North South University

Department of Electrical & Computer Engineering

LAB REPORT - 05

Course Code: EEE111L

Course Title: ANALOG ELECTRONICS-I LAB

Section: 6

Lab Number: 05

Experiment Name:

The Input-Output characteristics of CE (common emitter) configuration of BJT.

Experiment Date: 15-04-2023 & 04-03-2023

Date of Submission: 13-05-2023

Submitted by Group Number:04

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Course Instructor: MHUD

Submitted To: Md. Anisur Rahman Asif

Experiment Name: The Input-Output characteristics of CE (common emitter) configuration of BJT.

Objective:

This experiment aims to Study the input-output characteristics of the CE (common-emitter) configuration of BJT.

Equipments and Components:

Serial no.	Component Details	Specification	Quantity
1	NPN - Transistor	2N2222A	One piece
2	Resistor	100kΩ, 1kΩ	One-piece each
3	DC power supply		1 unit
4	Digital Multimeter		1 unit

Theory:

The transistor is the formation of two junction diodes.

When it is composed of 2 n-type semiconductors, separated by a thin section of p-type, it is called an **N-P-N transistor**.

When it is composed of 2 p-type semiconductors, separated by a thin section of n-type, it is called a **P-N-P transistor**.

It has a total of 3 terminals, which are-

- **Emitter**
- **Base**
- **Collector**

A transistor has three different configurations, such as –

- **Common Base Connection** → The base will be between the Emitter and Collector.
- **Common Emitter Connection** → It means that the Emitter will be between the Base and collector
- **Common Collector Connection** → It is between the Base and Emitter.

A transistor has three different modes of operation. Such as-

- **Active Mode**
- **Saturation Mode**
- **Cut off mode**

Two characteristic curves measure the characteristics of a transistor.

a) Input characteristics curve.

b) Output characteristics curve.

Input Characteristics: Input current(I) vs input Voltage(V) for a fixed output Voltage.

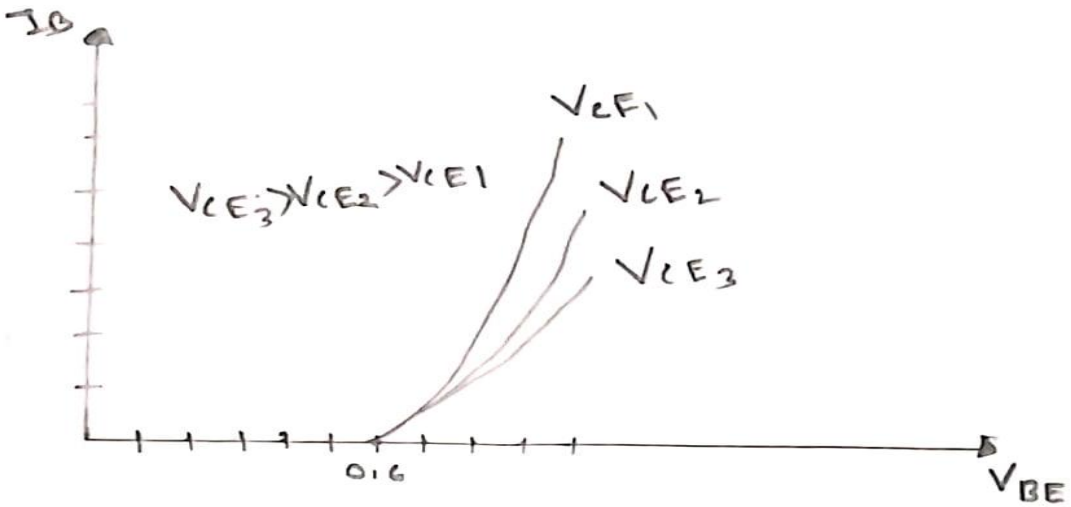


FIG: Input characteristics

Output Characteristics: Output current(I) vs Output voltage(v) for a fixed input current.

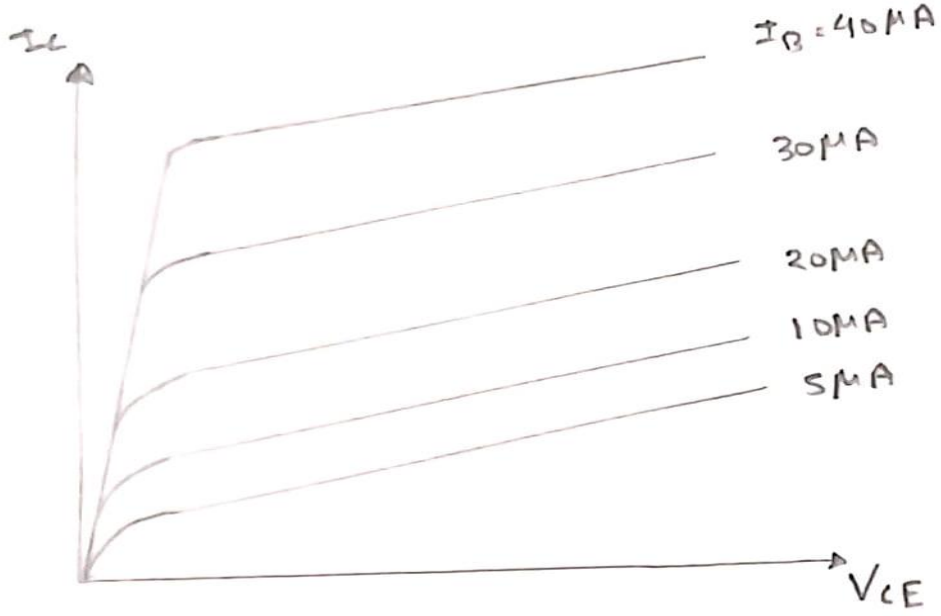
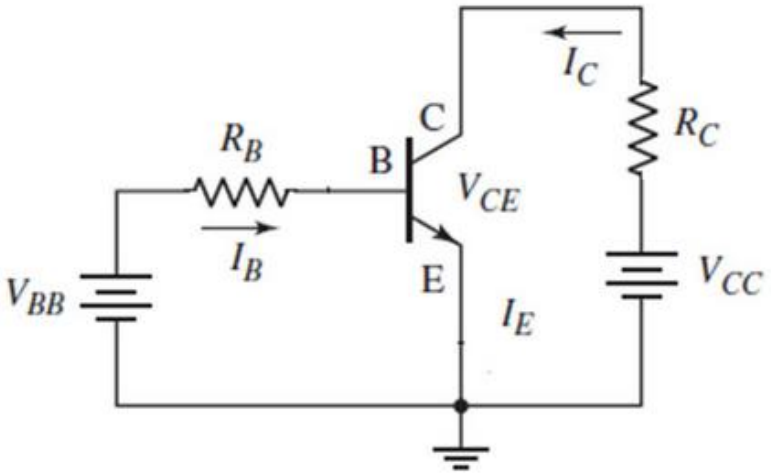


Fig: output characteristics

Circuit Diagram(s):

$\boldsymbol{R_B}$100k
$\boldsymbol{R_C} = 1\text{K}$



Experimental procedure:

We have divided the experiment into two parts, where we have seen the input and output characteristics.

For the input characteristics:

We have built a total of 1 circuit. The steps we followed are given below.

Step 01: At first, we opened the Multisim software. Then we went to the "Place source" and selected the required component such as two Resistors (100kΩ,1kΩ), one n-p-n transistor(2N2222A), ground, and finally two DC sources. Then we build the circuit successfully.

Step 02: Then, we set the value of V_{bb} and Vc to zero to know which value of Vc, we get the value of Vce one. After that, we put that value to the Vc, and we have to vary the deal of V_{bb}.

Step 03: Next, we went to the "Analyses and simulation" then "Parameter sweep," after that, we set the required input and output values. Finally, we observed and recorded the data in the data table.

For the output Characteristics:

Here, we just modified the value of the circuit that we have built previously. We did not make any extra circuits for that. The steps we followed are given below.

Step 01: We just changed the value of V_{bb} to 2.55v as required without changing the value of Vc. Then we went to the "Analyses and simulation" then "Parameter sweep," where we set the required input and output values and recorded the data in the data table.

Step 02: Lastly, we just changed the value of V_{bb} to 3.55v as required without changing the value of Vc. After that, we followed the same footstep as the previous one.

Experimental Data Table:

Input Characteristics

V_{BB}	VCE = 1V			VCE = 5V		
	VBE	VRB	IB = (VRB/RB)	VBE	VRB	IB = (VRB/RB)
0.1	0.1	6.44E-09	6.44E-14	0.100001	-8.23E-07	-8.23E-12
0.3	0.299938	6.24E-05	6.24E-10	0.299938	6.16E-05	6.16E-10
0.5	0.487196	0.012804	1.28E-07	0.487196	0.012804	1.28E-07
0.7	0.567184	0.132816	1.33E-06	0.567187	0.132813	1.33E-06
1	0.603855	0.396145	3.96E-06	0.603866	0.396134	3.96E-06
2	0.630974	1.36903	1.37E-05	0.644634	1.35537	1.36E-05
3	0.632595	2.36741	2.37E-05	0.662551	2.33745	2.34E-05
4	0.63358	3.36642	3.37E-05	0.674108	3.32589	3.33E-05
5	0.63437	4.36563	4.37E-05	0.681294	4.31871	4.32E-05
6	0.635061	5.36494	5.36E-05	0.681941	5.31806	5.32E-05
7	0.635693	6.36431	6.36E-05	0.682248	6.31775	6.32E-05
8	0.636282	7.36372	7.36E-05	0.682484	7.31752	7.32E-05
9	0.63684	8.36316	8.36E-05	0.68269	8.31731	8.32E-05
10	0.637374	9.36263	9.36E-05	0.682879	9.31712	9.32E-05
11	0.637888	10.36211	1.04E-04	0.683056	10.31694	1.03E-04
12	0.638386	11.36161	1.14E-04	0.683225	11.31678	1.13E-04
13	0.638869	12.36113	1.24E-04	0.683388	12.31661	1.23E-04
14	0.639339	13.36066	1.34E-04	0.683546	13.31645	1.33E-04
15	0.639798	14.3602	1.44E-04	0.683701	14.3163	1.43E-04

Output Characteristics

VCC	IB = 20 (VRB = 2.55v)				IB = 30 (VRB=3.55v)			
	VCE	VRC	IC = (VRC/RC)	Beta(B)	VCE	VRC	IC = (VRC/RC)	Beta(**B**)
1	0.119785	0.880215	8.80E-04	44.01076	0.100383	9.00E-01	9.00E-04	29.98724
2	0.19129	1.80871	1.81E-03	90.4355	0.138153	1.86E+00	1.86E-03	62.06167
3	0.835173	2.16483	2.16E-03	108.2415	0.187037	2.81296	2.81E-03	93.76533
4	1.65889	2.34111	2.34E-03	117.0555	0.631372	3.36863	3.37E-03	112.2877
5	2.48261	2.51739	2.52E-03	125.8695	1.37743	3.62257	3.62E-03	120.7523
6	3.30633	2.69367	2.69E-03	134.6835	2.12349	3.87651	3.88E-03	129.217
7	4.13005	2.86995	2.87E-03	143.4975	2.86955	4.13045	4.13E-03	137.6817
8	4.95377	3.04623	3.05E-03	152.3115	3.61562	4.38438	4.38E-03	146.146
9	5.7775	3.2225	3.22E-03	161.125	4.36169	4.63831	4.64E-03	154.6103
10	6.60123	3.39877	3.40E-03	169.9385	5.10776	4.89224	4.89E-03	163.0747
11	7.42496	3.57504	3.58E-03	178.752	5.85383	5.14617	5.15E-03	171.539
12	8.2487	3.7513	3.75E-03	187.565	6.59991	5.40009	5.40E-03	180.003
13	9.07244	3.92756	3.93E-03	196.378	7.34599	5.65401	5.65E-03	188.467
14	9.89618	4.10382	4.10E-03	205.191	8.09208	5.90792	5.91E-03	196.9307
15	10.71992	4.28008	4.28E-03	214.004	8.83816	6.16184	6.16E-03	205.3947
16	11.54366	4.45634	4.46E-03	222.817	9.58425	6.41575	6.42E-03	213.8583
17	12.36741	4.63259	4.63E-03	231.6295	10.33035	6.66965	6.67E-03	222.3217
18	13.19116	4.80884	4.81E-03	240.442	11.07644	6.92356	6.92E-03	230.7853
19	14.01491	4.98509	4.99E-03	249.2545	11.82254	7.17746	7.18E-03	239.2487
20	14.83867	5.16133	5.16E-03	258.0665	12.56865	7.43135	7.43E-03	247.7117
21	15.66243	5.33757	5.34E-03	266.8785	13.31475	7.68525	7.69E-03	256.175
22	16.48619	5.51381	5.51E-03	275.6905	14.06086	7.93914	7.94E-03	264.638
23	17.30995	5.69005	5.69E-03	284.5025	14.80697	8.19303	8.19E-03	273.101
24	18.13372	5.86628	5.87E-03	293.314	15.55309	8.44691	8.45E-03	281.5637

IC

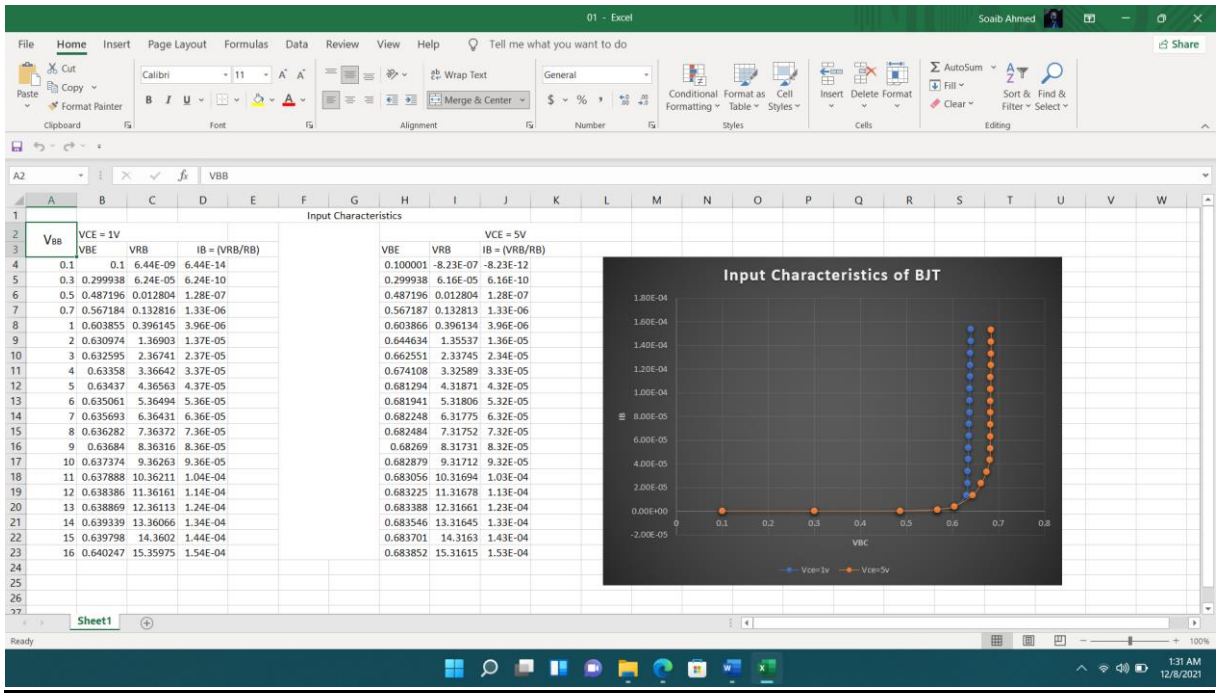
Result and Analysis:

In this experiment, we learned about the input and output characteristics of a transistor. The base current Ib increases with the emitter-base voltage VBE, which is similar to the forward diode characteristics.
The value of the collector current Ic increased with the increase in VCE. The value of Beta(B) also increases when VCE falls. The Ic also decreases rapidly. The collector-base junction of the transistor in saturation works as forward but in the active region work as reverse biased. While doing this experiment, I did not face any difficulty. Thus, the experiment was successful.

Questions and Answers:

1. Answer:

Plot I_B **vs.** V_{BE} for different values of V_{CE}.



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15	0.639798	14.3602	1.44E-04	0.683701	14.3163	1.43E-04
16	0.640247	15.35975	1.54E-04	0.683852	15.31615	1.53E-04

2. Answer

Plot I_C vs. V_{CE} for different values of I_B. Find Beta(B) for each I_B. For V_{CC} = 12V, draw the load line and find the Q-point.

02 - Excel — Soaib Ahmed

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	A	B	C	D	E	F	G	H	I	J	K	L
1				Output Characteristics								
2	VCC	IB = 20 (VRB = 2.55v)						IB = 30 (VRB=3.55v)				
3		VCE	VRC	IC = (VRC/RC)		Beta(B)		VCE	VRC	IC = (VRC/RC)		Beta(B)
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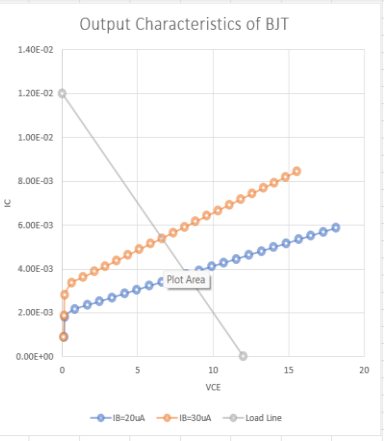

Vcc = 12v
Vce = Vcc - IcRc
if Vce = 0, then Ic = Vcc/Rc
If Ic = 0 mA, then Vce = Vcc = 12 v

Vce	Ic
0	0.012
12	0

Sheet1

Ready — 100%

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