EXPERIMENT NO. 4

AIM OF THE EXPERIMENT:
Investigation of BJT in CE configuration and sketch its input and output characteristics.

EQUIPMENTS and COMPONENTS REQUIRED:

Sl. No	Name	Specification
1	Transistor	BC 547
2	Resistors	10kΩ, 1kΩ
3	Variable resistors	100k,1k
4	Voltmeter	(0-10)V- 2 Nos.
5	Ammeter	(0-200)μA &(0-10) mA
6	Bread Board	
7	Connecting wire	

CIRCUIT DIAGRAM:

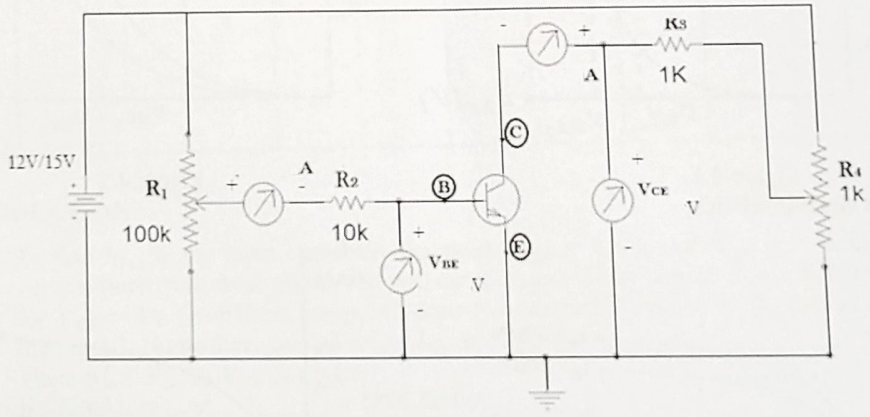

Figure.4 (Circuit diagram for CE configuration)

THEORY:
The transistor is a two port device. Its input circuit contains a dependent voltage source in series with impedance and output circuit contains a dependent current source in parallel with impedance. Define by the relations as shown below:

$V_{be} = h_{ie} I_b + h_{re} V_{ce}$ ---------- (1)

$I_c = h_{fe} I_b + h_{oe} V_{ce}$ ---------- (2)

From equation (1) $h_{ie} = V_{be}/I_b|V_{ce} = 0$, Input impedance with output short-circuit.

$h_{re} = V_{be}/V_{ce}|I_b = 0$, Reverse open circuit voltage gain.

These two parameters h_{ie} and h_{re} can be found from the input characteristics.

From the Fig:4.1, $h_{ie} = V_{be}/I_b|V_{CE} = constant$

and from Fig: 4.2, $h_{re} = V_{be}/V_{ce}|I_B = constant$

From equation (2) $h_{fe} = I_c/I_b|V_{ce} = 0$, Forward short circuit current gain.

$h_{oe} = I_c/V_{ce}|I_b = 0$, Output admittance with input open-circuited.

These two parameters h_{fe} and h_{oe} can be found from the output characteristics.

From the Fig:4.3, $h_{fe} = I_c/I_b|V_{CE} = constant$

and from Fig:4.4, $h_{oe} = I_c/V_{ce}|I_B = constant$

Input characteristics:

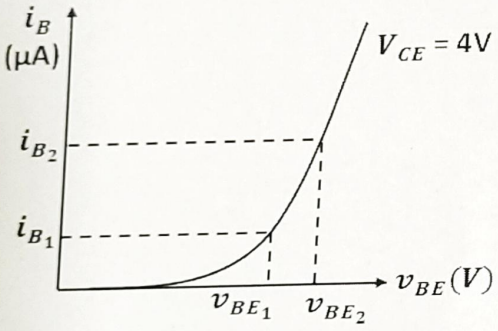

Figure.4.1

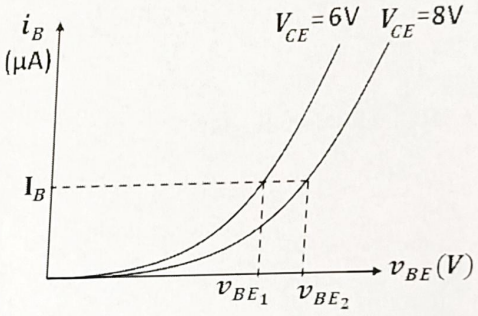

Figure.4.2

Output characteristics:

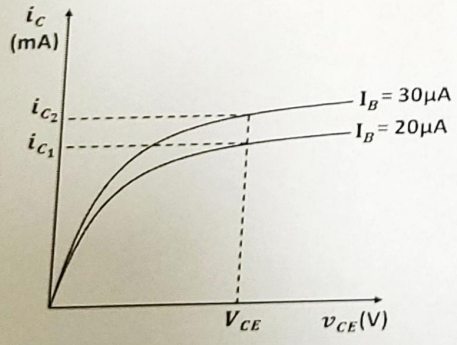

Figure.4.3

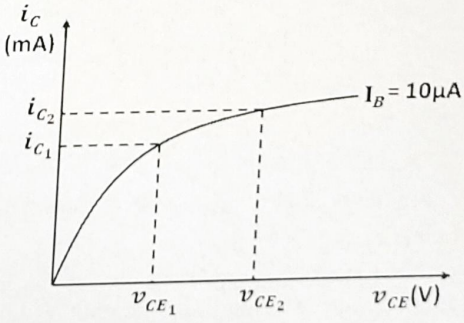

Figure.4.4

PROCEDURE:

1. Make the connection as per circuit diagram.

For the input characteristics:

2. Set $V_{CE} = 4v$ by adjusting R_4
3. Varying R_1, note the values of I_B and V_{BE}, so that $V_{CE} = 4v$ always (adjust R_4 for each set of I_B and V_{BE})
4. Repeat this for the values of $V_{CE} = 6v$ and $8v$.

For the output characteristics:

5. Set I_B = 10μ A, by adjusting R_1.
6. Varying R_4 note the values of I_C and V_{CE}.
7. Repeat this for the values of I_B = 20μ A and 30μ A.
8. Draw the graph between I_B and V_{BE} for the input characteristics, and between I_C and V_{CE} for the output characteristics.

TABULATION:

$V_{CE} = 4v$		$V_{CE} = 6v$		$V_{CE} = 8v$		I_B = 10μ A		I_B = 20μ A		I_B = 30μ A	
IB	VBE	IB	VBE	IB	VBE	IC	VCE	IC	VCE	IC	VCE

CALCULATION:

1. To find h_{ie}, in the input characteristics mark V_{BE} = 0.5 V and V_{BE} = 1 V. Draw two vertical lines from these points that will cut the input characteristic at two different points for $V_{CE} = 4v$. From these two points draw two horizontal lines to the I_B axis as shown in the Fig:4.1. Name these two points as I_{B1} and I_{B2}.
   Then, $h_{ie} = V_{be}/I_b|V_{CE} = 4v$ i.e.
   $h_{ie} = \Delta v_{BE}/\Delta i_B|V_{CE=constant} = \frac{v_{BE2}-v_{BE1}}{i_{B2}-i_{B1}}|V_{CE=constant}$

2. To find h_{re}, in the input characteristics draw a horizontal line from I_B axis. It will cut the characteristics for $V_{CE} = 6v$ and $8v$ at two points. From these two points draw two vertical lines to the V_{BE} axis, mark as V_{BE1} and V_{BE2}.
   Then, $h_{re} = V_{be}/V_{ce}|I_{B=constant}$ i.e.
   $h_{re} = \Delta v_{BE}/\Delta v_{CE}|I_{B=constant} = \frac{v_{BE2}-v_{BE1}}{v_{CE2}-v_{CE1}}|I_{B=constant}$

3. To find h_{oe}, in the output characteristics mark V_{CE} = 3.0 V and V_{CE}=6.0 V. Draw two vertical lines from these points that will cut the output characteristic at two different points for $I_B = 10\mu$ A. From these two points draw two horizontal lines to the I_C axis as shown in the Fig:4.4. Name these two points as I_{C1} and I_{C2}.

Then, $h_{oe} = I_c/V_{ce}|I_B = 10\mu$ A **i.e.**

$h_{oe} = \Delta i_C/\Delta v_{CE}|I_{B=constant} = \frac{i_{C2}-i_{C1}}{v_{CE2}-v_{CE1}}|I_{B=constant}$

4. To find h_{fe}, in the output characteristics draw a vertical line from V_{CE} axis. It will cut the characteristics for $I_B = 20\mu$ A and $I_B = 30\mu$A at two points. From these two points draw two horizontal lines to the I_C axis, mark as I_{C1} and I_{C2}.
   Then, $h_{fe} = I_c/I_b|V_{CE=constant}$ **i.e.**

   $h_{fe} = \Delta i_C/\Delta i_B|V_{CE=constant} = \frac{i_{C2}-i_{C1}}{i_{B2}-i_{B1}}|V_{CE=constant}$

CONCLUSION:

(***To be written by students after the experiment***)