

INPUT AND OUTPUT CHARACTERISTICS OF BJT

Aim of the experiment:

To study the input and output characteristics of BJT.

Objective of the experiment:

Design the circuit diagram. Take the reading and draw the characteristics curve. Determine the input and output resistance.

Equipments required:

Voltmeter, Ammeter, breadboard, 0-30V DC-P.S

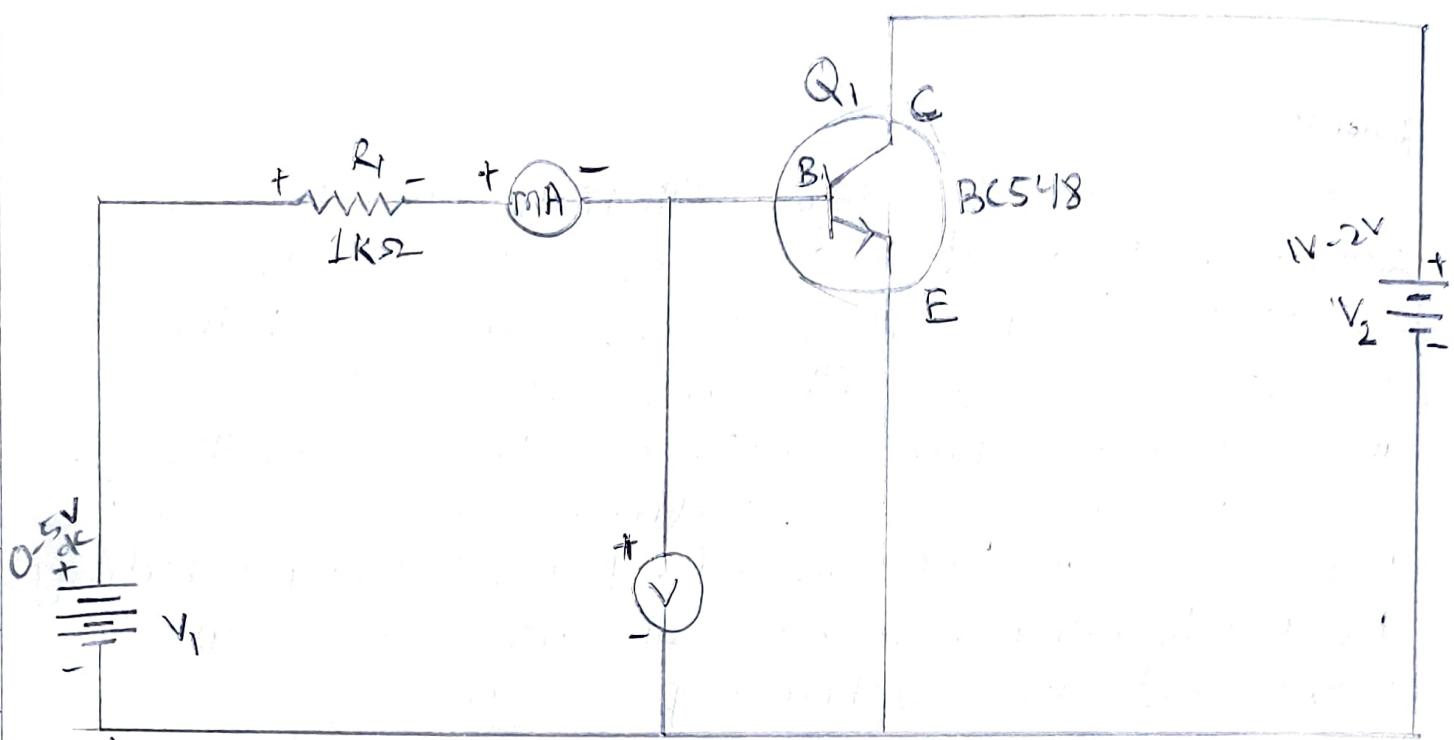
Component required:

Resistors = $1\text{k}\Omega$, $470\text{ }\mu\text{A}$, $1\text{m}\Omega$

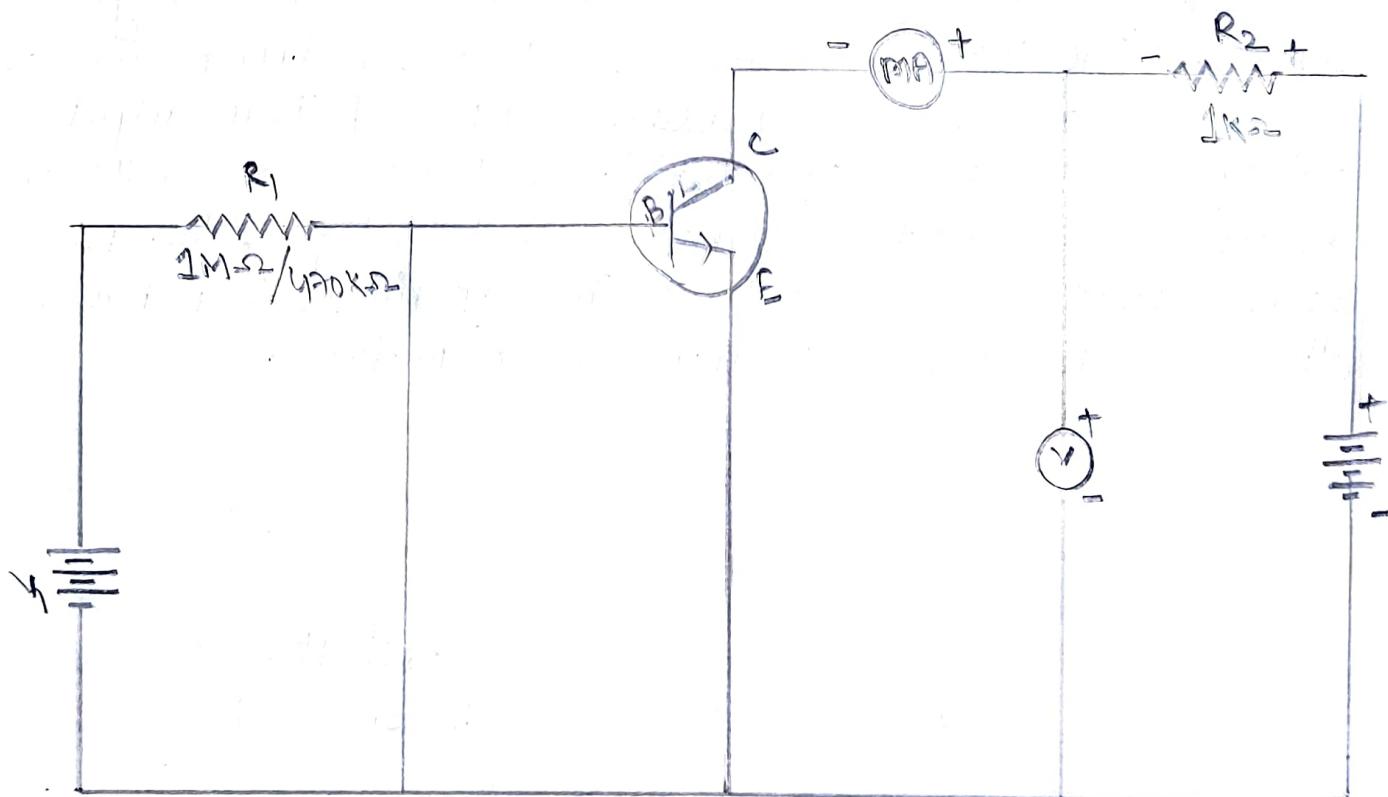
Transistor (NO-BC548) NPN

Theory:

The three terminals of a bipolar junction transistor (BJT) are emitters (E), collector (C) and base (B). The common emitter (CE) configuration is most frequently encountered configuration. In this the Emitter is common or resistance to both the input and output terminals (in this case common to both the base and collector terminals). Two sets of characteristics are necessary to describe fully the behaviour of the CE configuration input and output characteristics.



(Input Characteristics circuit diagram of BJT)



(output characteristics circuit diagram of BJT)

Input characteristics:

The plot of base current I_B versus the voltage V_{BE} across its base and emitter for different constant values of voltage V_{CE} is called input characteristics.

Output characteristics:

The plot of collector current I_C versus the voltage V_{CE} across its collector and emitter for different values of base current I_B is called the output characteristics.

Procedure:

A) Input characteristics:

- The circuit was setup as shown in the circuit diagram.
- The output voltage V_{CE} was set at 1V.
- The input voltage V_{BE} was increased in steps of 0.5V and the corresponding base current I_B was noted.
- The same procedure was repeated for $V_{CE} = 2V$.
- The input characteristics curve was plotted with V_{BE} on x-axis and I_B on y-axis.

B) Output characteristics:

- The circuit was setup as shown in the circuit diagram.
- For $R_1 = 1\text{M}\Omega$, I_B is set.
- V_2 in steps of 1V was varied and the corresponding I_C and V_{CE} were noted.
- For $R_1 = 470\text{K}\Omega$ & $I_B = 10\text{nA}$ was repeated.
- The output characteristic curve with V_{CE} on x-axis and I_C on y-axis was plotted.

Observation:Table 1: Input characteristics reading

$V_{CE} = 1V$			$V_{CE} = 2V$		
V_I (in volt)	I_B (in mA)	V_{BE} (in volt)	V_I (in volt)	I_B (in mA)	V_{BE} (in volt)
0	0	0	0	0	0
0.5	0	0.49	0.5	0	0.49
1.0	0.261	0.74	1.0	0.299	0.74
1.5	0.785	0.78	1.5	0.730	0.75
2.0	1.202	0.79	2.0	1.299	0.75
2.5	1.702	0.802	2.5	1.729	0.76
3.0	2.197	0.811	3.0	2.236	0.769
3.5	2.697	0.82	3.5	2.786	0.77
4.0	3.19	0.828	4.0	3.219	0.77
4.5	3.728	0.835	4.5	3.246	0.78

Table 2: Output characteristics reading:

$R_L = 1M\Omega, I_B = 4.31mA$			$R_L = 470K\Omega, I_B = 10\mu A$		
V_2 (in volt)	I_C (in mA)	V_{CE} (in volt)	V_2 (in volt)	I_C (in mA)	V_{CE} (in volt)
1	0	0	1	0.979	0.023
2	0.891	0.419	2	1.913	0.044
3	1.601	1.484	3	2.848	0.060
4	1.619	2.39	4	3.477	0.51
5	1.631	3.43	5	3.519	0.52
6	1.657	4.4	6	3.558	0.63
7	1.667	5.4	7	3.598	0.82
8	1.677	6.41	8	3.629	1.0
9	1.687	7.36	9	3.668	1.24
10	1.701	8.3	10	3.698	1.49

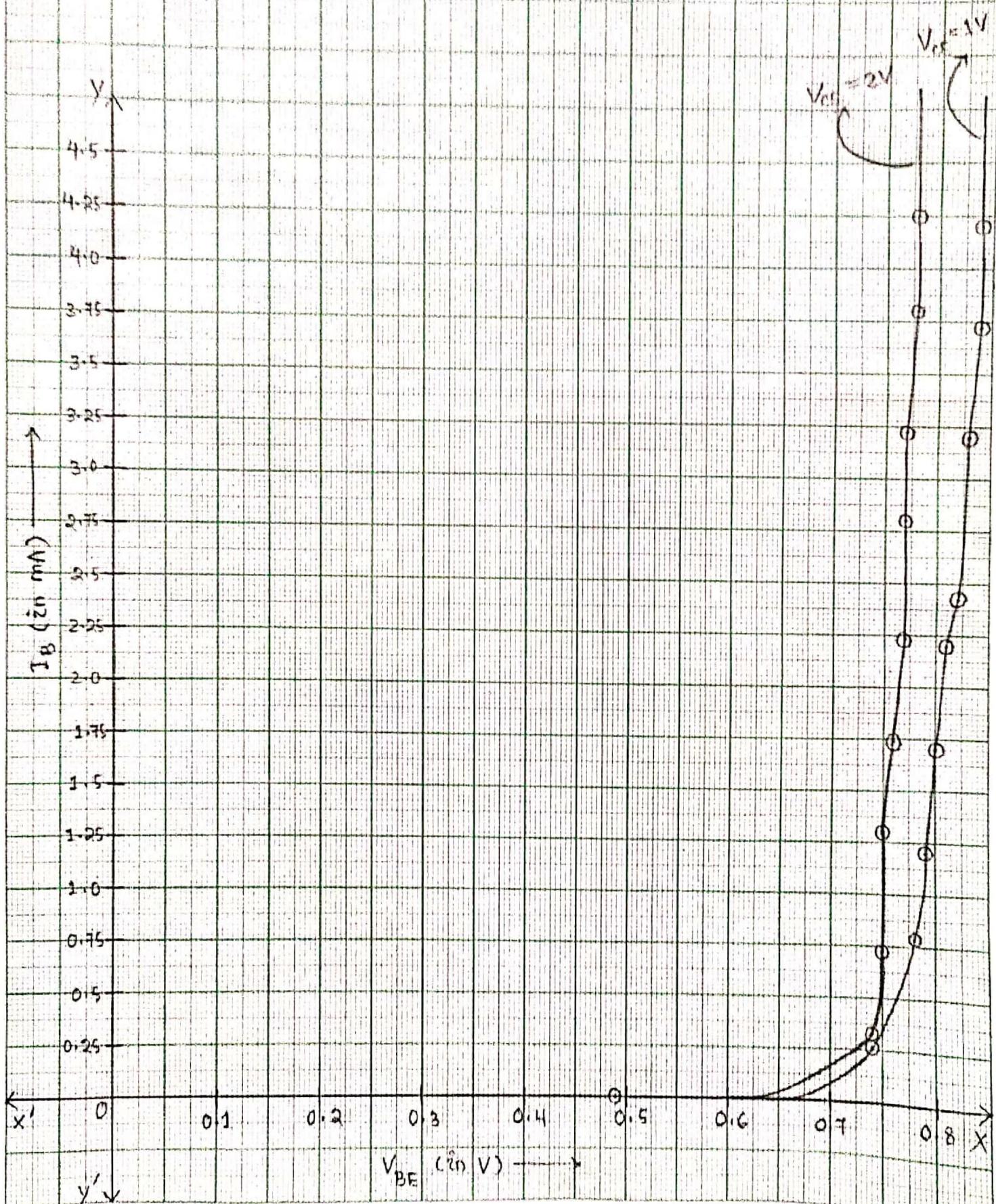
Teacher's Signature _____

Scale:

$$X - \Delta V_E = 20 \text{ units} = 0.1V$$

$$Y - \Delta I_E = 10 \text{ units} = 0.25mA$$

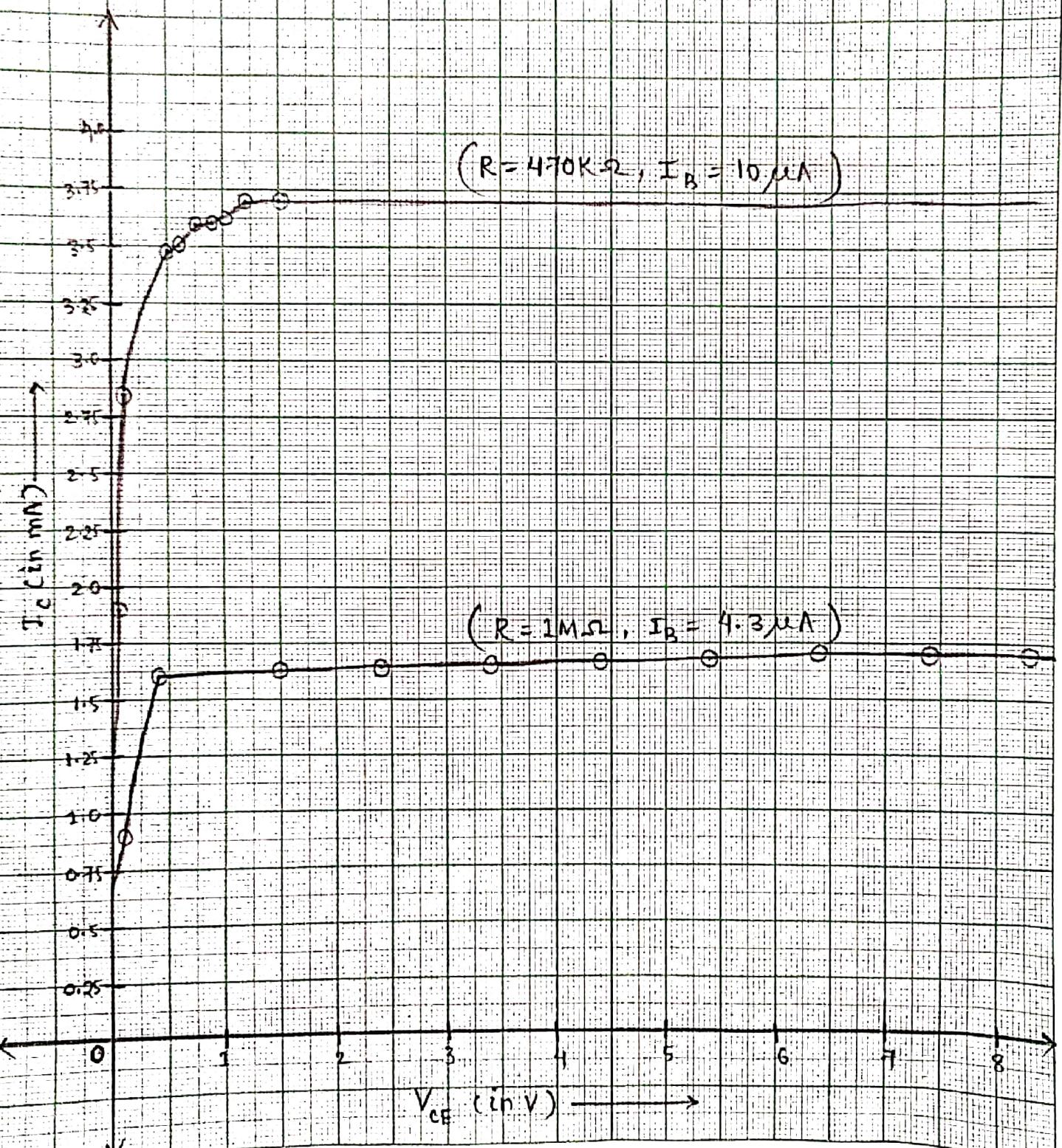
Input Characteristics



Scale

X-axis = 1 unit = 1V
Y-axis = 1 unit = 0.25mA

Output Characteristics



Calculation:Input resistance (R_i)for $V_{CE} = 1V$,

$$R_i^o = \frac{\Delta V_{BE}}{\Delta I_B} = \frac{(0.78 - 0.74)}{(0.785 - 0.261) \times 10^{-3}} = 76.33 \Omega$$

for $V_{CE} = 2V$,

$$R_i^o = \frac{\Delta V_{BE}}{\Delta I_B} = \frac{(0.76 - 0.74)}{(1.729 - 1.299) \times 10^{-3}} = 46.51 \Omega$$

Output resistance (R_o)for $I_B = 4.3 \text{ mA}$

$$R_o = \frac{4V_{CE}}{\Delta I_C} = \frac{(1.48 - 0.41)}{(1.619 - 1.59) \times 10^{-3}} = 36.89 \text{ k}\Omega$$

for $I_B = 10 \text{ mA}$

$$R_o = \frac{\Delta V_{CE}}{\Delta I_C} = \frac{0.060 - 0.044}{(2.84 - 1.91) \times 10^{-3}} = 17.23 \text{ k}\Omega$$

Result and Discussion:

From the above experiment we observed that when $V_{CE} = 1V$, input resistance was found 76.33Ω and $V_{CE} = 2V$, input resistance was 46.51Ω . When I_B (base current) is 4.3 mA then output resistance $36.89 \text{ k}\Omega$ and when $I_B = 10 \text{ mA}$, output resistance was found to be $17.23 \text{ k}\Omega$. The I_B value is constant until the breakdown.

region of the transistor is reached.

Conclusion :

Thus the experiment was completed and we got to know about the input and output characteristics of BJT. We also learned about different configuration and characterise by plotting graph before I_B and V_{BE} and I_C and V_{CE} .

Purushottam Behera
119 BM 0004