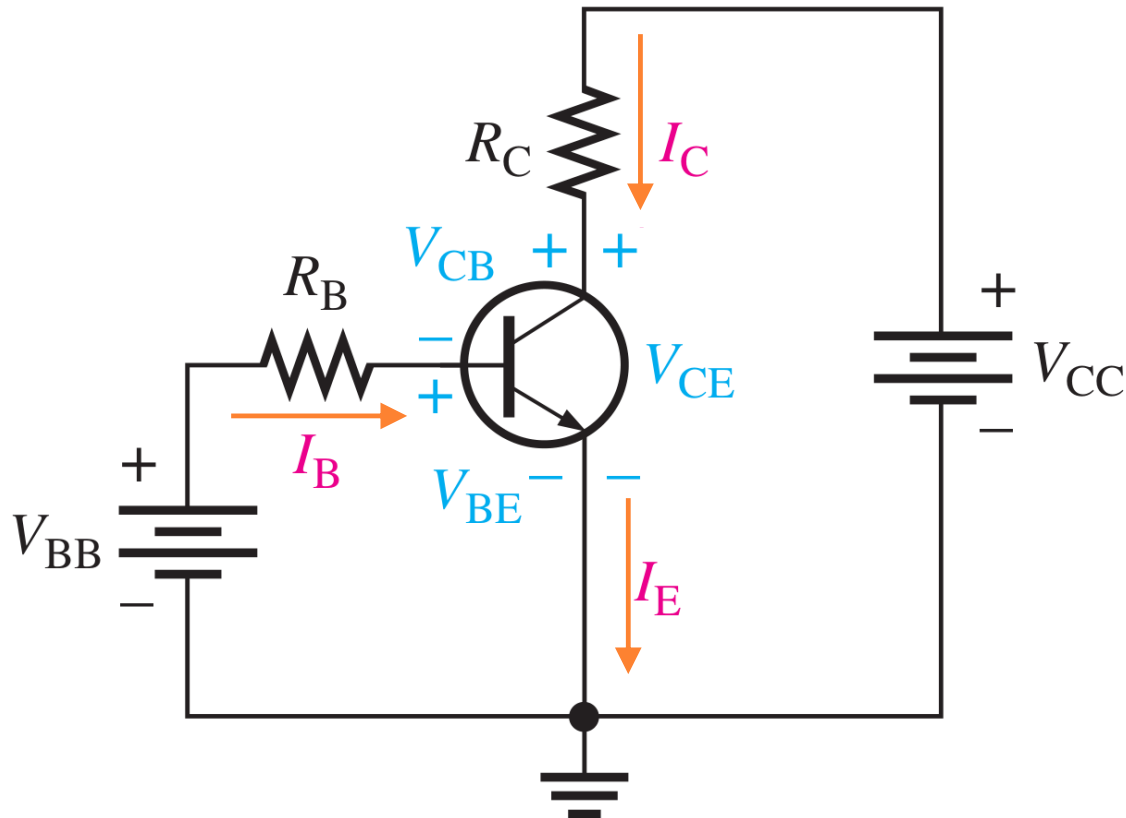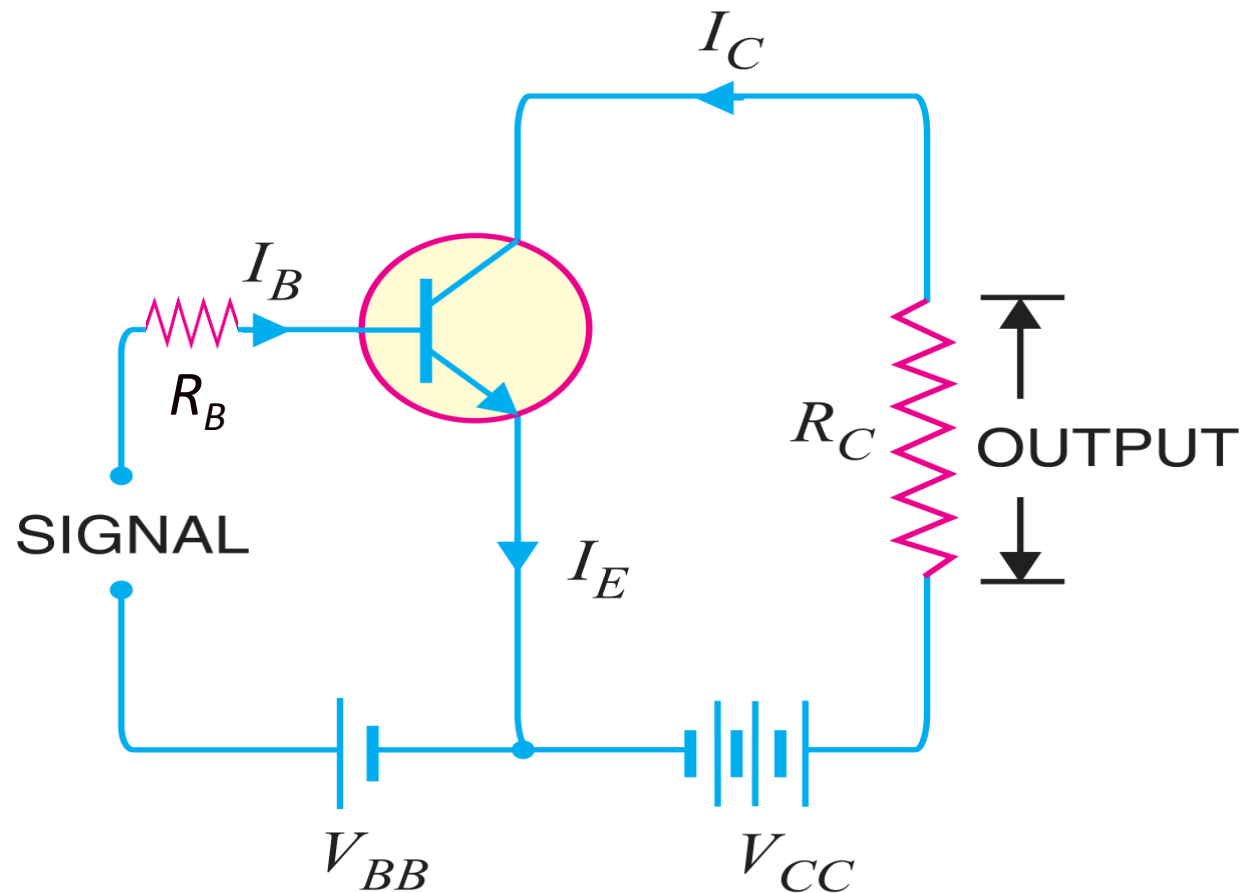
Lecture-15

Bipolar Junction Transistors

Transistor DC Model

Transistor Circuit

Transistor Circuit as an Amplifier

Transistor Connections

Transistor Connections

❑ **Transistor can be connected in a circuit in 3 ways**

- **Common base connection**

- **Common emitter connection**

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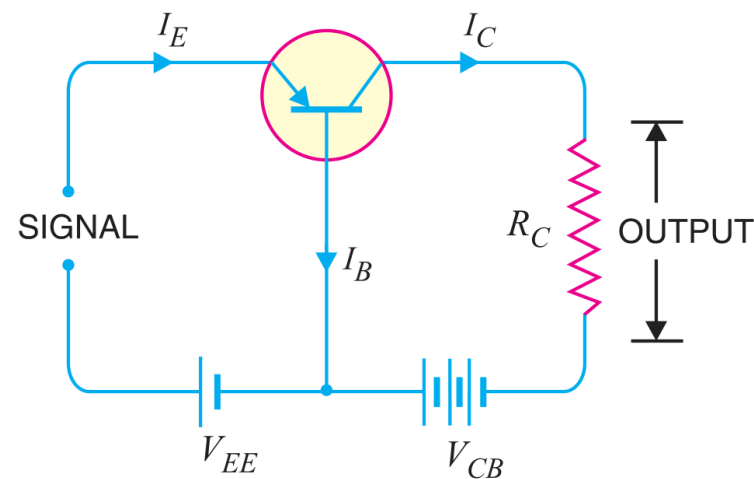❑ **Each connection has their own advantages and disadvantages.**

❑ **In all cases, the emitter-base junction is forward biased and collector-base junction is reverse biased (amplifier application).**

Common Base Connection
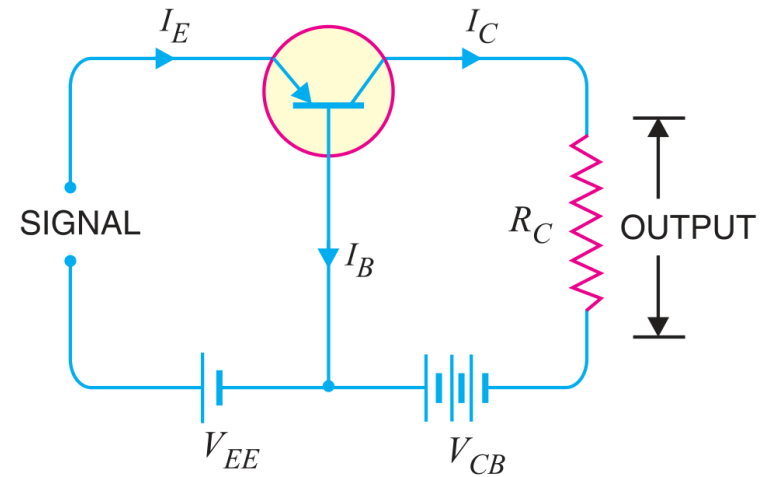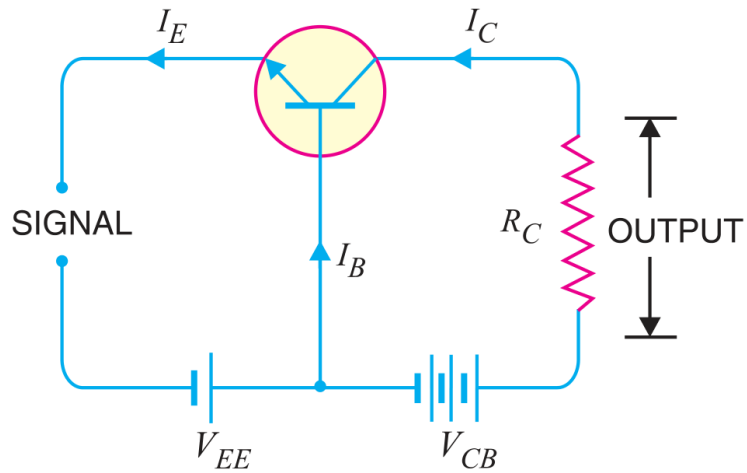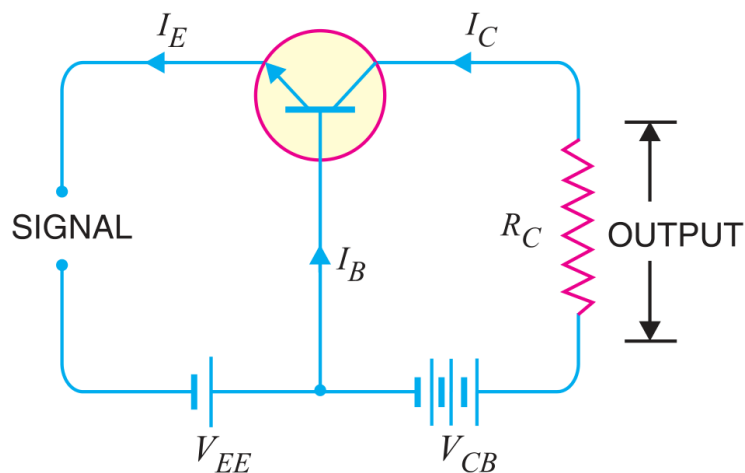
Common Base Connection

❑ **Current amplification factor (α): The ratio of change in collector current to change in emitter current at constant collector base voltage (V_{CB})**

Common Base Connection

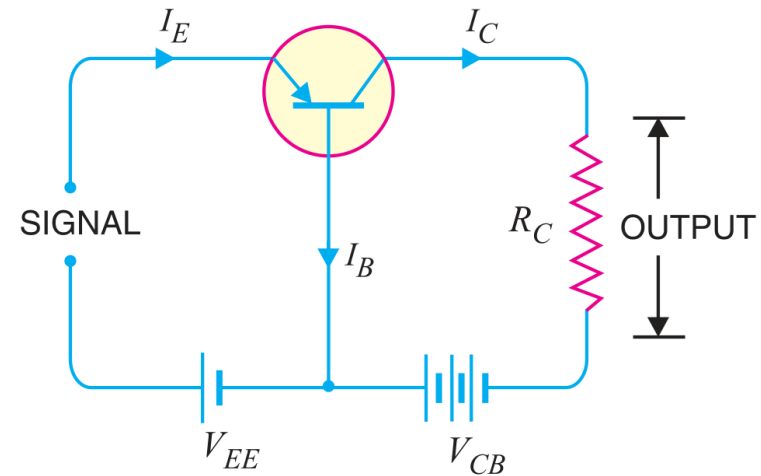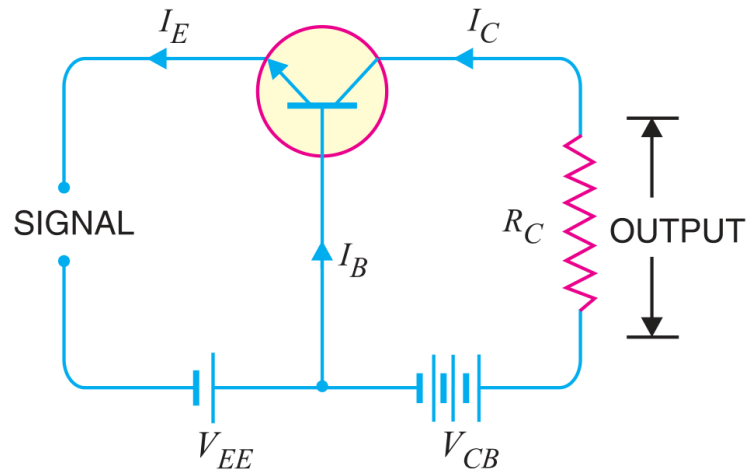❑ **Current amplification factor (α): The ratio of change in collector current to change in emitter current at constant collector base voltage (V_{CB})**

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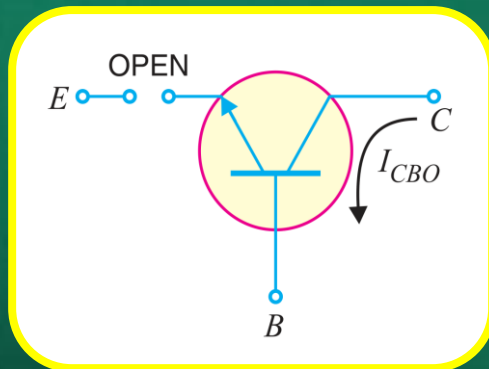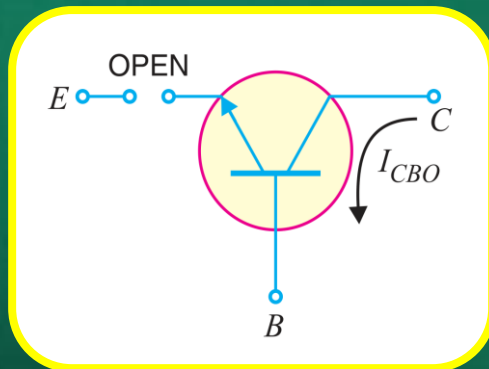$$I_C = \alpha I_E + I_{leakage}$$

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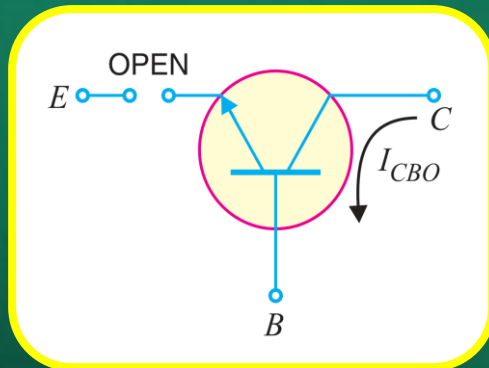
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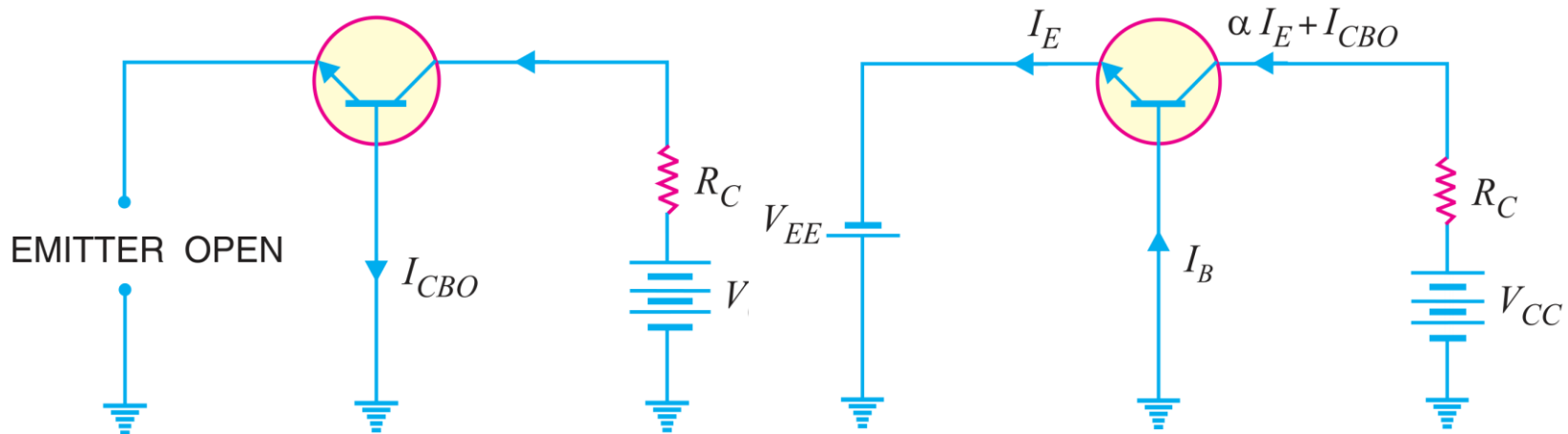
Common Base Characteristics

❑ **Important characteristics of a common base connection**

- **Input characteristics (I_E vs V_{EB})**
- **Output characteristics (I_C vs V_{CB})**

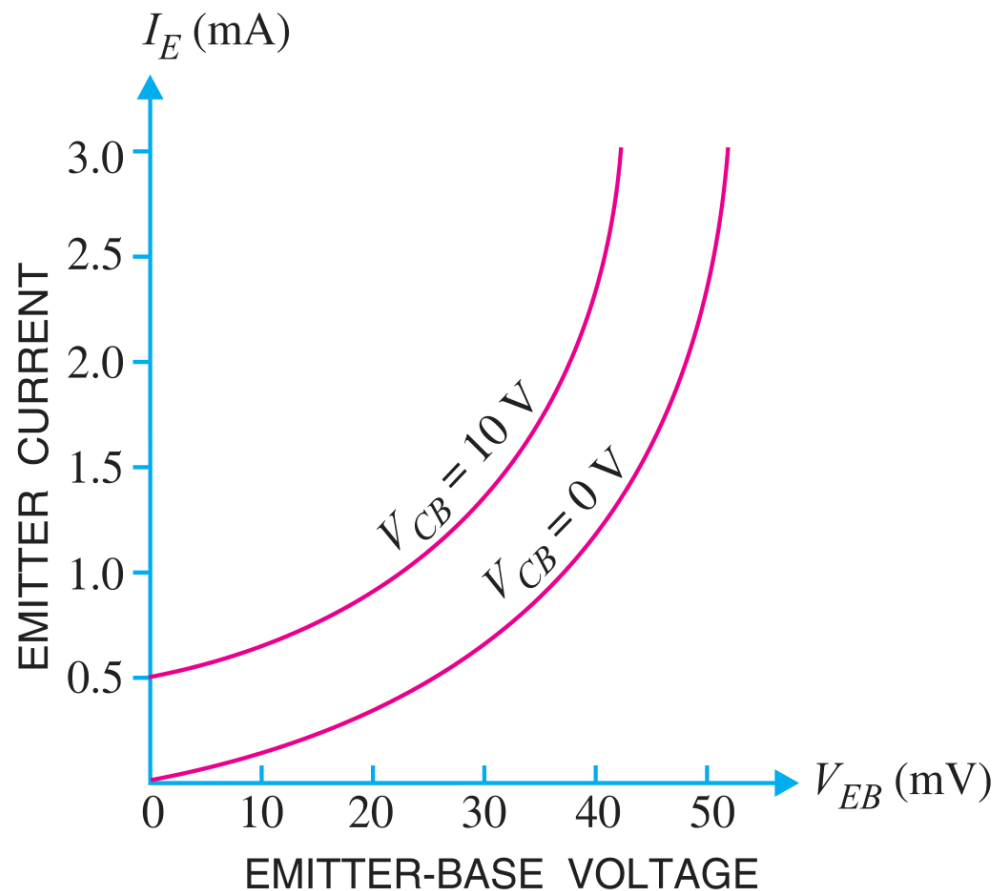# Input Characteristics (CB)

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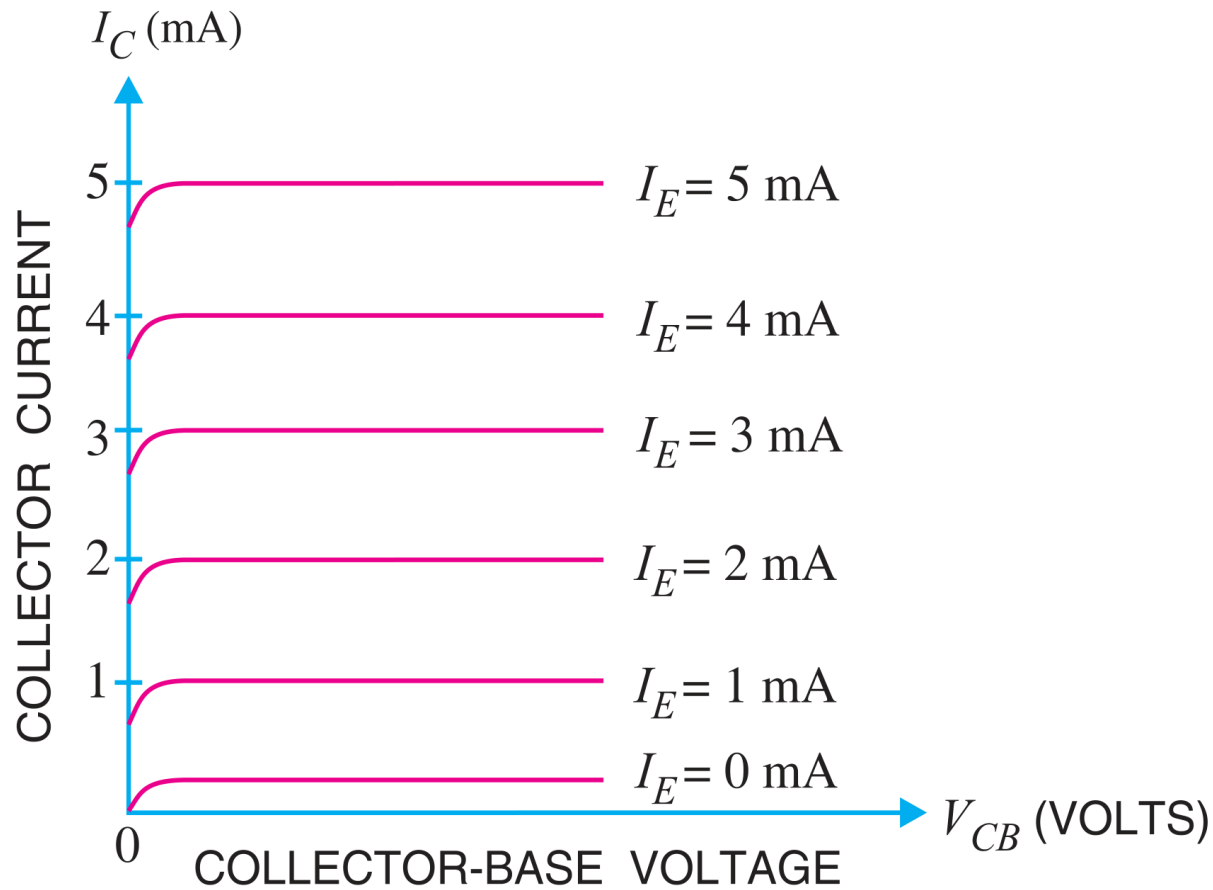# Input Characteristics (CB)

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❑ **Input resistance is very small and is of the order of few ohms.**

Output Characteristics (CB)

I_C (mA)

5 — $I_E = 5$ mA

4 — $I_E = 4$ mA

3 — $I_E = 3$ mA

2 — $I_E = 2$ mA

1 — $I_E = 1$ mA

$I_E = 0$ mA

COLLECTOR CURRENT

0   COLLECTOR-BASE VOLTAGE V_{CB} (VOLTS)

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❑ **Output resistance is very high and is of the order of tens of kilo ohms.**
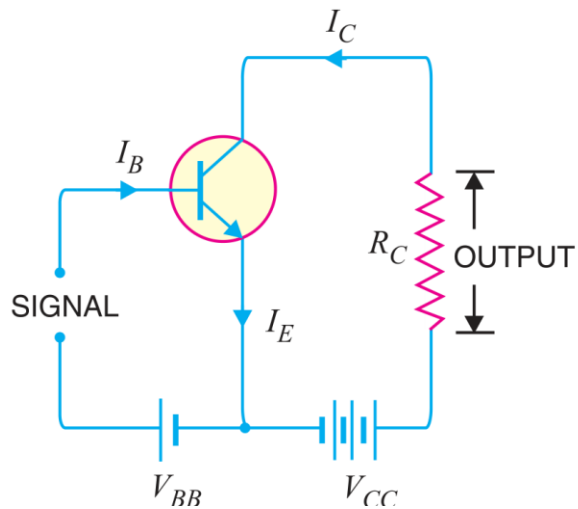
Example

In a common base connection $\alpha = 0.95$. The voltage drop across $2\ \mathrm{k\Omega}$ resistance connected in collector circuit is $2\mathrm{V}$. Find the base current $\mathrm{I_B}$.
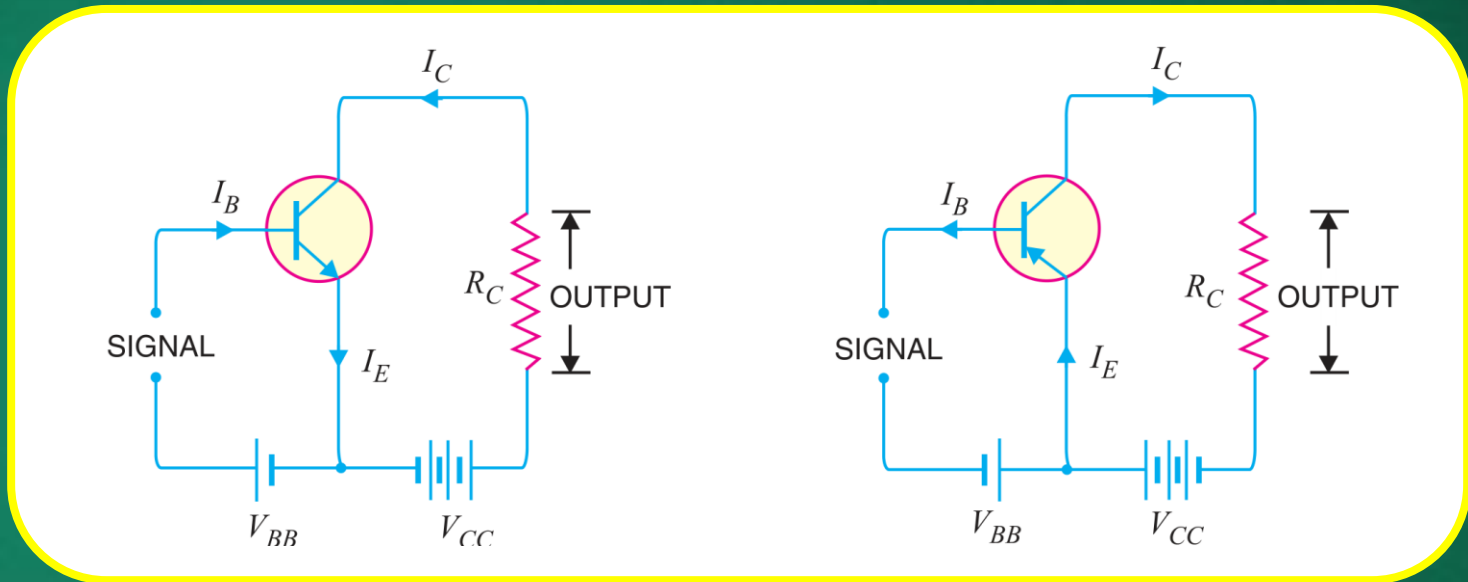
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Answer: $\mathrm{I_B}$=0.05 mA

Common Emitter Connection
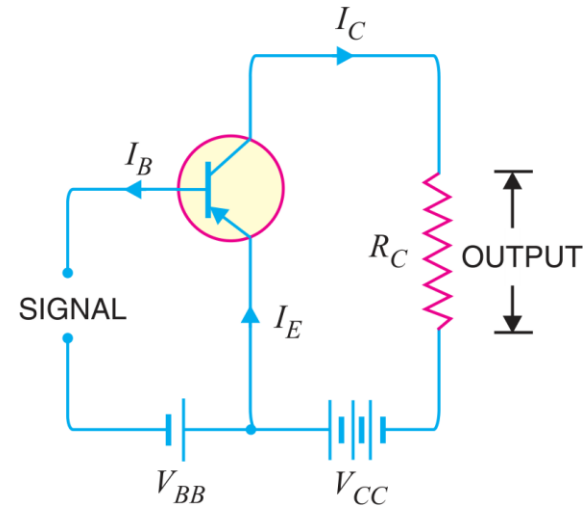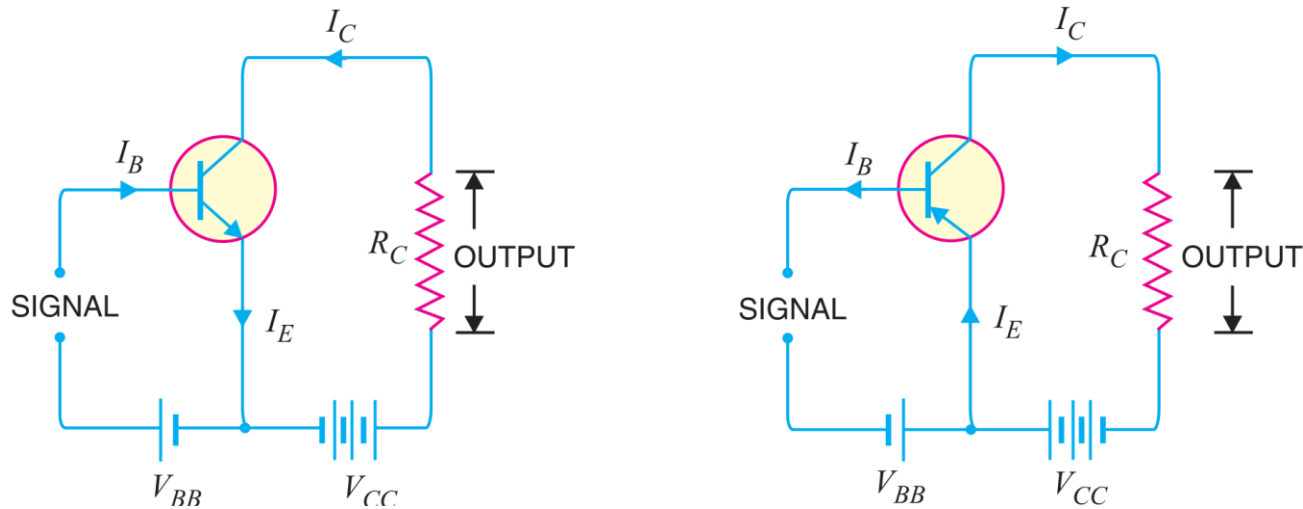
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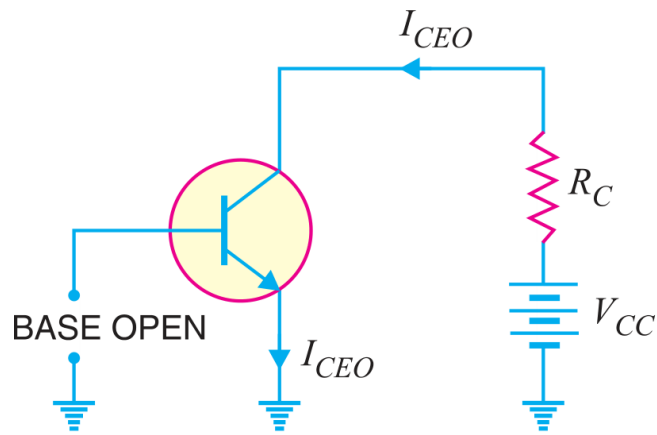
$$\Rightarrow I_C = \beta I_B + I_{CEO}$$
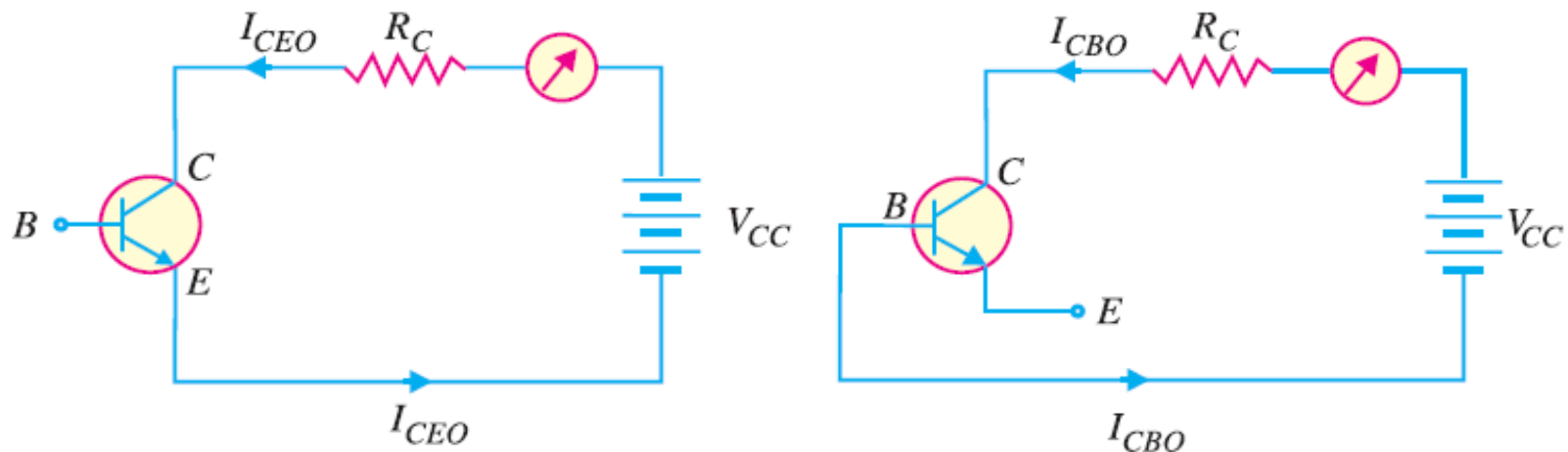
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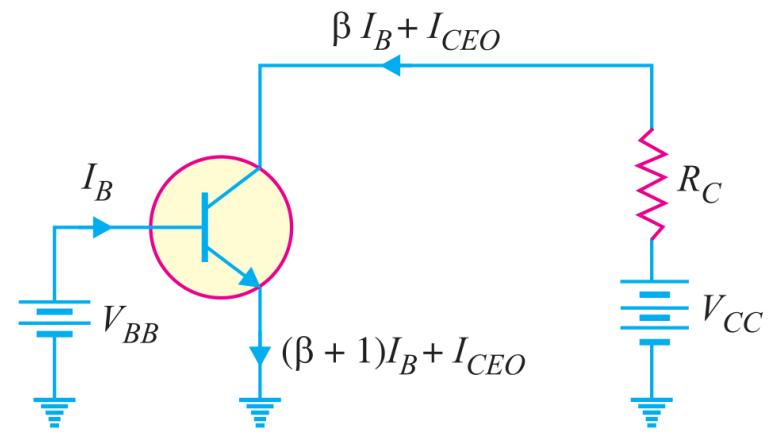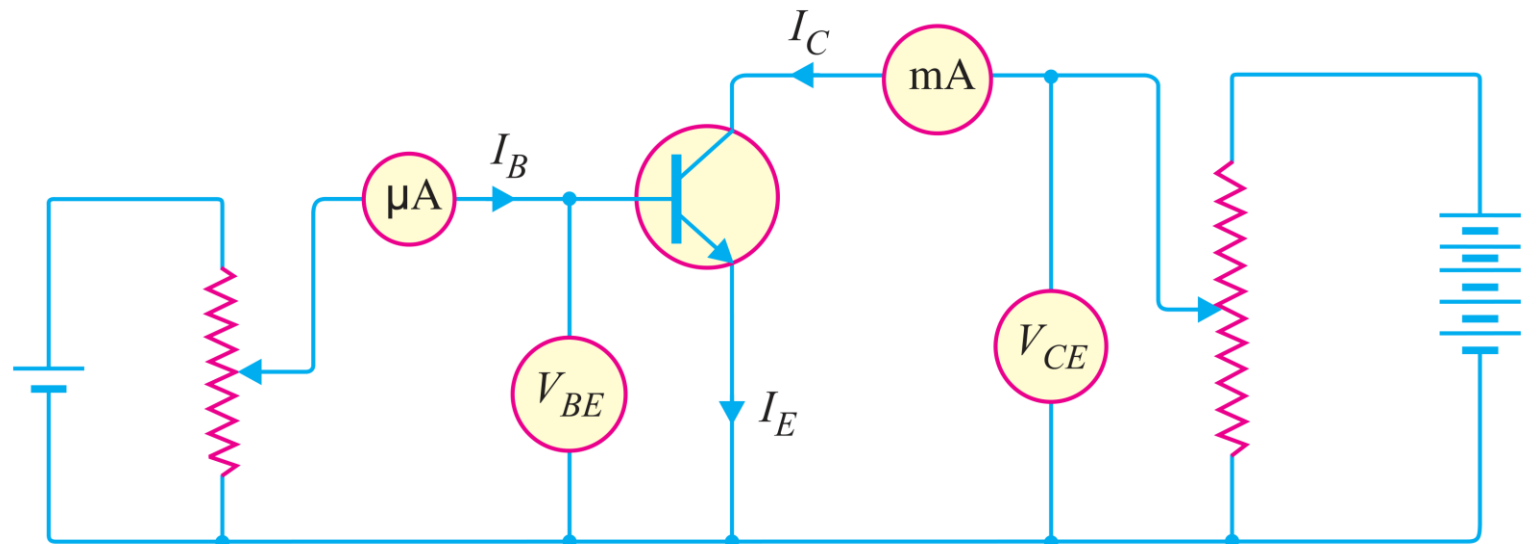
Measurement of Leakage Current

Common Emitter Characteristics

❑ **Important characteristics of a common emitter connection**

- **Input characteristics (I_B vs V_{BE})**
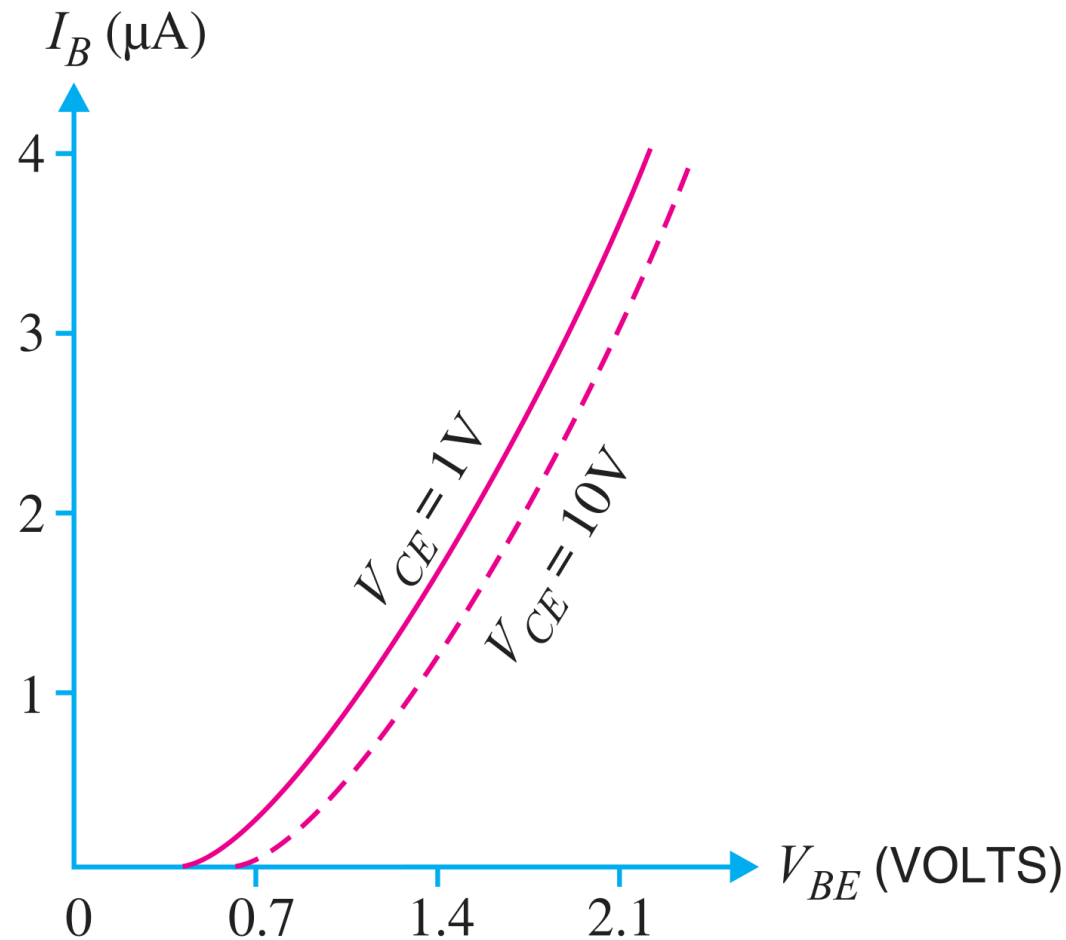- **Output characteristics (I_C vs V_{CE})**

Common Emitter Characteristics

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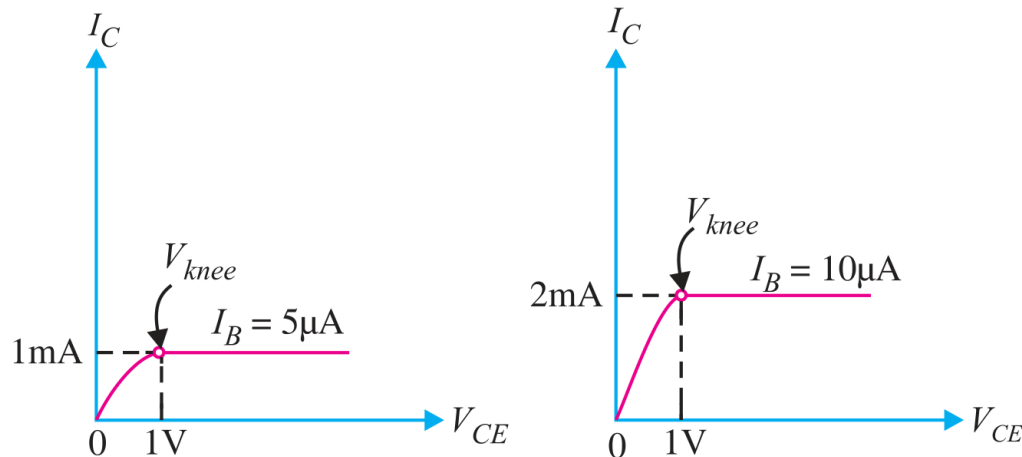$$\text{Input resistance} \quad r_i = \frac{\Delta V_{BE}}{\Delta I_E} \quad \text{at constant } V_{CE}$$
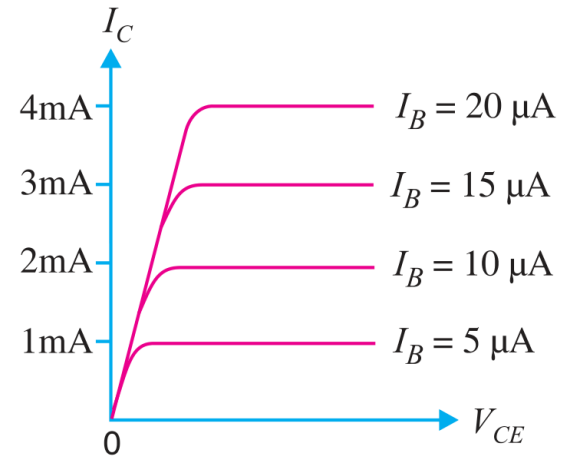
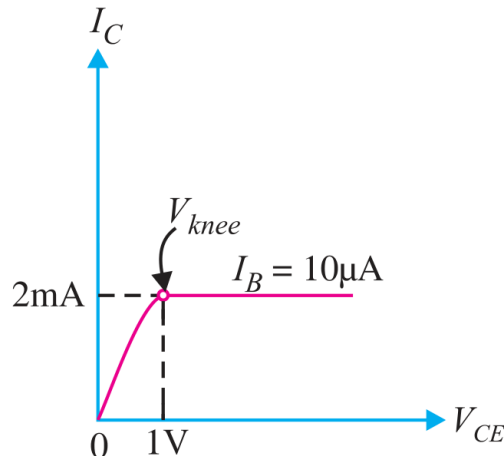❑ **Input resistance is very small and is of the order of few hundred ohms.**
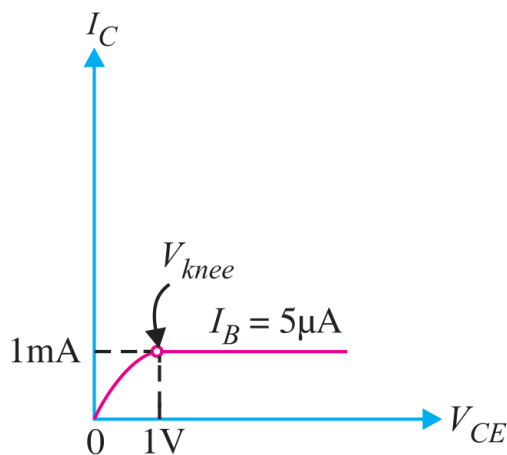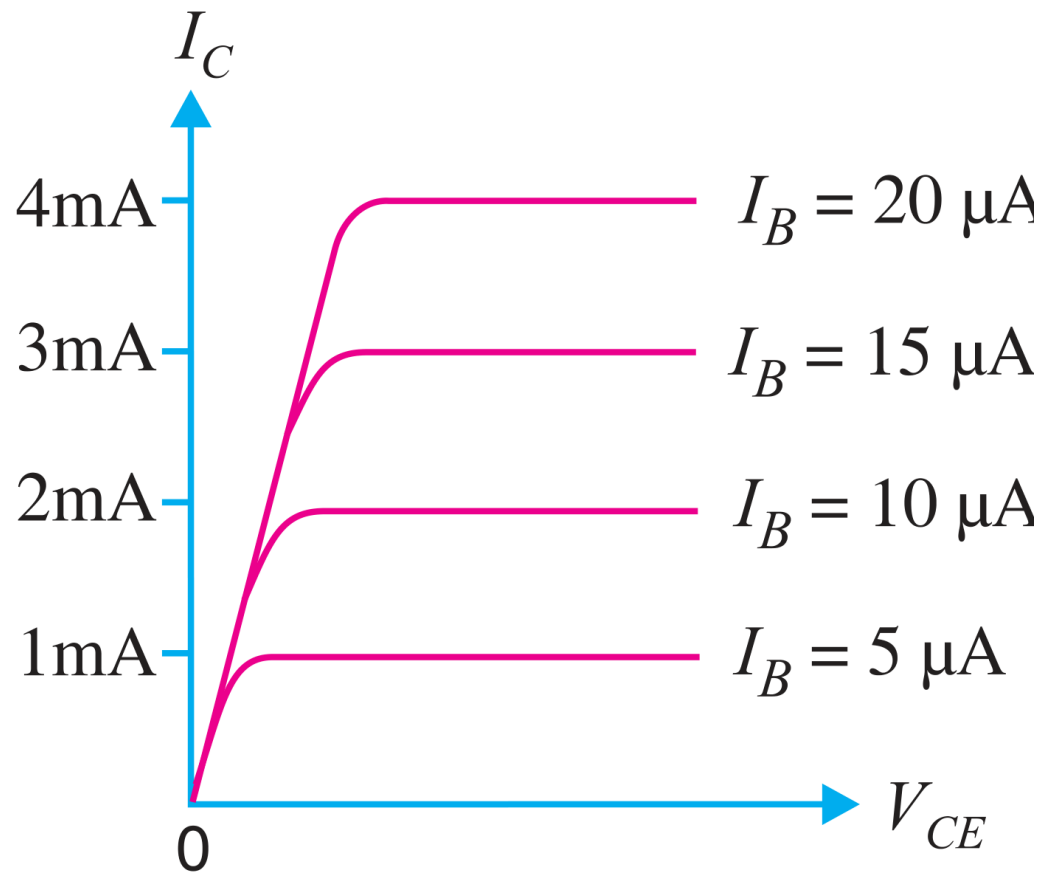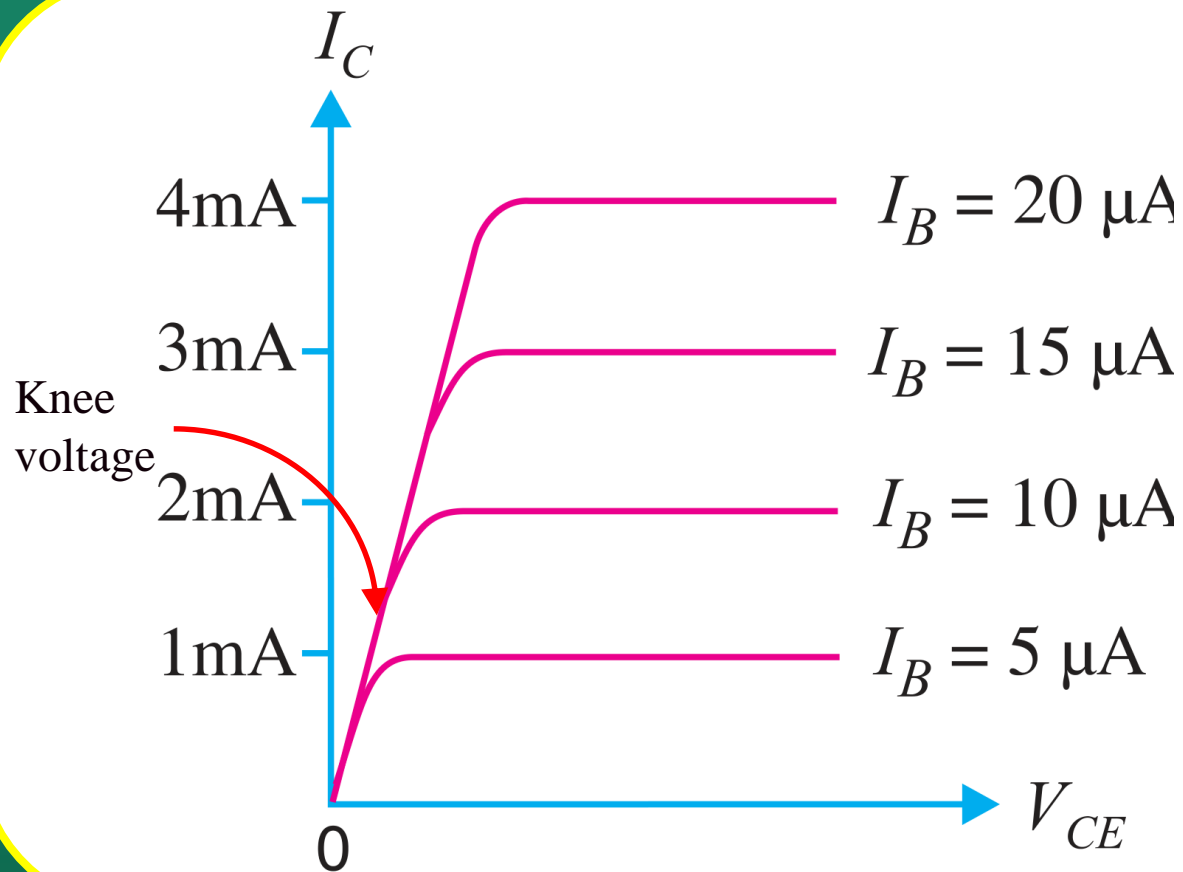
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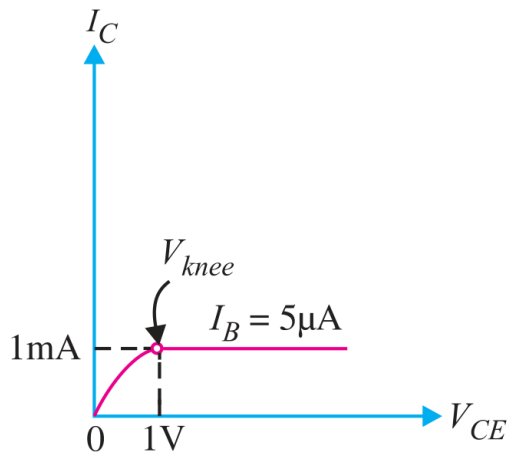
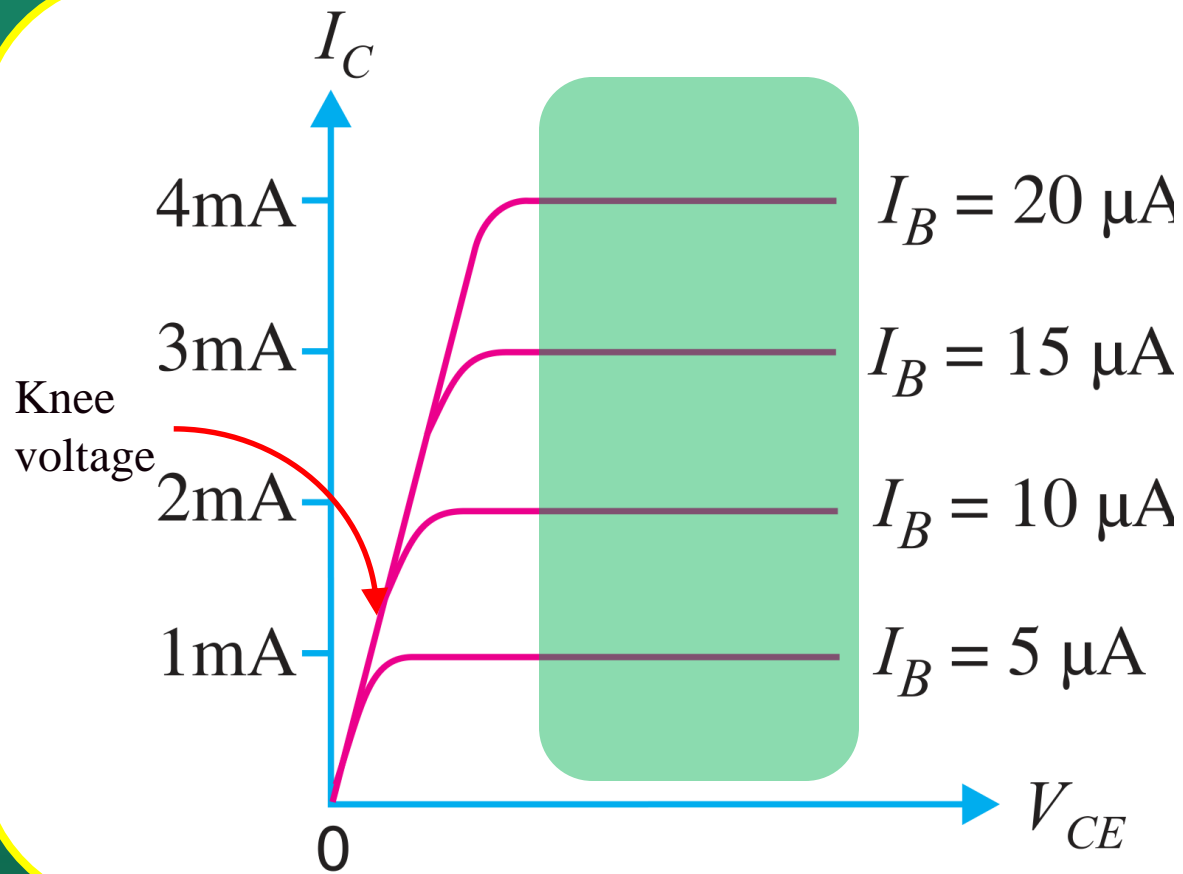# Output Characteristics (CE)

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$$\text{Output resistance} \quad r_o = \frac{\Delta V_{CE}}{\Delta I_C} \quad \text{at constant } I_B$$

❑ **Output resistance is very high but less than that of CB connection and is of the order of $50\text{ K}\Omega$.**

Example

A transistor is connected in CE configuration in which the collector supply is $8 \, \mathrm{V}$ and voltage drop across $\mathrm{R_C}$ connected in the collector circuit is $0.5 \, \mathrm{V}$. The value of $\mathrm{R_C} = 800 \, \Omega$. If $\alpha = 0.96$, determine

a) collector-emitter voltage

b) Base current

Example

A transistor is connected in CE **configuration in which the collector supply is** 8 V **and voltage drop across** R_C **connected in the collector circuit is** 0.5 V**. The value of** $R_C = 800 \ \Omega$**. If** $\alpha = 0.96$**, determine**
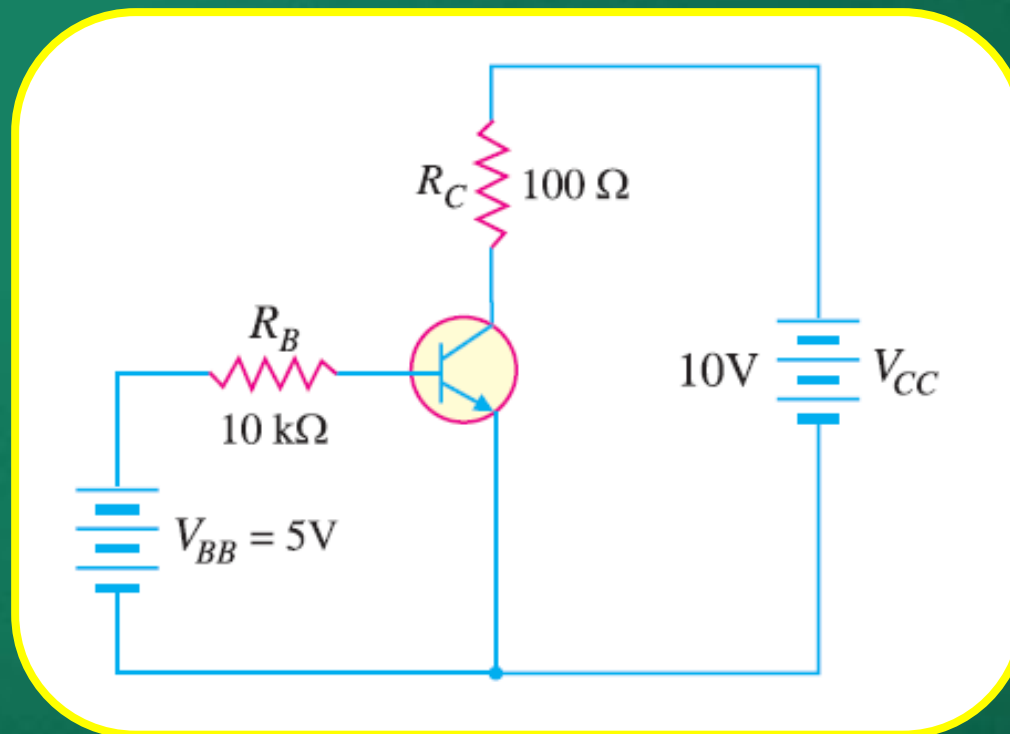
a) collector-emitter voltage

b) Base current

Answer: $V_{CE} = 7.5 \text{ V}$, $I_B = 26 \ \mu A$
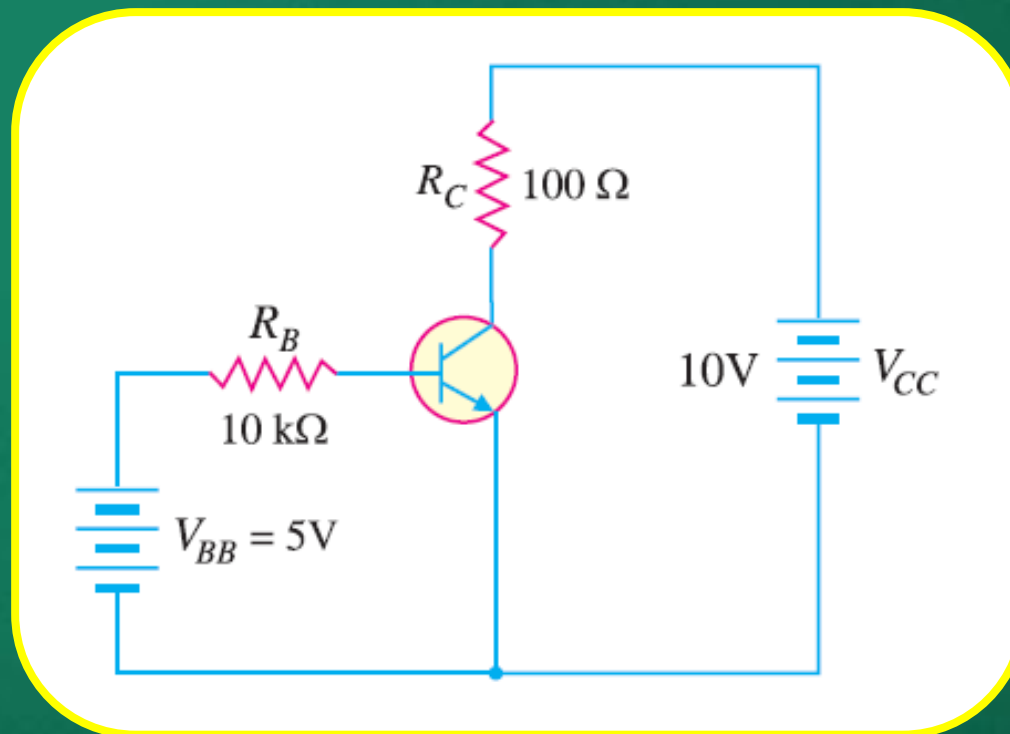
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Determine V_{CB} in the transistor circuit shown in Fig. below. The transistor is of silicon and has $\beta = 150$.

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Determine V_{CB} in the transistor circuit shown in Fig. below. The transistor is of silicon and has $\beta = 150$.

Answer: $V_{CB} = V_{CE} - V_{BE} = 2.85$ V