Experiment No. 9

Common Emitter Configuration Experiment

1. OBJECTIVES

- To study the input and output characteristics of a transistor (Common Emitter configuration).

2. COMPONENTS REQUIRED

- DC Regulated Power supply(0-15V)
- Connecting wires.
- Digital Ammeters (0 - 200 mA, 0-200A).
- Tow Digital Voltmeter (0 - 20V).
- Resistors 1kΩ, 100 kΩ.
- Bread Board.
- (BC 141 npn) transistor.

**Specifications for Transistor ------: Max Collector Current = -----A; V_{CEO} max ------.

3. THEORY

Circuit Diagram

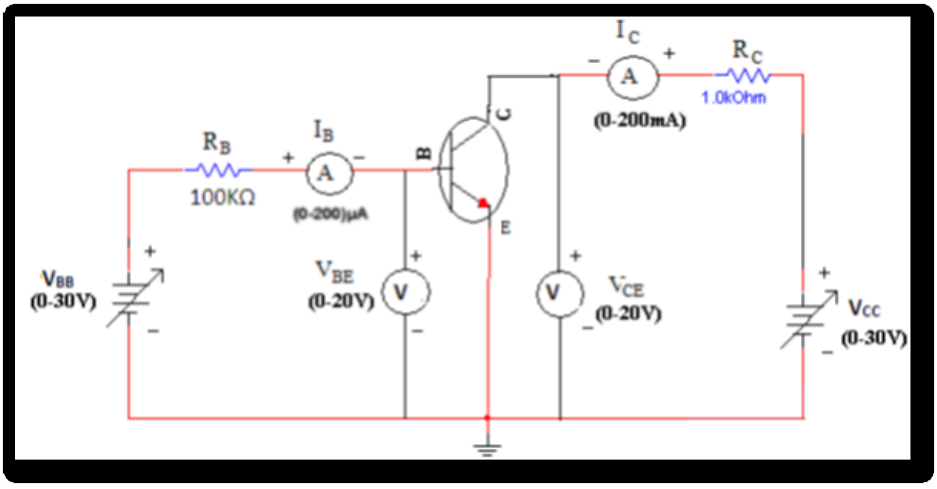

Fig. 1: Common Emitter configuration.

$$V_{BE} = V_{BB} - I_B R_B$$

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

Operation:

Input characteristics are obtained between the input current I_B and input voltage V_{BE} at constant output voltage V_{CE}. This portion of an NPN BJT is just like a p-n junction. Consequently, the I_B and V_{BE} relationship in the common emitter configuration is the same as the I-V characteristic of a diode. The typical value of V_{BE} for silicon BJT is 0.7 V. After cut in voltage the I_B increases rapidly with small increase in V_{BE}. It means that dynamic input resistance is small in CE configuration. It is the ratio of change in V_{BE} to the resulting change in base current at constant collector emitter voltage. It is given by $\Delta V_{BE} / \Delta I_B$.

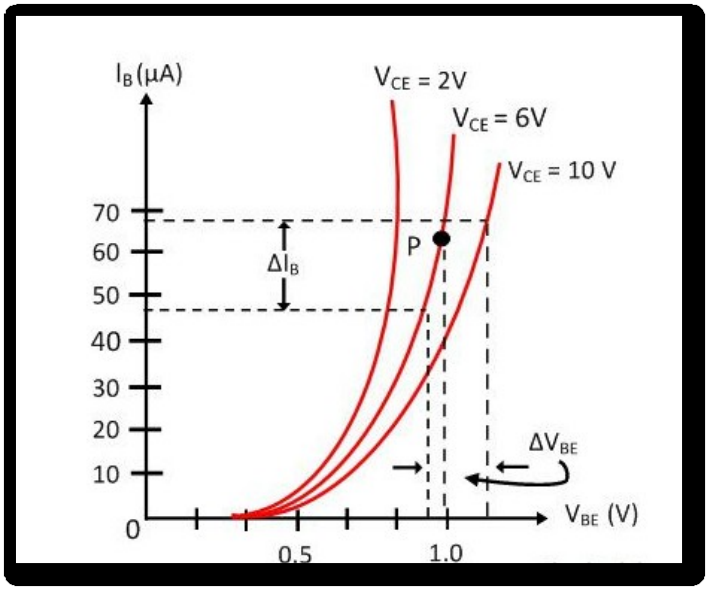

Fig. 2: Model for input I-V characteristic.

Output characteristics shows relation between collector current I_C and collector voltage for various values of base current. The change in collector emitter voltage causes small change in the collector current for the constant base current, which defines the dynamic resistance and is given as $\Delta V_{CE}/\Delta I_C$ at constant I_B. The output characteristic of common emitter configuration consists of three regions: Active, Saturation and Cut-off.

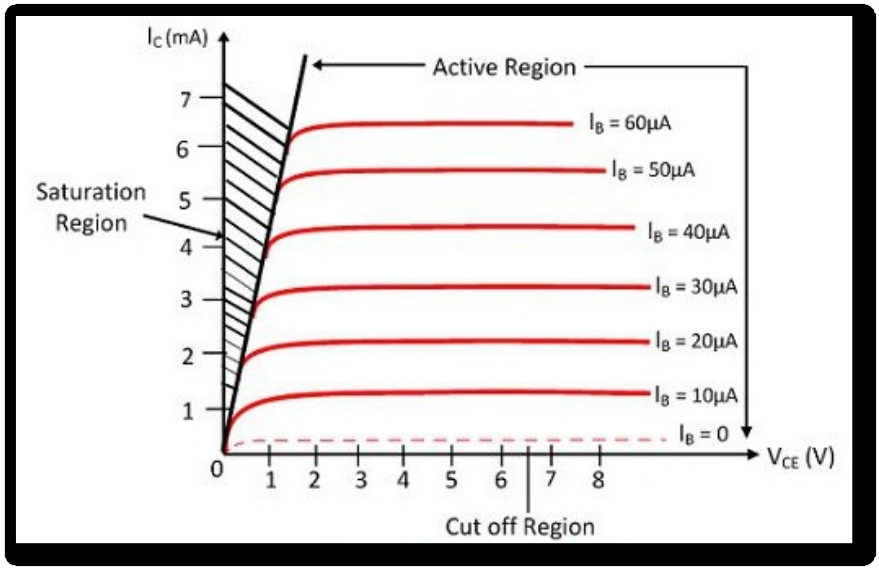

Fig. 3: Model for output I-V characteristic.

Active region: In this region base-emitter junction is forward biased and base-collector junction is reversed biased. The curves are approximately horizontal in this region.

Saturation region: In this region both the junctions are forward biased.

Cut-off: In this region, both the junctions are reverse biased. When the base current is made equal to zero, the collector current is reverse leakage current ICEO. The region below IB = 0 is the called the cutoff region.

4. PROCEDURE

Input Characteristics:

1. Connect the circuit as shown in the circuit diagram (Fig.1).
2. Keep output voltage V_{CE} = 0V by varying V_{CC}.
3. Varying V_{BB} gradually, note down base current I_B and base-emitter voltage V_{BE}.
4. Step size is not fixed because of nonlinear curve. Initially vary V_{BB} in steps of 0.1V. Once the current starts increasing vary V_{BB} in steps of 1V.
5. Repeat above procedure (step 3) for V_{CE} = 2V and 5V.
6. Plot the input characteristics: V_{BE} on X-axis and I_B on Y-axis at a constant V_{CE} as a constant parameter.

Output Characteristics:

1. Connect the circuit as shown in the circuit diagram.
2. Keep emitter current I_B = 20A by varying V_{BB}.
3. Varying V_{CC} (1V up to 12V), note down collector current I_C and Collector-Emitter Voltage (V_{CE}).
4. Repeat above procedure (step 3) for **IB** = 40μA and 60μA.
5. Plot the output characteristics: V_{CE} on X-axis and taking I_C on Y-axis taking **IB** as a constant parameter.

5. DATA AND RESULT

Input Characteristics

V_{CE} = 0 V		V_{CE} = 2 V		V_{CE} = 5 V	
$V_{BE(V)}$	$I_{B(\mu A)}$	$V_{BE(V)}$	$I_{B(\mu A)}$	$V_{BE(V)}$	$I_{B(\mu A)}$

Output Characteristics

$I_{B=0\ \mu A}$		$I_{B=20\ \mu A}$		$I_{B=40\ \mu A}$		$I_{B=60\ \mu A}$	
$V_{cE(V)}$	$I_{C(mA)}$	$V_{cE(V)}$	$I_{C(mA)}$	$V_{CE(V)}$	$I_{C(mA)}$	$V_{CE(V)}$	$I_{C(mA)}$

Calculations:

1. Small-Signal Current Gain: $\beta = \Delta \mathbf{I_C} / \Delta \mathbf{I_B}$ with the $\mathbf{V_{CE}}$ at a constant voltage.
2. Dynamic input resistance: It is given by $\Delta \mathbf{V_{BE}} / \Delta \mathbf{I_B}$ at constant $\mathbf{V_{CE}}$.
3. Dynamic output resistance: It is given as $\Delta \mathbf{V_{CE}} / \Delta \mathbf{I_C}$ at constant $\mathbf{I_B}$.

Results:

1. Small-Signal Current Gain: _____
2. Dynamic input resistance: _____
3. Dynamic output resistance: _____