Course Name:	**EEEE**	**Semester:**	**I**
Date of Performance:	**21-11-23**	**Batch No:**	**C5-3**
Faculty Name:	**SPJ**	**Roll No:**	**16010123325 (53)**
Faculty Sign & Date:		**Grade/Marks:**	

Experiment No: 8
Title: BJT Common Emitter Characteristics

Aim and Objective of the Experiment:

- To understand the structure and working of Bipolar Junction Transistor
- To plot the Common Emitter characteristics of a BJT

COs to be achieved:

CO5: Understand Bipolar Junction transistor and its applications.

Requirements:

PC with internet facility

Link for virtual lab:
https://be-iitkgp.vlabs.ac.in/exp/common-emitter-characteristics/

Theory:

Structure of Bipolar Junction Transistor

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. They have three regions and three terminals, emitter, base, and collector represented by E, B, and C respectively.

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.

Input Characteristics

It is the plot of the base current, I_B, versus the base-emitter voltage,VBE, for various values of the collector-emitter voltage,V_{CE} for constant V_{CE}

Output Characteristics

It is the plot of the collector current, I_C, versus the collector-emitter voltage, V_{CE}, for various values of the base current, I_B

Circuit Diagram/ Block Diagram:

BJT Common Emitter - Input Characteristics

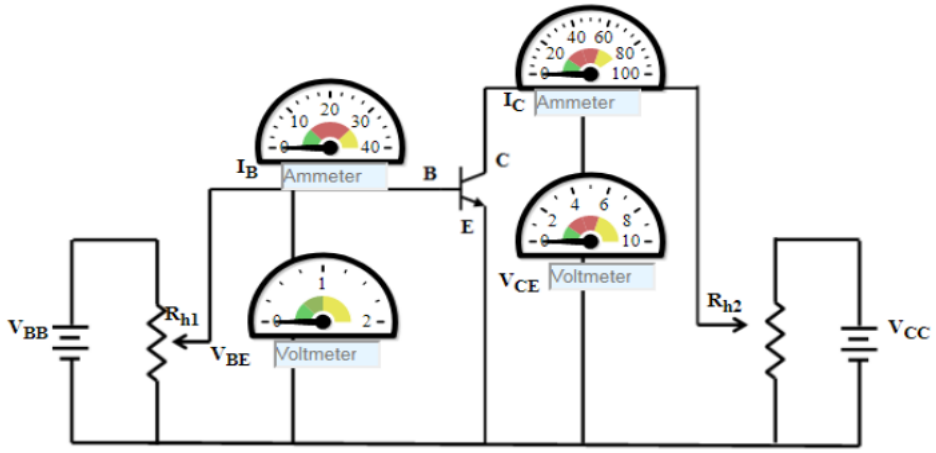


Figure:1

BJT Common Emitter - Output Characteristics

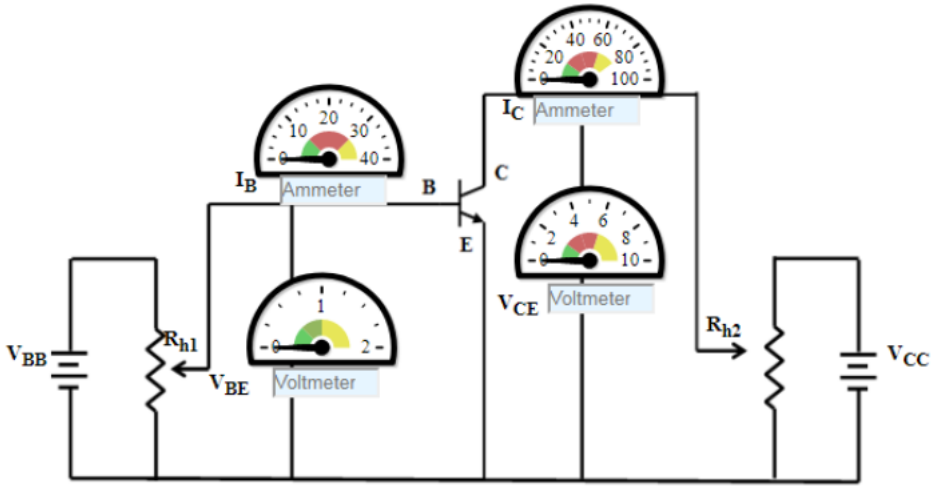


Figure: 2

Stepwise-Procedure:

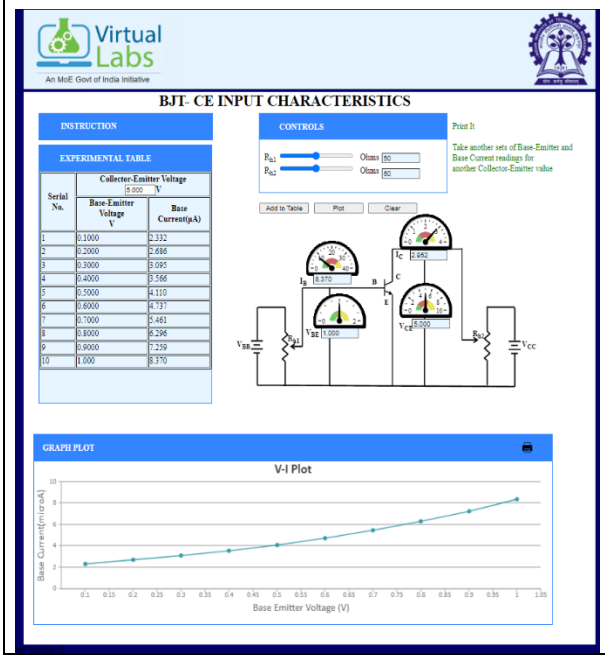
BJT Common Emitter - Input Characteristics

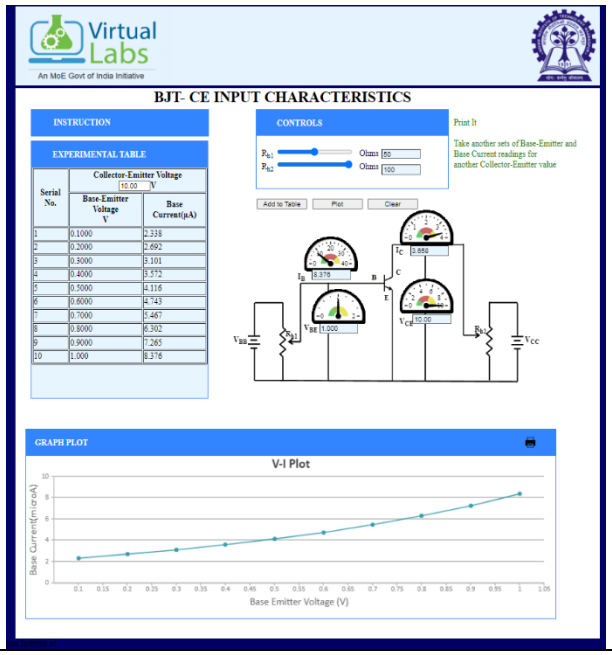
1. Initially set rheostat Rh1 = 1 Ω and rheostat Rh2 = 1 Ω
2. Set the Collector-Emitter Voltage(VCE) to 1 V by adjusting the rheostat Rh2
3. Base Emitter Voltage(VBE) is varied by adjusting the rheostat Rh1.
4. Note the reading of Base current(IB)in micro Ampere.
5. Click on 'Plot' to plot the I-V characteristics of Common-Emitter configuration. A graph is drawn with VBE along X-axis and IB along Y-axis.
6. Click on 'Clear' button to take another sets of readings
7. Now set the Collector-Emitter Voltage(VCE) to 2 V, 3 V, 4 V

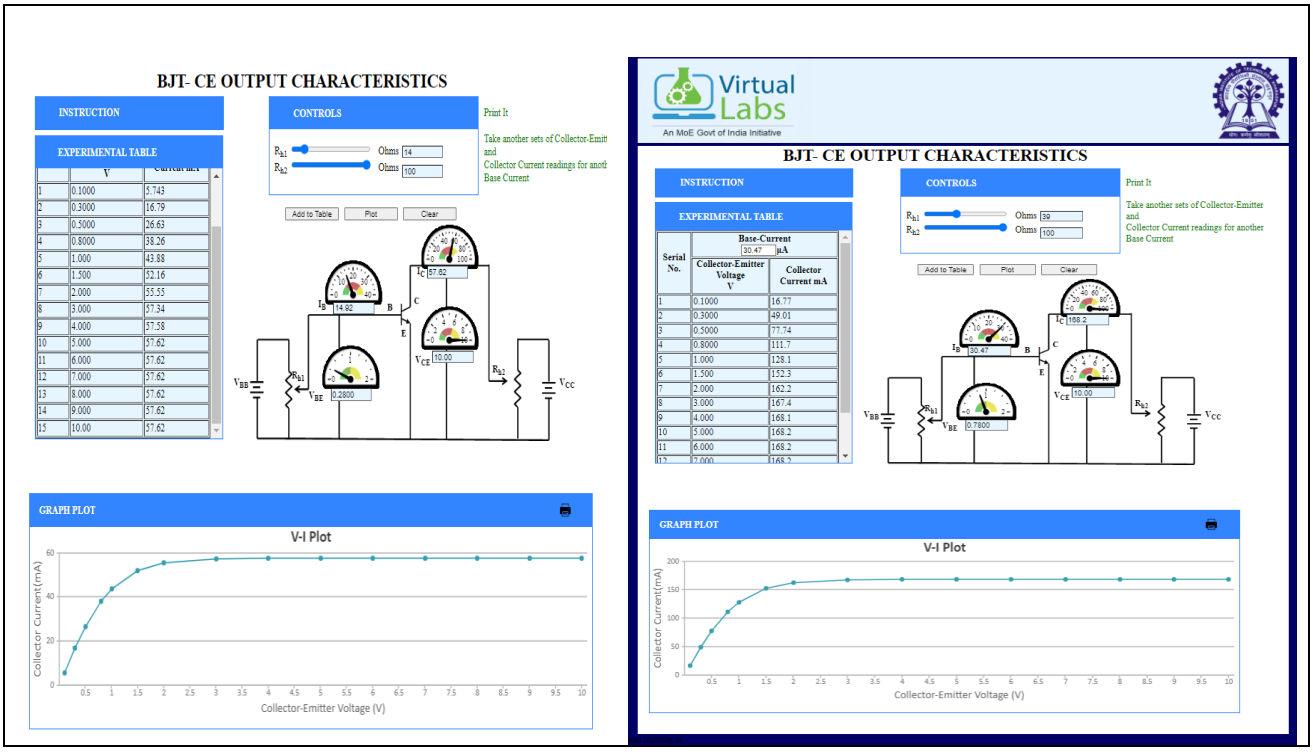
BJT Common Emitter - Output Characteristics

1. Initially set rheostat Rh1 = 1 Ω and rheostat Rh2 = 1 Ω
2. Set the Base current(IB)15 uA by adjusting the rheostat Rh1
3. Vary the Collector-Emitter Voltage(VCE)is varied by adjusting the rheostat Rh2.
4. Note the reading of Collector current(IC).
5. Click on 'Plot' to plot the I-V characteristics of Common-Emitter configuration. A graph is drawn with VCE along X-axis and IC along Y-axis.
6. Click on 'Clear' button to take another sets of readings
7. Now set the Base Current(IB) to 20 uA

V-Lab Screen shots







Observation Table:

BJT Common Emitter - Input Characteristics

Collector to Emitter voltage VCE= 5 Volts			Collector to Emitter voltage VCE = 10 Volts	
V_{BE} (V)	I_B(µA)		V_{BE} (V)	I_B(µA)
0.1	2.332		0.1	2.338
0.2	2.686		0.2	2.692
0.3	3.095		0.3	3.101
0.4	3.566		0.4	3.572
0.5	4.110		0.5	4.116
0.6	4.737		0.6	4.743
0.7	5.461		0.7	5.467
0.8	6.296		0.8	6.302
0.9	7.259		0.9	7.265

BJT Common Emitter - output Characteristics

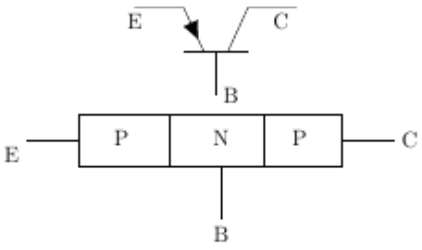
Base current I_B = 14.92(µA)		Base current I_B = 30.47 (µA)

V_{CE} (V)	I_C(mA)		V_{CE} (V)	I_C(mA)
0.1	5.743		0.1	16.77
0.3	16.79		0.3	49.01
0.5	26.63		0.5	77.74
0.8	38.26		0.8	111.7
1.0	43.88		1.0	128.1
1.5	52.16		1.5	152.3
2.0	55.55		2.0	162.2
3.0	57.34		3.0	167.4
4.0	57.58		4.0	168.1

Post Lab Subjective/Objective type Questions:

1.Explain the structute of a BJT and the current relationships of the BJT CE amplifier

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



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.

1. Emitter (E): The emitter is heavily doped, and its primary function is to emit carriers (electrons for an NPN transistor or holes for a PNP transistor) into the base region.
2. Base (B): The base is lightly doped and is very thin compared to the other layers. The base controls the flow of charge carriers from the emitter to the collector.
3. Collector (C): The collector is moderately doped and is responsible for collecting the majority charge carriers (electrons for NPN or holes for PNP) that cross the base region.

The emitter current is the sum of the base current and the collector current. In an ideal situation,

$$I_B + I_C = I_E$$

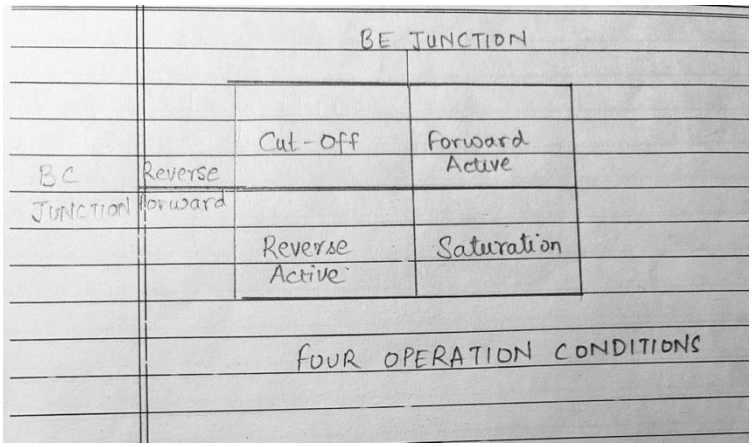
The current relationships in the BJT CE amplifier are often described by the following equations:

$$I_C = \beta \times I_B$$

$$I_E = (\beta + 1) \times I_B$$

Where:
β is the common-base current gain (a dimensionless quantity).
IC is the collector current.
IB is the base current.
IE is the emitter current.

2.Draw and explain the various regions of operation of the BJT amplifier



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.
Breakdown Region: IC and VCE exceed specifications and can cause damage to the transistor.

Conclusion:

Hence from the above experiment we were able to understand structure of Bipolar Junction Transistor, Operation of Bipolar Junction Transistor and explain Common Emitter characteristics of a BJT virtually. Not only were we able to understand the input and output characteristics of CE theoretically but also practically along with graphical representations in the virtual lab.

Signature of faculty in-charge with Date: