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Batch – 2024
Application No - 158377
Subgroup – 1H3

Experiment: BJT CE Mode

Aim: To obtain Input and Output Characteristics of Bipolar Junction Transistor in Common Emitter Mode

Apparatus: Online (using Virtual Lab (http://vlabs.iitkgp.ernet.in/be/)

Theory:

A bipolar junction transistor, BJT, is a single piece of silicon with two back-to-back P-N junctions. BJTs can be made either as PNP or as NPN.

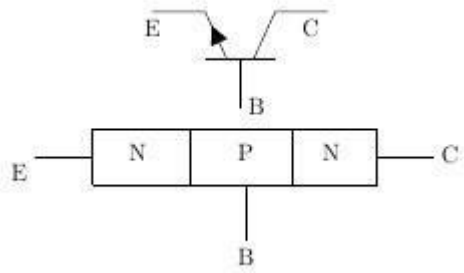


Figure 1: Structures, layers and circuit symbol of NPN transistor

They have three regions and three terminals, emitter, base, and collector represented by E, B, and C respectively. The direction of the arrow indicates the direction of the current in the emitter when the transistor is conducting normally. An easy way to remember this is NPN stands for "Not Pointing iN".

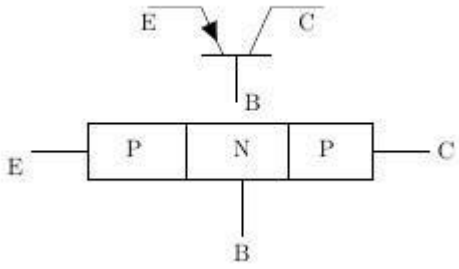


Figure 2: Structures, layers and circuit symbol of PNP transistor

Emitter (E): It is the region to the left end which supply free charge carriers i.e., electrons in n-p-n or holes in p-n-p transistors. These majority carriers are injected to the middle region i.e. electrons in the p region of n-p-n or holes in the n region of p-n-p transistor. Emitter is a heavily doped region to supply a large number of majority carriers into the base.

Base (B): It is the middle region where either two p-type layers or two n-type layers are sandwiched. The majority carriers from the emitter region are injected into this region. This region is thin and very lightly doped.

Collector (C): It is the region to right end where charge carriers are collected. The area of this region is largest compared to emitter and base region . The doping level of this region is intermediate between heavily doped emitter region and lightly doped base region.

Cutoff Region: Base-emitter junction is reverse biased. No current flow.

Saturation Region: Base-emitter junction is forward biased and Collector-base junction is forward biased.

Active Region: Base-emitter is junction forward biased and Collector-base junction is reverse biased.

Procedure:

1. **BJT Common Emitter - Input Characteristics**
   (http://vlabs.iitkgp.ernet.in/be/exp11/bjtcein_ver1.html)
   1. Initially set rheostat R_{h1} = 1 Ω and rheostat R_{h2} = 1 Ω
   2. Set the Collector-Emitter Voltage(V_{CE}) to 1 V by adjusting the rheostat R_{h2} 3. Base Emitter Voltage(V_{BE}) is varied by adjusting the rheostat R_{h1}.
   4. Note the reading of Base current(I_B)in micro Ampere.
   5. Click on 'Plot' to plot the I-V characteristics of Common-Emitter configuration. A graph is drawn with V_{BE} along X-axis and I_B along Y-axis.
   6. Click on 'Clear' button to take another sets of readings
   7. Now set the Collector-Emitter Voltage(V_{CE}) to 2 V, 3 V, 4 V

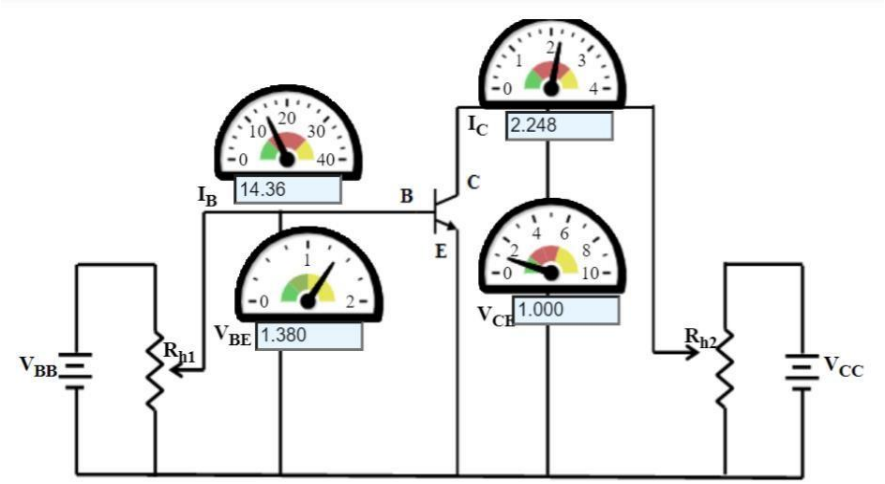
2. **BJT Common Emitter - Output Characteristics**
   (http://vlabs.iitkgp.ernet.in/be/exp11/bjtceop_ver1.html)
   1. Initially set rheostat R_{h1} = 1 Ω and rheostat R_{h2} = 1 Ω

2. Set the Base current(I_B)15 uA by adjusting the rheostat R_{h1}
3. Vary the Collector-Emitter Voltage(V_{CE})is varied by adjusting the rheostat R_{h2}.
4. Note the reading of Collector current(I_C).
5. Click on 'Plot' to plot the I-V characteristics of Common-Emitter configuration. A graph is drawn with V_{CE} along X-axis and I_C along Y-axis.
6. Click on 'Clear' button to take another sets of readings
7. Now set the Base Current(I_B) to 20 uA

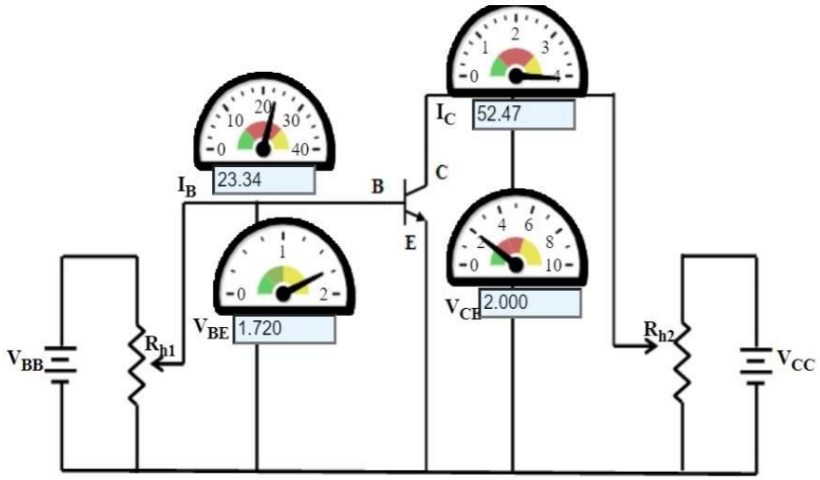
Circuit Diagram:

1. *BJT CE Input Characteristics*

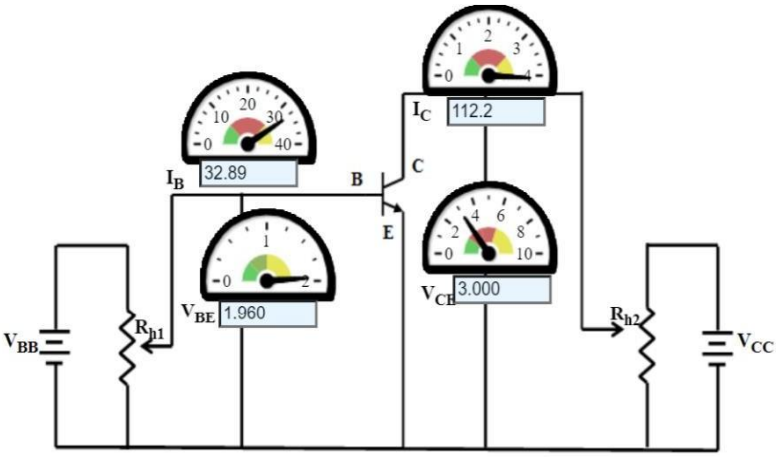
Circuit Diagram for 1V :



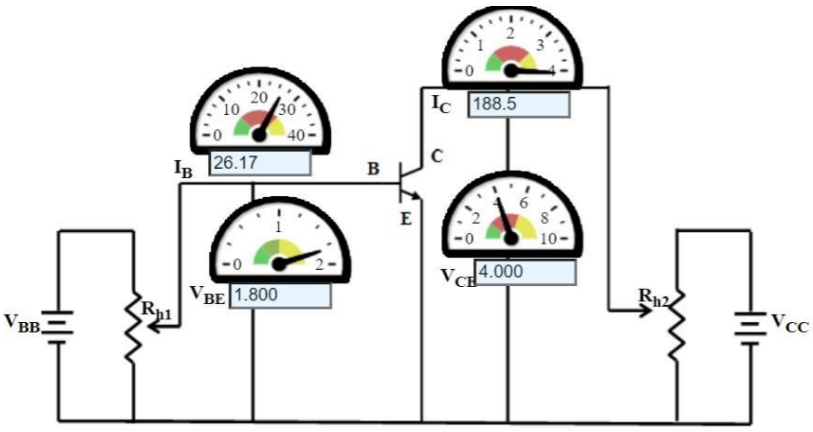
Circuit Diagram for 2V :



Circuit Diagram for 3V :

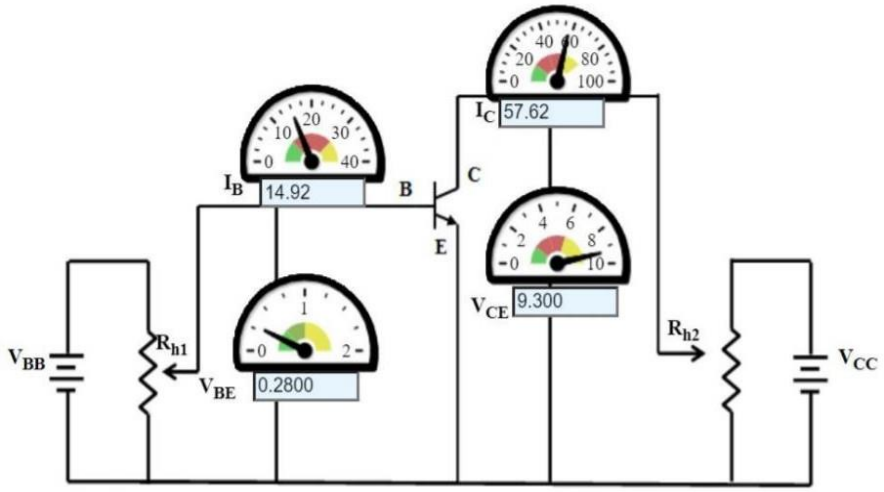


Circuit Diagram for 4V :

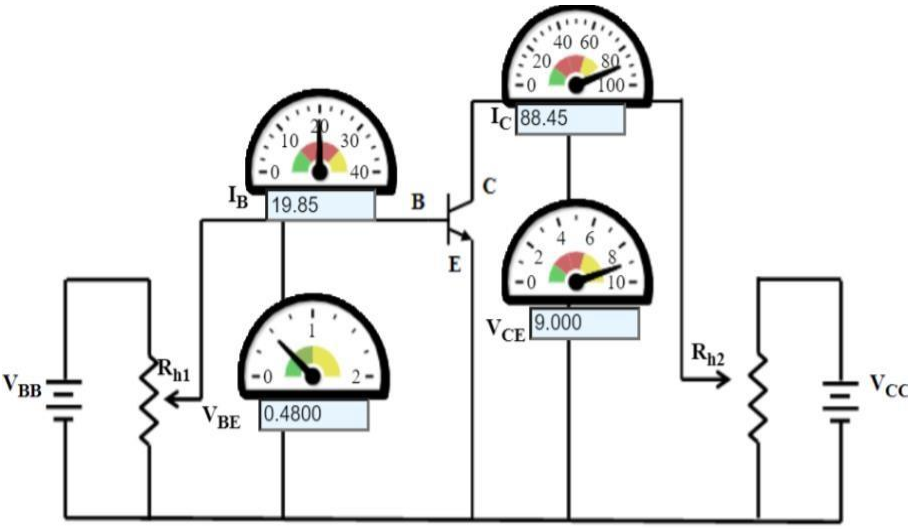


2. BJT CE Output Characteristics:

Circuit Diagram for 15uA :



Circuit Diagram for 20uA :



Observation Table:

BJT CE Input Characteristics :

Observation Table for 1V :

Serial No.	Collector-Emitter Voltage 1.000 V	
	Base-Emitter Voltage V	Base Current(μA)
1	0.1200	2.374
2	0.2800	2.984
3	0.4400	3.750
4	0.5600	4.451
5	0.6800	5.283
6	0.8200	6.453
7	0.9400	7.660
8	1.060	9.092
9	1.260	12.10
10	1.380	14.36

Observation Table for 2V :

Serial No.	Collector-Emitter Voltage 2.000 V	
	Base-Emitter Voltage V	Base Current(μA)
1	0.2000	2.661
2	0.3000	3.070
3	0.5200	4.204
4	0.6400	4.990
5	0.8400	6.640
6	1.000	8.345
7	1.140	10.19
8	1.300	12.81
9	1.460	16.10
10	1.720	23.34

Observation Table for 3V :

Serial No.	Collector-Emitter Voltage 3.000 V	
	Base-Emitter Voltage V	Base Current(μA)
1	0.1400	2.443
2	0.3000	3.070
3	0.5200	4.204
4	0.8400	6.640
5	1.260	12.10
6	1.500	17.05
7	1.760	24.72
8	1.820	26.93
9	1.940	31.96
10	1.960	32.89

Observation Table for 4V :

Serial No.	Collector-Emitter Voltage 4.000 V	
	Base-Emitter Voltage V	Base Current(μA)
1	0.2200	2.739
2	0.3800	3.442
3	0.5400	4.326
4	0.7200	5.594
5	0.9000	7.235
6	1.100	9.627
7	1.260	12.10
8	1.460	16.10
9	1.620	20.24
10	1.800	26.17

Observation Table for 15uA :

Serial No.	Base-Current 14.92 μA	
	Collector-Emitter Voltage V	Collector Current mA
1	1.000	43.88
2	1.700	53.90
3	2.500	56.85
4	4.000	57.58
5	4.600	57.61
6	5.800	57.62
7	6.700	57.62
8	7.400	57.62
9	8.300	57.62
10	9.300	57.62

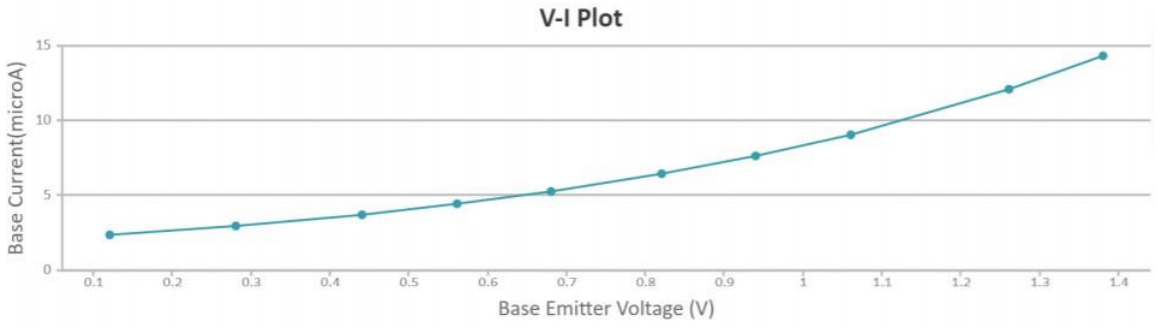
Observation Table for20uA :

Serial No.	Base-Current 19.85 µA	
	Collector-Emitter Voltage V	Collector Current mA
1	0.9000	63.36
2	1.600	81.52
3	2.300	86.69
4	3.200	88.16
5	4.100	88.40
6	5.500	88.45
7	6.400	88.45
8	7.100	88.45
9	7.800	88.45
10	9.000	88.45

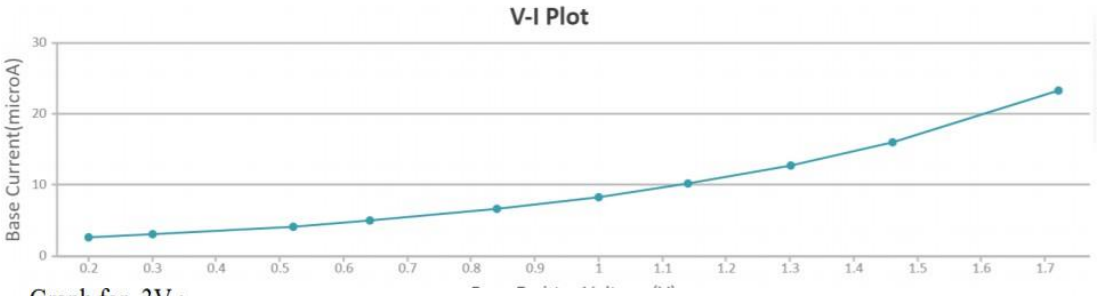
Results:

1. ***BJT CE Input Characteristics***

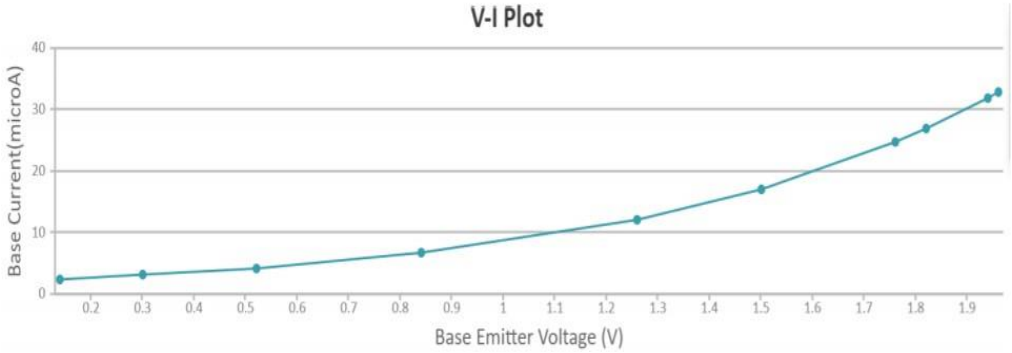
Graph for 1V :



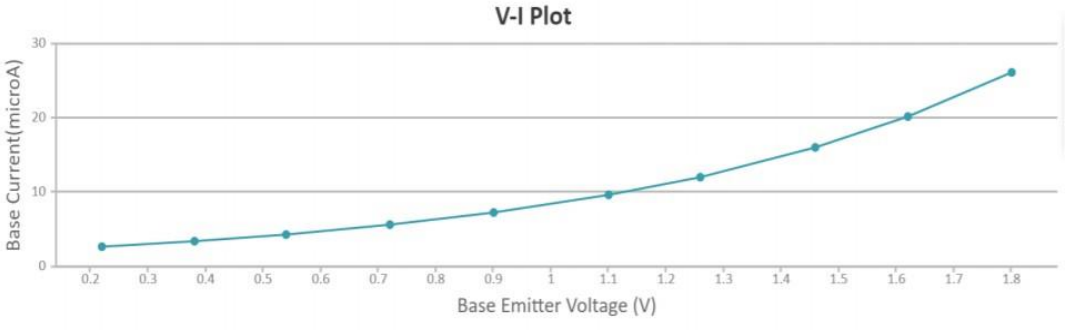
Graph for 2V :



Graph for 3V :

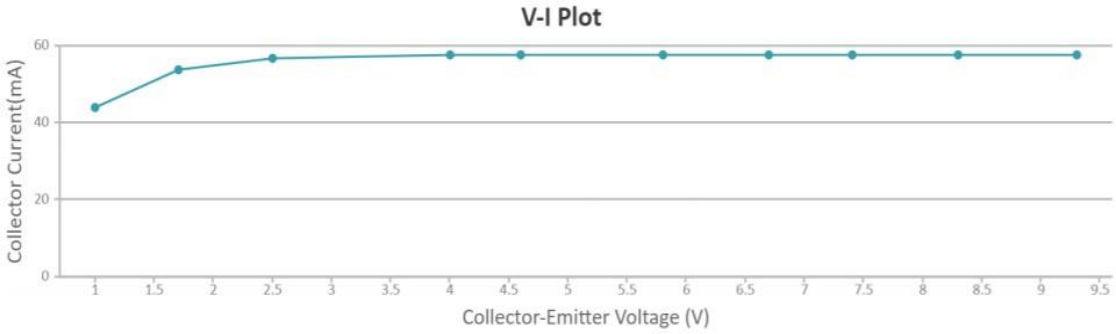


Graph for 4V :

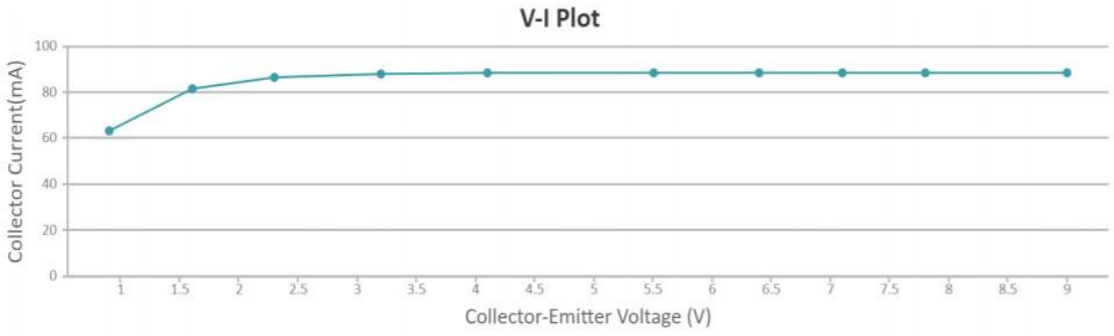


2. *BJT CE Output Characteristics :*

Graph for 15uA :



Graph for 20uA :



Conclusion: The results obtained from the graphs above show the behavior of BJT Common Emitter for both input and output.

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