AMERICAN INTERNATIONAL UNIVERSITY BANGLADESH
Faculty of Engineering

Laboratory Report Cover Sheet

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Please submit all reports to your subject supervisor or the office of the concerned faculty.

Laboratory Title: Study of Transistor Characteristics in Common Emitter Amplifiers
Experiment Number: 5 Due Date: _____ Semester: Fall 2022-23
Subject Code: EEE____ Subject Name: Electronic Device LAB Section: C
Course Instructor: Dr. Mohammad Shidujaman Degree Program: BSC. EEE

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Faculty comments _____

Title: Study of Transistor Characteristics in Common Emitter Amplifier.

Introduction:

A BJT is a three terminal semiconductor device. It is widely used in discrete circuit as well as in integrated circuits. The main applications of BJTs are analog circuit. For example, BJTs are used for amplifiers in particular for high speed amplifiers.

The main objectives of this experiment are to –

1. become familiar with bipolar junction transistor (BJTs).
2. study the biasing of a common Emitter (CE) Amplifier, and
3. Obtain the input and output characteristics of a common-emitter based BJT circuits.

Theory and Methodology:

Device structure of bipolar junction transistor

Each BJT consists of two anti serial connected diodes. The BJT can be either implemented as an npn or a pnp transistor. In both cases the center region forms the base (B) of the transistor, while the external regions forms the collector (C) and the emitter (E) of the transistor. External wire connection to the p and n regions (transistor terminals) are made through metal (e.g. Aluminum) contracts. A cross section of the two types of BJTs consisting of an emitter-base junction and a collector-base junction is shown in the figure below. An npn or a pnp transistor are called bipolar because both types of carries (electrons and holes) contribute to the

overall current. In the case of a field effect transistor, either the electronics or the holes determine the current flow. Therefore a field effect transistor is a unipolar device. The current and voltage amplification of a BJT is controlled by the geometry of the device (for example width of the base region) and the doping concentrations in the individual regions of the device. In order to achieve a high current amplification, the doping concentration in the emitter region is typically higher than that of the base region. The base is a lightly doped very thin region between the emitter and the collector and it controls the flow of charge carriers from the emitter to collector region.

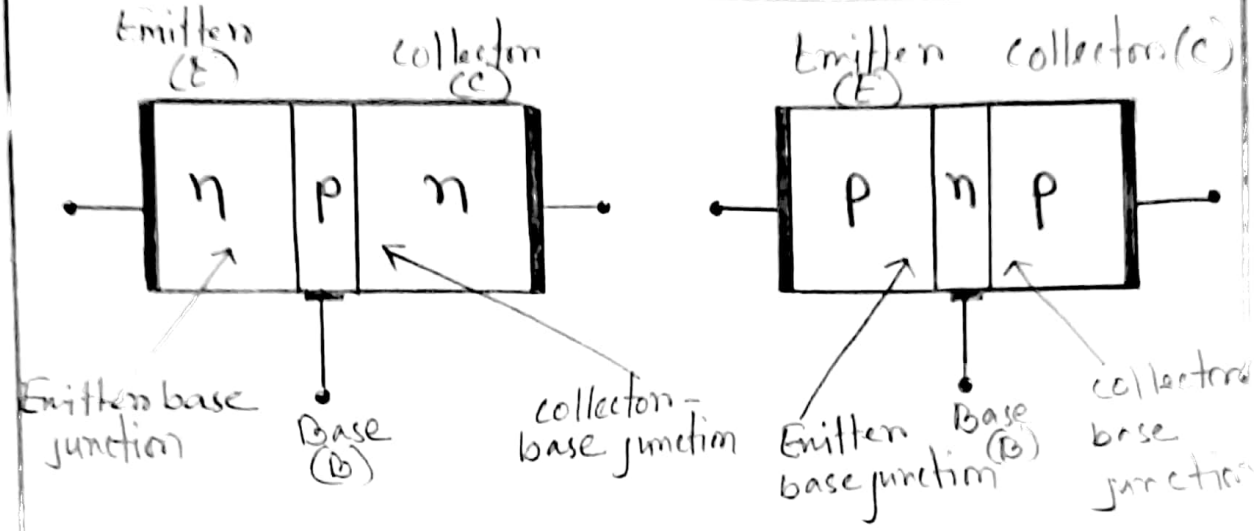
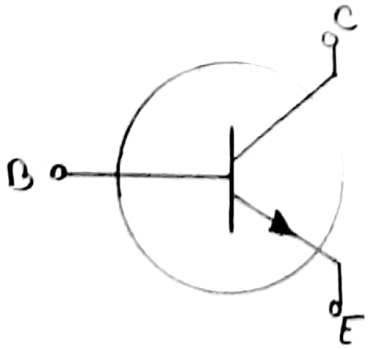


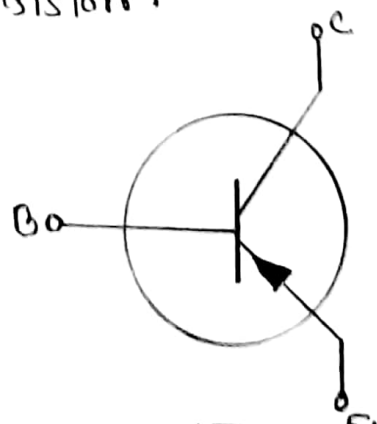
Fig: structure of bipolar transistor

Circuit Configuration:

The following figures show the symbol for the npn transistor and pnp transistor. The emitter of the BJT is always marked by an arrow which indicates whether the transistor is an npn or a pnp transistor.



npn BJT symbol



pnp BJT symbol

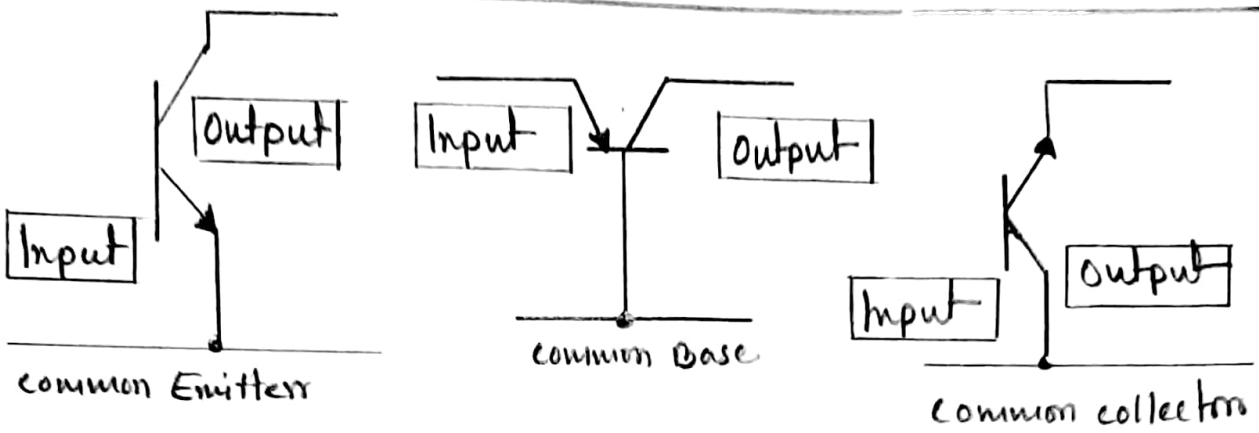


Fig:- Circuit Configuration

There are three basic ways in which a BJT can be configured. In each case, one terminal is common to both the input and output circuit shown in figure above.

1. The common emitter configuration often called and emitter follower, since its output is taken from the emitter resistor It is useful as an impedance matching device since its input impedance is much higher than its output impedance.

2. The common emitter configuration is used for voltage and current amplification and is the most common configuration for transistor

amplifiers.

3. The common base configuration is used for high frequency applications because the base separates the input and output minimizing oscillations at high frequency It has a high voltage gain, relatively low input impedance and high output impedance compared to the common collector.

Biasing of Bipolar Junction Transistors:

In most of the cases, the BJT is used as an amplifier or switch. In order to perform these functions, the transistor must be correctly biased Depending on the bias condition (forward or reverse) of each of the BJT junctions. different modes

amplifiers.

3. The common base configuration is used for high frequency applications because the base separates the input and output minimizing oscillations at high frequency It has a high voltage gain, relatively low input impedance and high output impedance compared to the common collector.

Biasing of Bipolar Junction Transistors:

In most of the cases, the BJT is used as an amplifier or switch. In order to perform these functions, the transistor must be correctly biased Depending on the bias condition (forward or reverse) of each of the BJT junctions. diffrent modes

of operation of the BJT are obtained.
There are three mode defined as follows:

1. Active:
Emitter junction is forward biased, collector junction is reverse biased. The BJT operates in the active mode and the BJT can be used as an amplifier.

2. Saturation:
Both the emitter are collector junction are forward biased. If the BJT is used as a switch, the saturation mode corresponds to the on state of the BJT.

3. Cut-off:
Both the emitter and collector junction are reverse biased. If the BJT is used a switch, the cut-off mode corresponds to the off state of the BJT.

Apparatus:

1. Trainer baard
2. Transistorr
3. Resistorrs (1 Kohm, 10 Kohm)
4. Dc power supply.
5. Multimeterr
6. Powerr supply cable.

Precaution:

Transistorr are sensitive to be damaged by electrical overloads, heat, humidity, and radiation. Damage of this naturre often occurs by applying the incorrect polarity voltage to the collector circuit or excessive voltage to the input circuit. One of the most frequent causes of damage to a transistor is the electrostatic discharge from the human body when the device is handled. The applied voltage, current should not exceed the maximum rating of the given transistor.

Circuit Diagram:

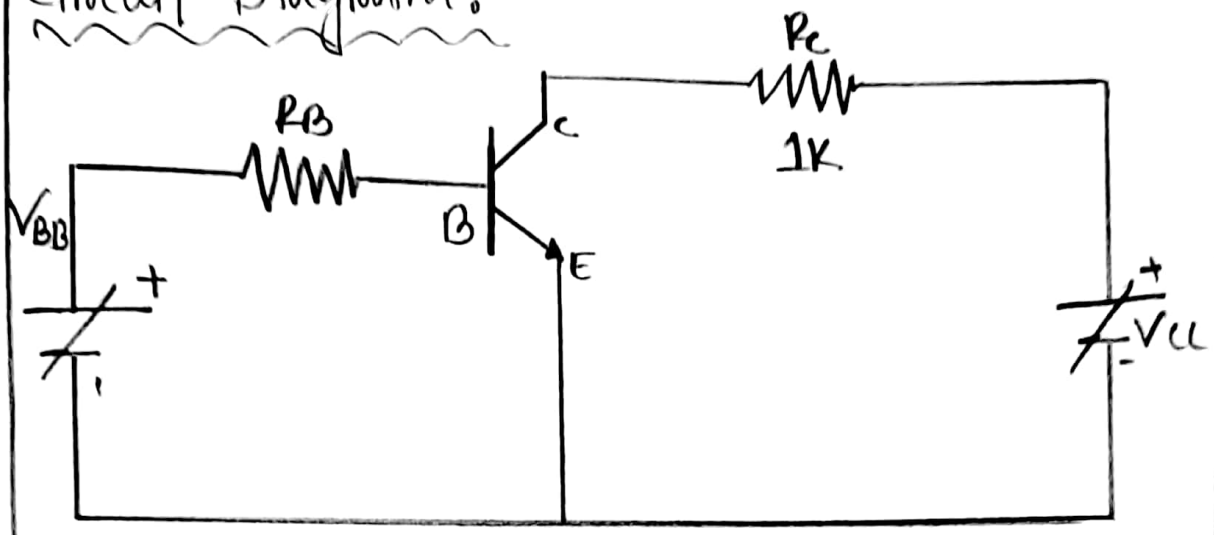


Fig: Transistor Characteristic in CE configuration

Experimental procedure:

1. The terminals of the transistor were identified
2. The circuit connections were made as shown in the above figure.
3. For input characteristics the voltage V_{CE} were fixed first and the voltage V_{BB} were varied and the Base current I_B were calculated.
4. For output characteristics, the input circuit were opened at first (i.e. to make $I_B = 0$). The collector voltage V_{cc} were varied in

steps of 4V and the collector current IC were calculated.

5. Now the input circuit was colsed and the base current IB was fixed at 50 μA by varying VBB. The voltage Vcc were varied according to the table and IC were calculated in each step. The process was repeated for other values of IB.

Data Table:

1. Input Characteristics:-

V_{CC} = 8V			V_{CC} = 16V		
V_{BB} (V)	V_{BE} (V)	I_B (A)	V_{BB} (V)	V_{BE} (V)	I_B (mA)
0	0	0	0	0	0
0.5	0.49	0	0.5	0.49	5
1	0.67	32.3	1	0.67	32.3
1.5	0.68	81.8	1.5	0.76	79.8
2	0.68	131.9	2	0.77	129.9
2.5	0.68	181.9	2.5	0.79	180

$I_B = 0\ \mu A$			$I_B = 50\ \mu A$			$I_B = 100\ \mu A$		
Vcc	V_{CE}(V)	I_C(mA)	Vcc	V_{CE}(V)	I_C(mA)	Vcc	V_{CE}(V)	I_C(mA)
0 V	0.49	0	0V	0.01	0.07	0V	0.07	0.017
4V	4.13	0	4V	0.14	3.94	4V	0.11	3.97
8V	8.11	0	8V	0.19	7.96	8V	0.13	8.02
12V	12.09	0	12V	1.82	10.38	12V	0.16	12.08
16 V	16.06	0	16V	5.41	10.75	16V	0.19	16.13

Simulations: (for input characteristics)

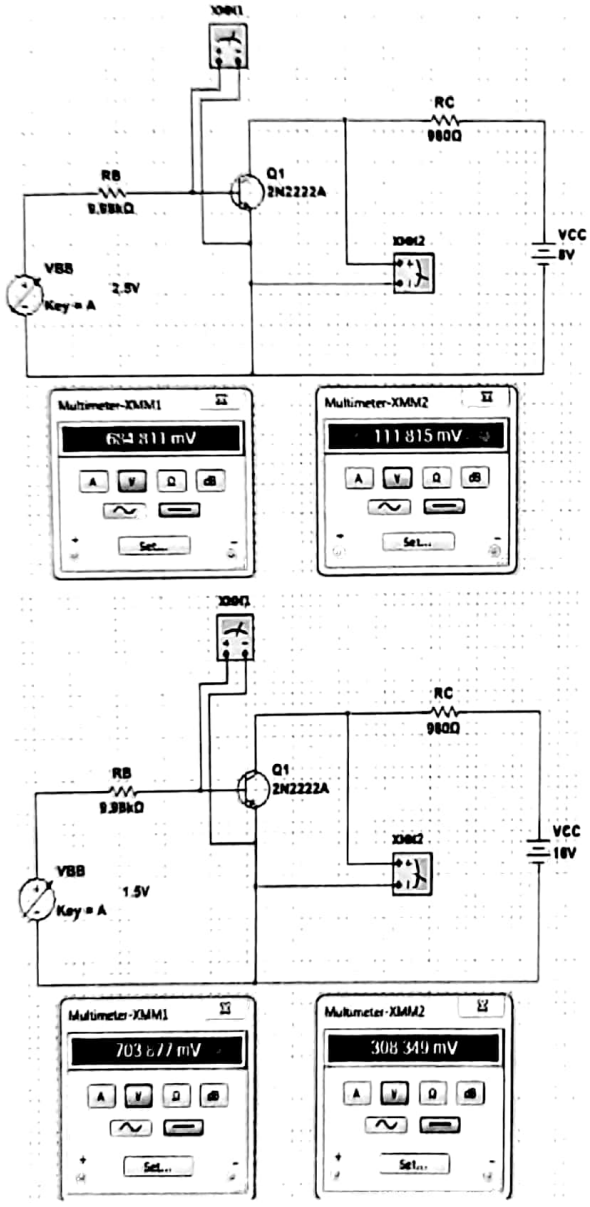


Figure: simulation For 8 volts

Figure: simulation for 16 volts.

(For output characteristics)

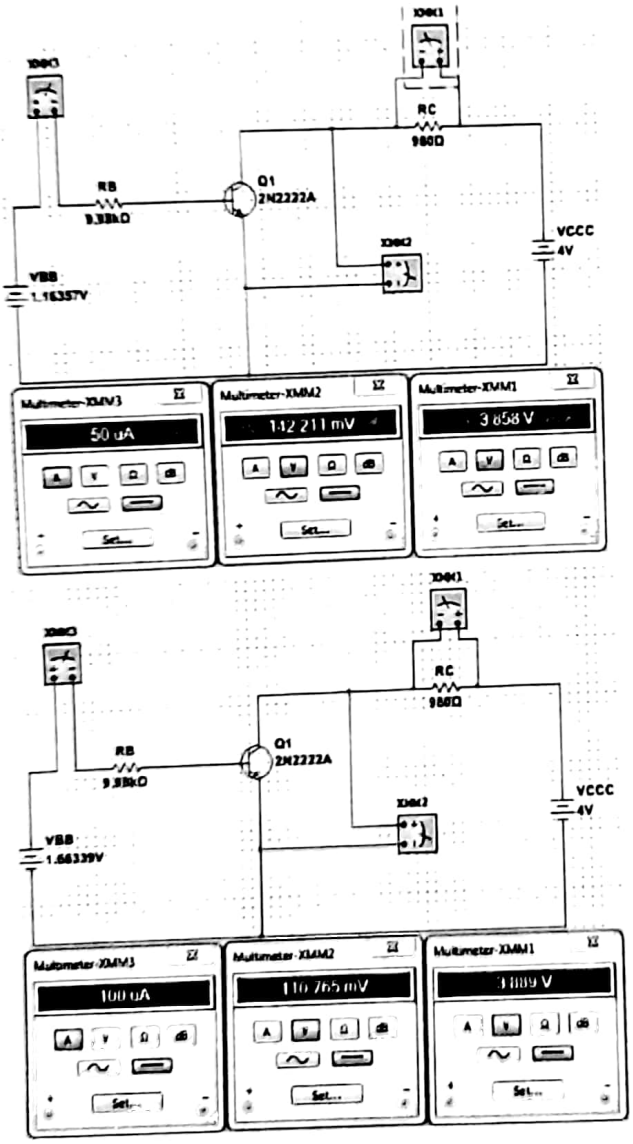


Figure: simulation for 50uA

Figure: simulation For 100uA

mental Graphs:

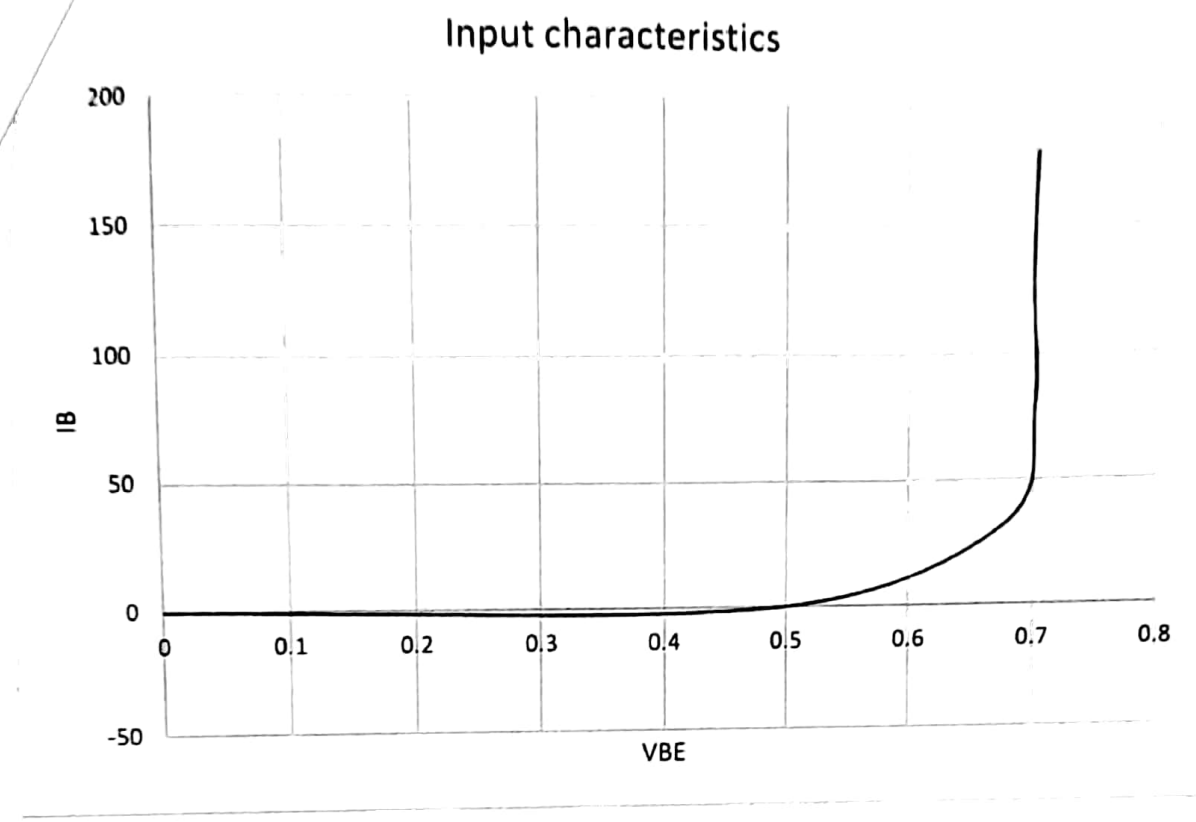


Figure: input characteristics

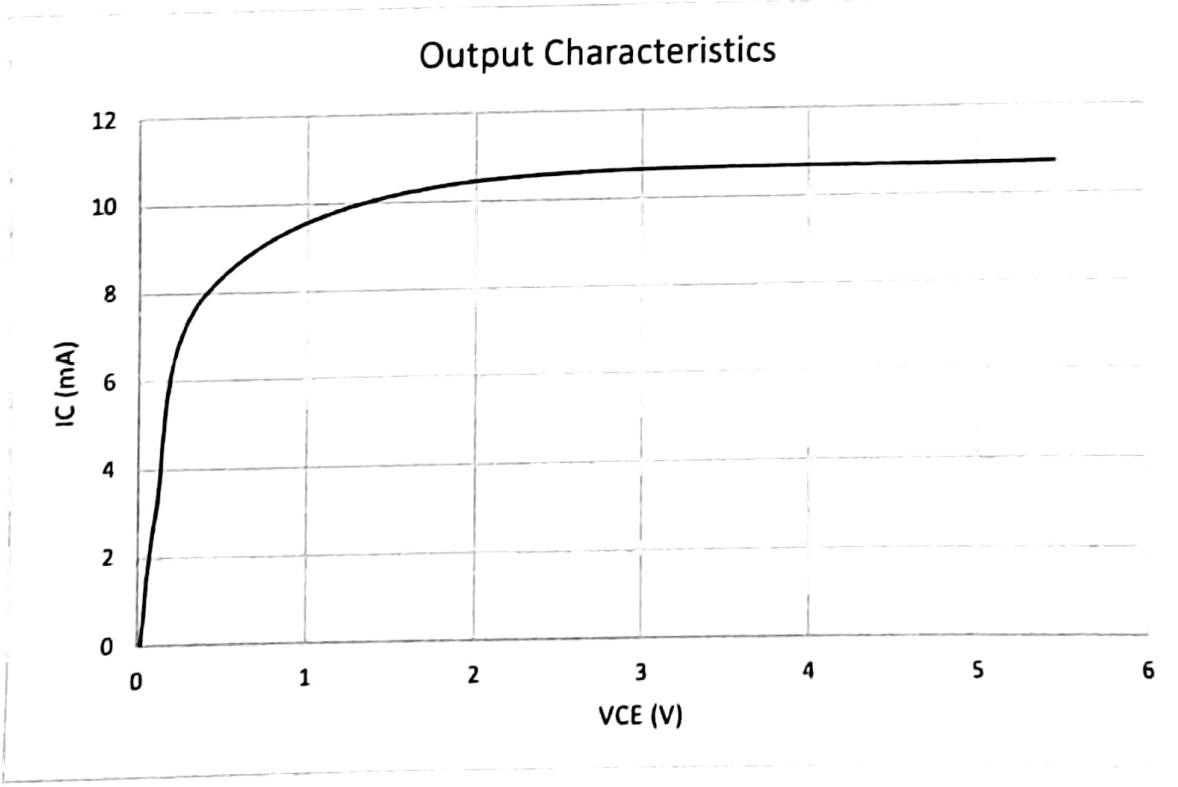
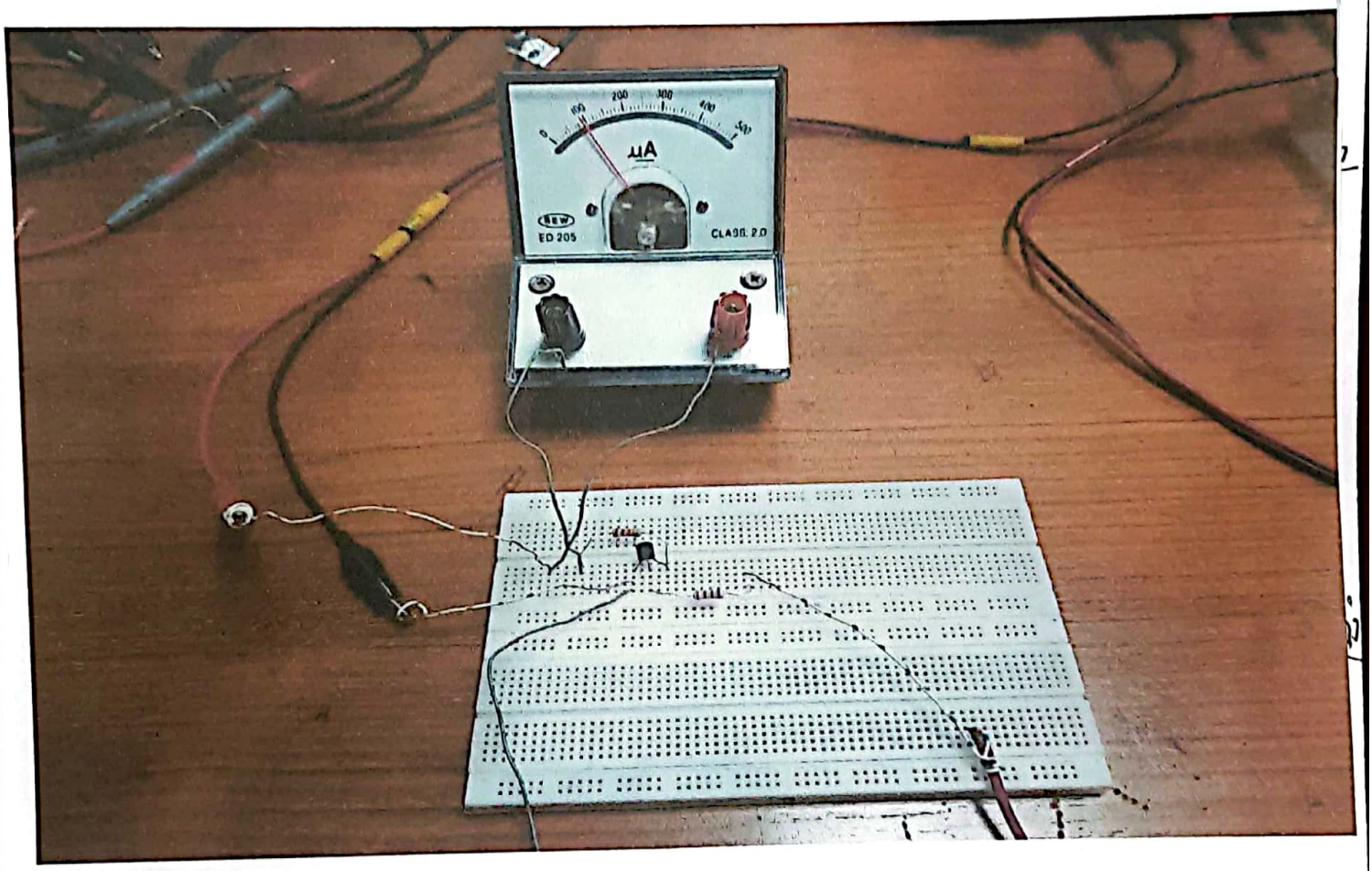


Figure: output characteristics.


μA
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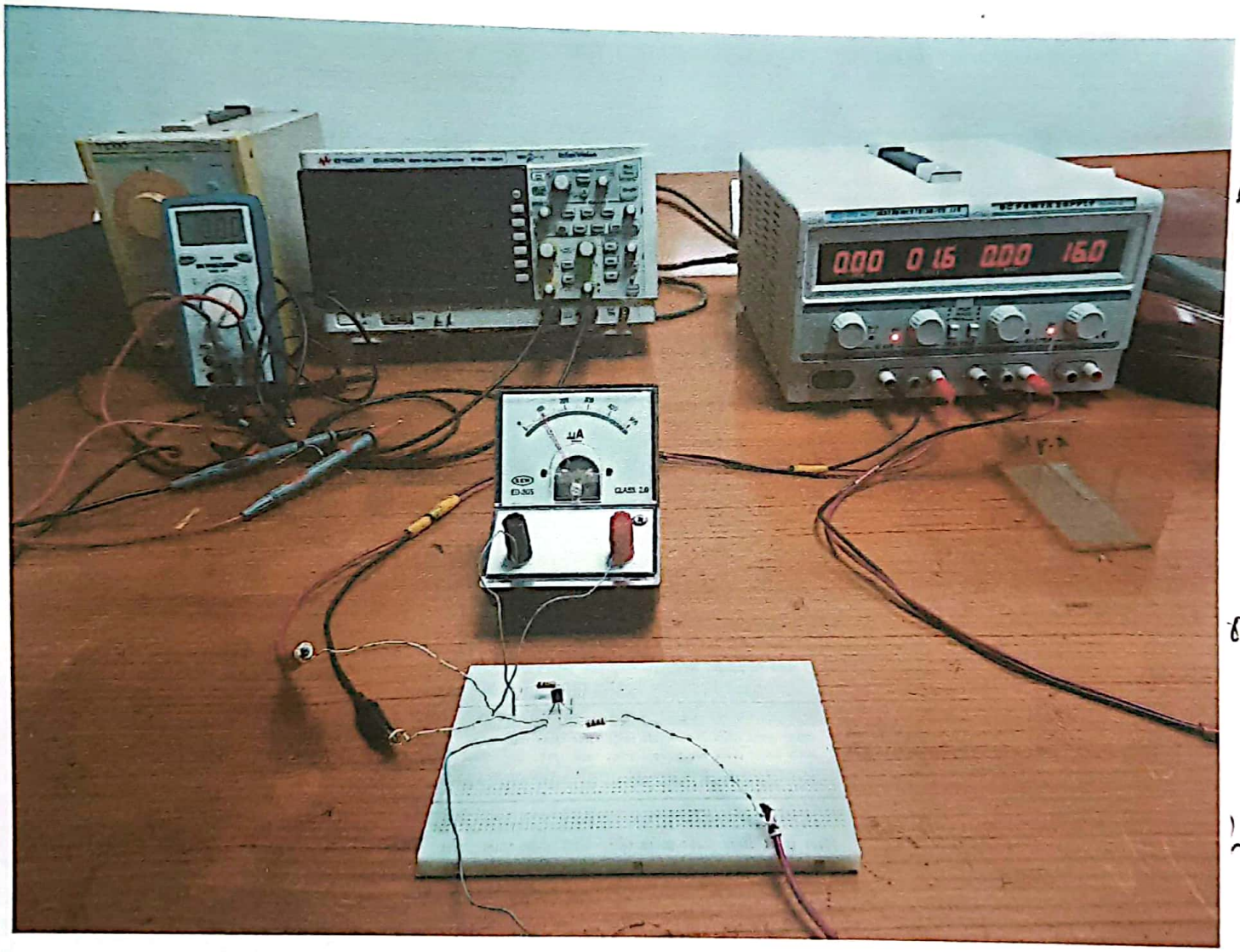
CLASS. 2.0


000 016 000 160
μA

Discussion and Conclusion:

Interpret the data/findings and determine the extent to the experiment was succesful in complying with the goal that was intially set. Discuss any mistake we might have made while conducting the investigation and desrible ways study could have been improved.

Reference(s):

1. Adel S. Sedra Kenneth C. smith Microelectronic circuit, Saunders college publishing, 3rd ed. ISBN:-0-03-051648-X, 1991.

2. American International University-Bangladesh (AIUB) Electronic Devices Lab Manual.

3. David J. Comer, Donald T. Comer, Fundamentals of Electronic Circuit Design, John Wiley & sons Canada, Ltd, ISBN: 0471410160, 2002.