AMERICAN INTERNATIONAL UNIVERSITY BANGLADESH
Faculty of Engineering

Laboratory Report Cover Sheet

Students must complete all details except the faculty use part.

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

Laboratory Title: Study of ~~Biasing~~ BJT Baising Circuit.

Experiment Number: 06 Due Date: 15/11/22 Semester: Fall 22-23

Subject Code: EEE____ Subject Name: Device LAB Section: C

Course Instructor: Dr. Mohammad Shidujaman Degree Program: BSc. EEE

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Group Number (if applicable): 07 ☐ Individual Submission ☑ Group Submission

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Title: Study of BJT biasing circuit

Abstract: This experiment is done to establish the proper operating point. It is also done to study the stability of the operating point with respect to changing β in biasing circuit.

Introduction: The operating point of BJT is very important for amplifiers. Since a wrong 'Q' operating point selection increases amplifiers distortion. It is imperative to have a stable 'Q' point, meaning that the operating point should not sensetive to variation to temparature or BJT β which can very widely. In this experiment four different circuits will be analyzed for two different β to check the stability of biassing points.

The analysis of the BJT circuit is a systematic process. Initially, the operating point of a transistor circuit is a transistor circuit is determined then the small signal BJT model parameteres are calculated. Finally, the dc sources are elimination, BJT model parameters are

calculated. Finally, the sources are eliminated, the BJT is replaced with an equivalent circuit model and the resulting circuit is analyzed to determine the voltage amplification current amplification. Input impedance. Output Impedance and the phase relation between the input voltage and the output voltage.

Theory and Methodology: The dc analysis is done to determine the mode of operation of BJT and to determine the voltages at all nodes and currents in all branches. The operating point of a transistor circuit can be determined by mathematical or graphical means. Here we will describe only the mathematical solution.

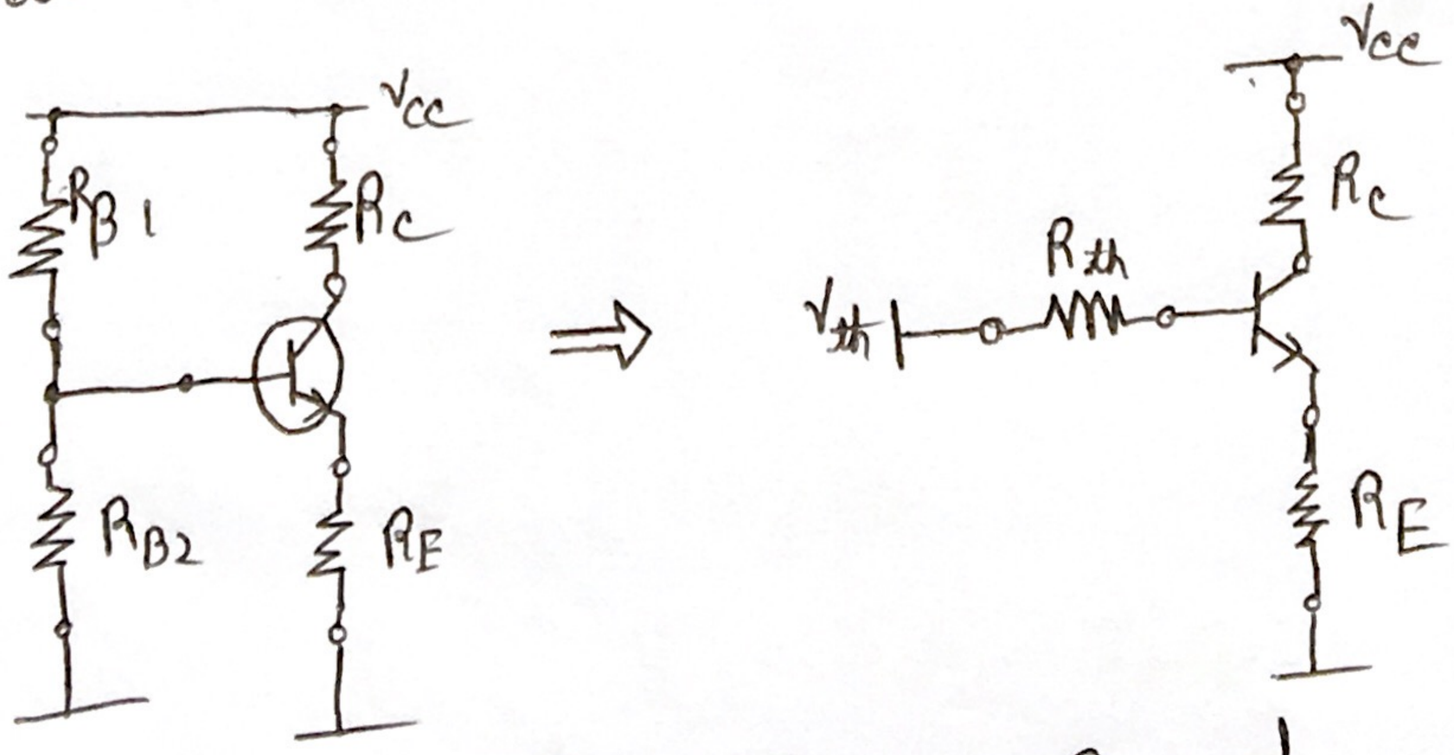


Figure: Biasing Circuit

We will use the most commonly applied biasing circuit to operate the BJT as an amplifier. A single power supply is used and the voltage divider network consisting of RB_1 and RB_2 is used to adjust the base voltage. Using the Thevenin equivalent, the voltage divider network is replaced by V_{th} and R_{th} where.

$$V_{th} = \frac{R_{B2}}{R_{B1}+R_{B2}} V_{cc} \quad \text{and} \quad R_{th} = \frac{R_{B1} R_{B2}}{R_{B1}+R_{B2}}$$

The dc analysis of the circuit is simple by two KVL's at the input and the output loop.

$$V_{th} = I_B R_{th} + R_{EE} + I_E R_E = I_B (R_{th} + (\beta+1) R_E) + V_{BE}$$

$$V_{cc} = I_c R_c + V_{CE} + I_E R_E = I_c \left(R_c + \frac{R_{B2}}{\alpha}\right) + V_{CE}$$

$$\rightarrow I_B = \frac{V_B - V_{BE}}{R_B + (1+\beta) R_E}$$

$$I_{CQ} = \beta I_B$$

$$I_{EQ} = (1+\beta) I_B$$

$$V_{CEQ} = V_{cc} - I_c R_c - I_E R_E$$

If the BJT is in the active mode the following typical can be observed.

$$V_{BE} \approx 0.7\,V \text{ and } I_C \approx \beta I_B$$

RC is used to adjust the collector voltage. Finally, RE is used to stabilize the dc biasing points for different transistor & β can be calculated.

Apparatus:

1) Trainer Board

2) Transistor (C828 (NPN), BD135 (NPN))

3) Resistors ($R = 22\,k\Omega$, $R_C = 470\,\Omega$, $R_{B1} = 10\,k\Omega$, $R_E = 560\,\Omega$)

4) DC Power supply ($V_{cc} = +15\,V\,DC$)

5) Multimeter

6) Power supply Cable

Precautions: Transistor are sensitive to be damaged by electrical overloads, heat, humidity and radiation. Damage of this nature often occurs by applying the incorrect polarity voltage to the input circuit. One of the most frequent causes of the 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 Diagrams:

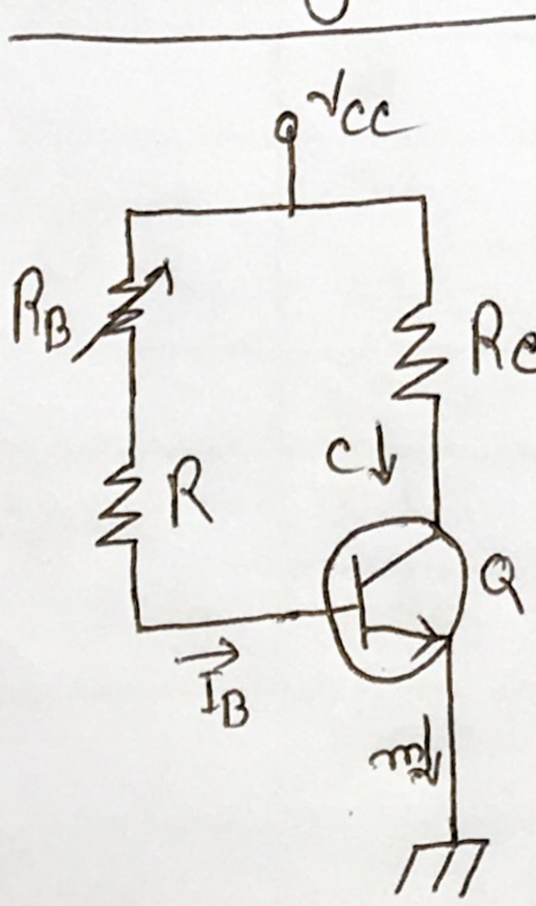


Figure 1(a)

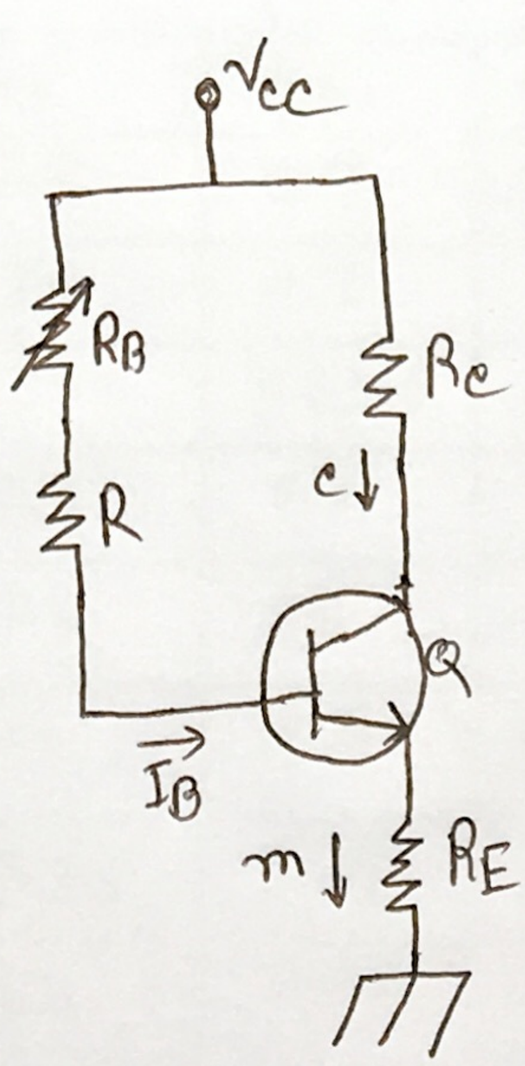


Figure 1(b)

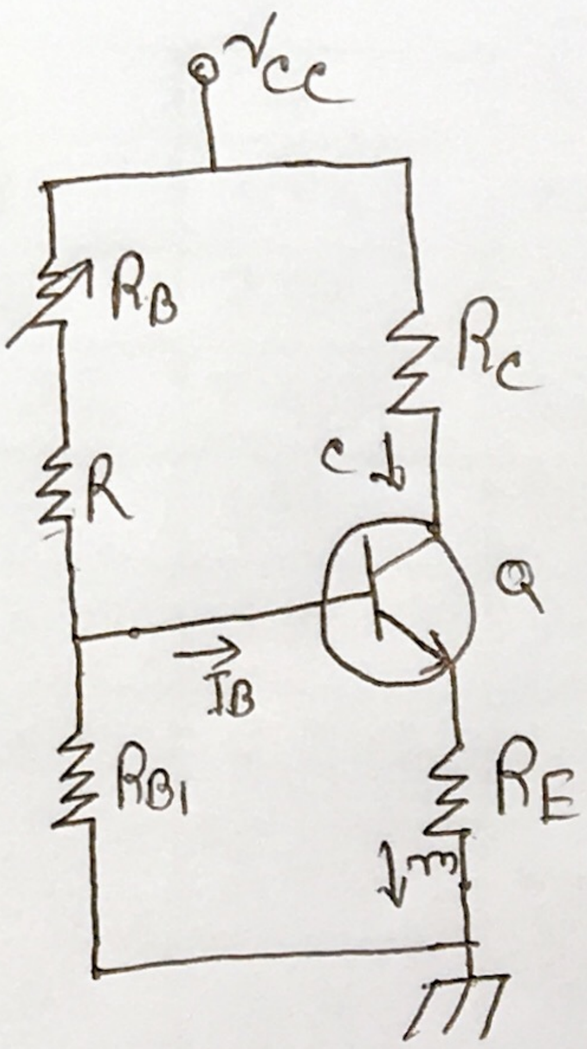


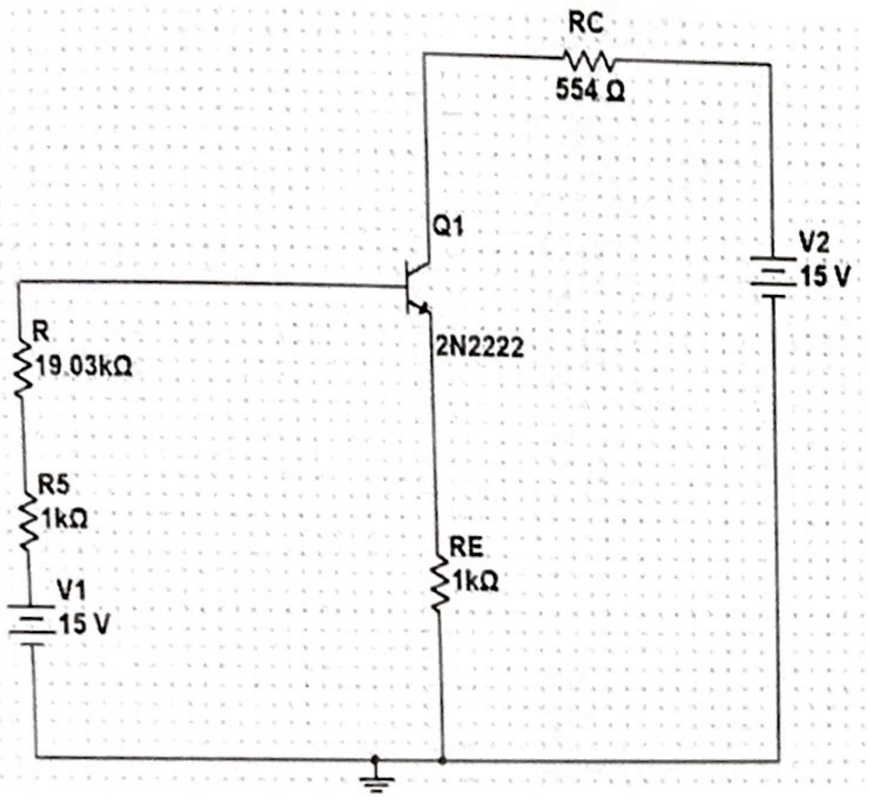
Figure 1(c)

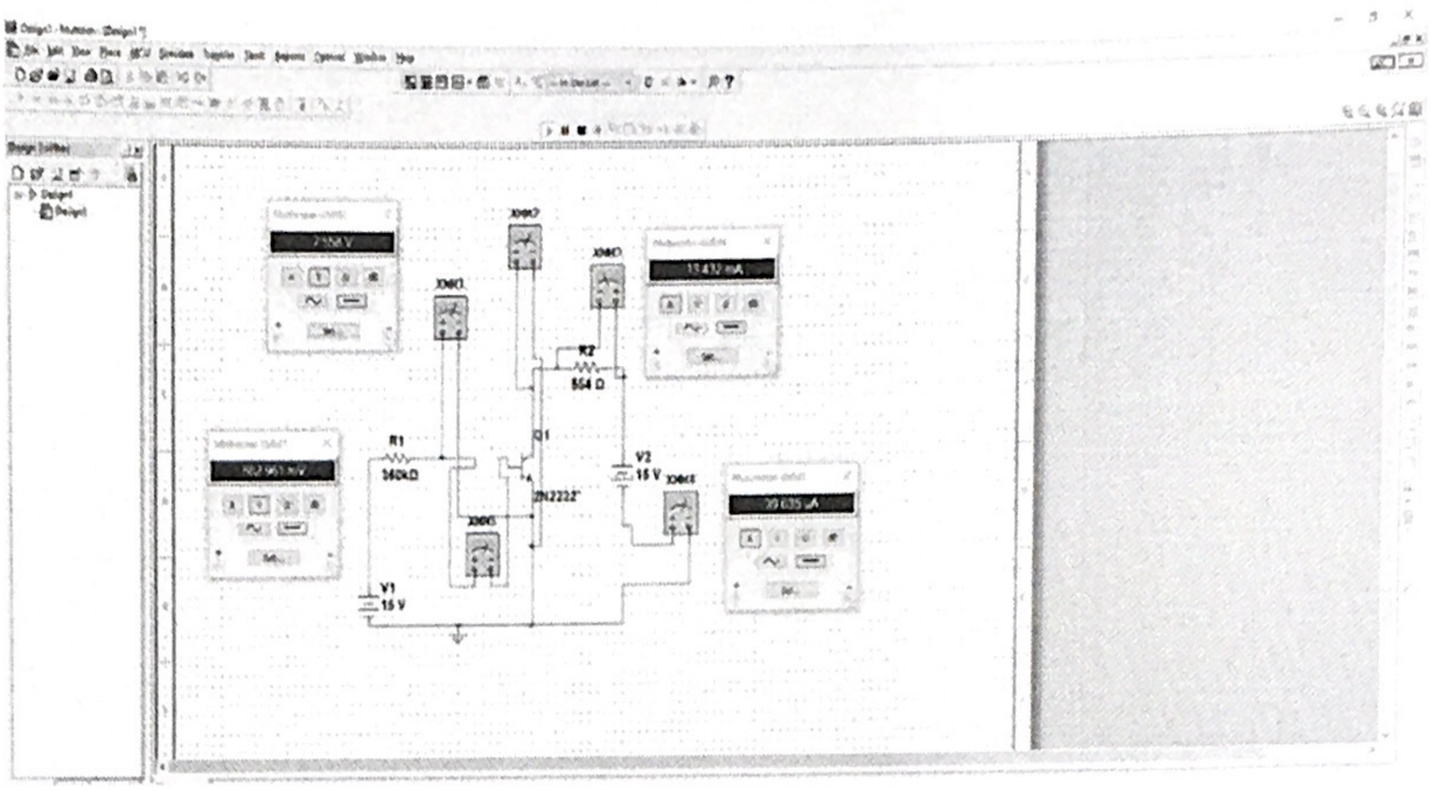
Experimental Procedure:

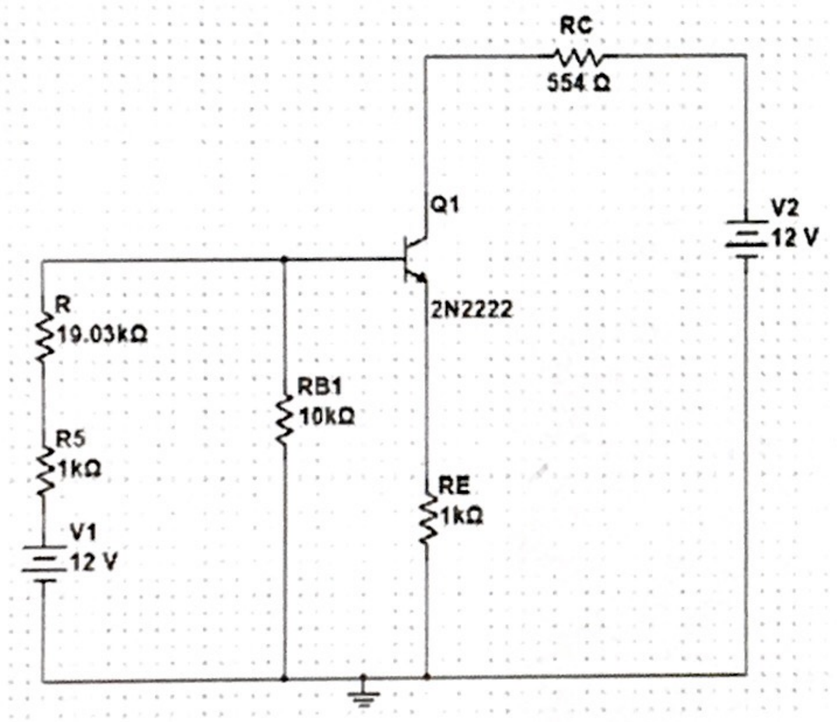
1. The value of R_C was measured by using multimeter.
2. The value of β was measured by using a multimeter for each transistor
3. The fixed bias circuit with transistor was constructed.
4. 500k potentiometer was adjust untill V_{CE} was equal to $V_{CC}/2$
5. V_{CE}, V_{BE} and V_{RC} was measured and after that calculated I_C from V_{RC} and R_C. Also I_B was calculated from I_C
6. Then replaced the first transistor by second one and repeted the step 5
7. The fixed bias circuit was constructed and repetated step 4, 5, 6
8. Same will constructed with self bias and over gain.

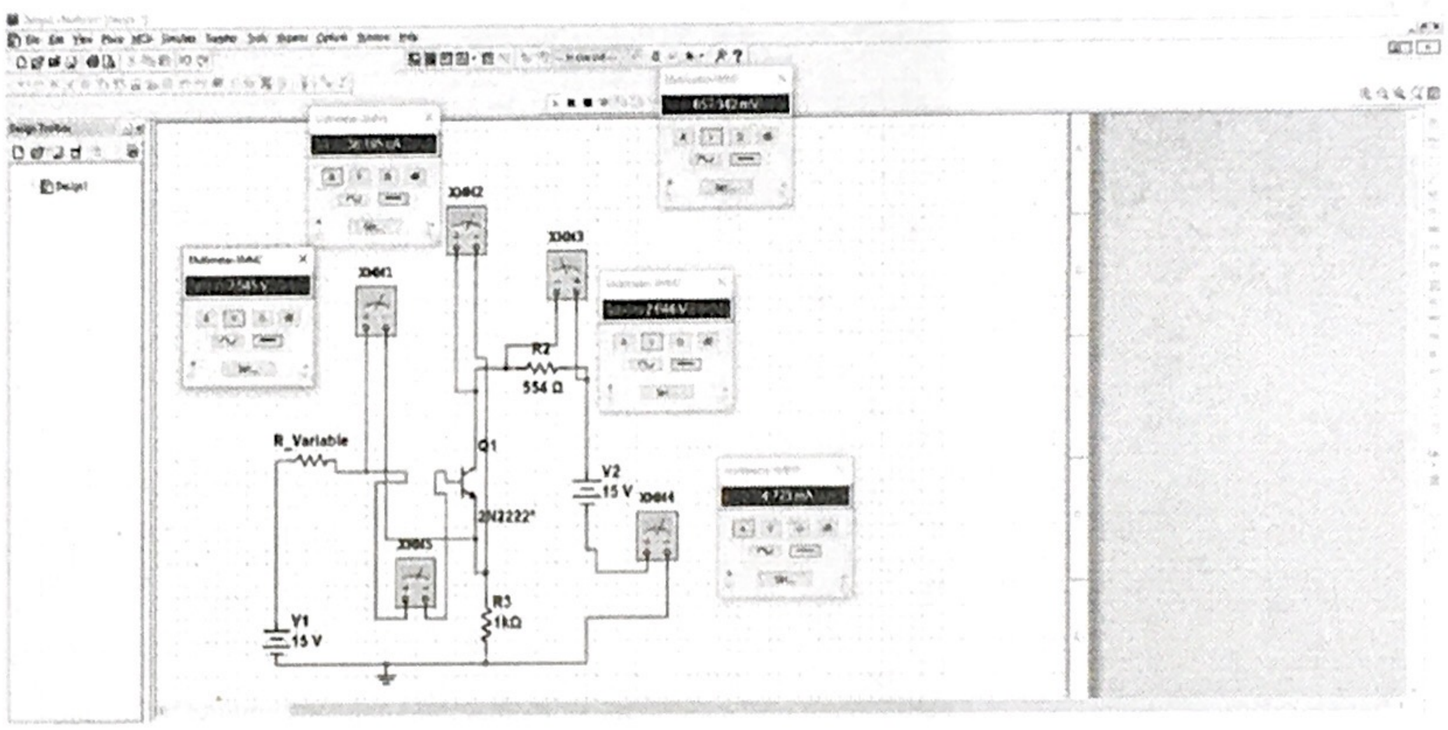
Data Table:

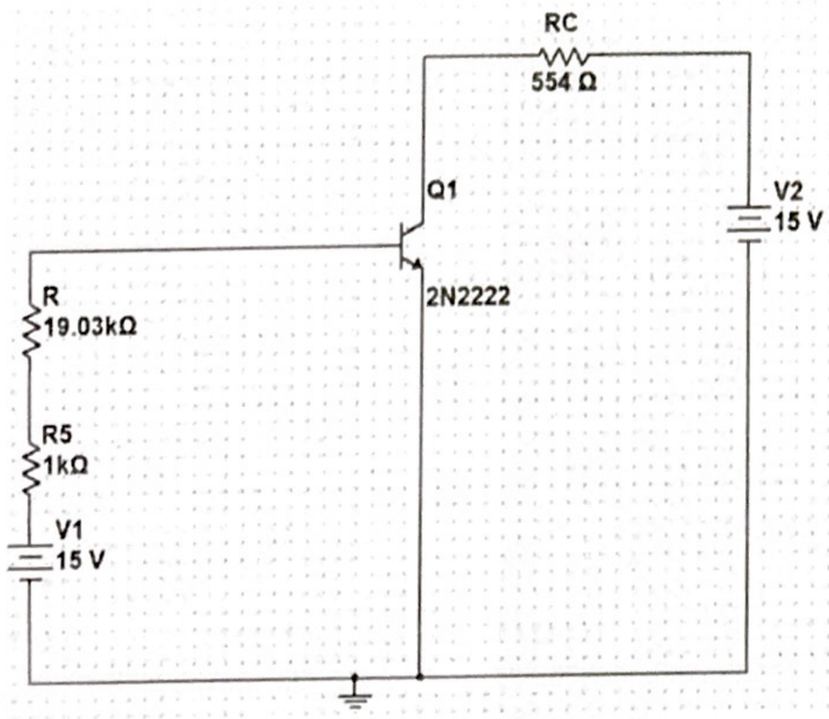
	β	V_{CE}	V_{BE}	V_{RC}	I_C	I_B
Figure 1(a)	93	7.5	0.3	7.8	1.92	0.02
	230	7.8	0.7	7.2	2.08	0.009
	59.56%	3.6%	57.14%	7.69%	7.69%	55%
Figure 1(b)	93	7.5	0.7	33	4.54	0.04
	230	7.5	0.6	3.4	4.41	0.012
	59.50%	0%	14.28%	2.94%	2.94%	70%
Figure 1(c)	93	7.56	0.74	2.93	5.11	0.05
	230	7.5	0.63	3.23	4.64	0.02
	59.56%	0.799%	14.97%	9.37%	9.19%	60%

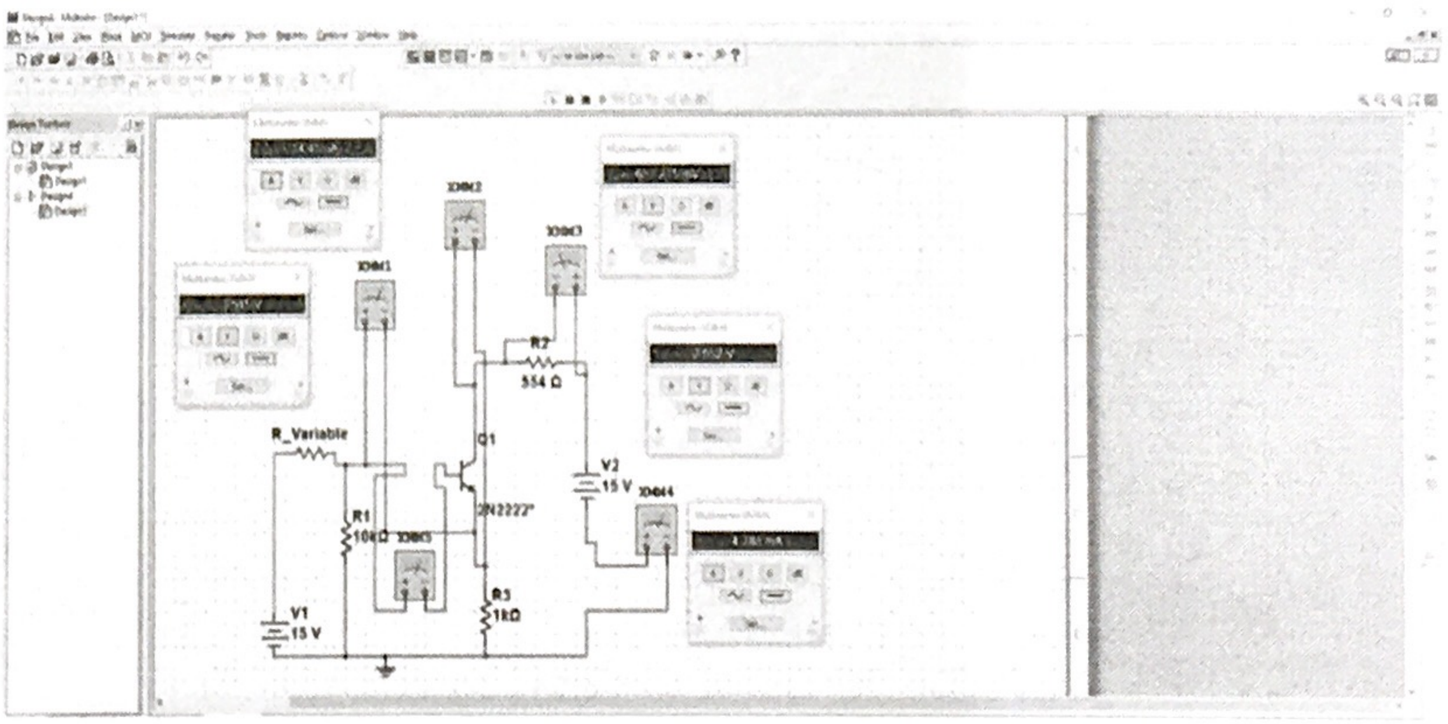

RC
554 Ω
Q1
V2
15 V
R
19.03kΩ
2N2222
R5
1kΩ
RE
1kΩ
V1
15 V

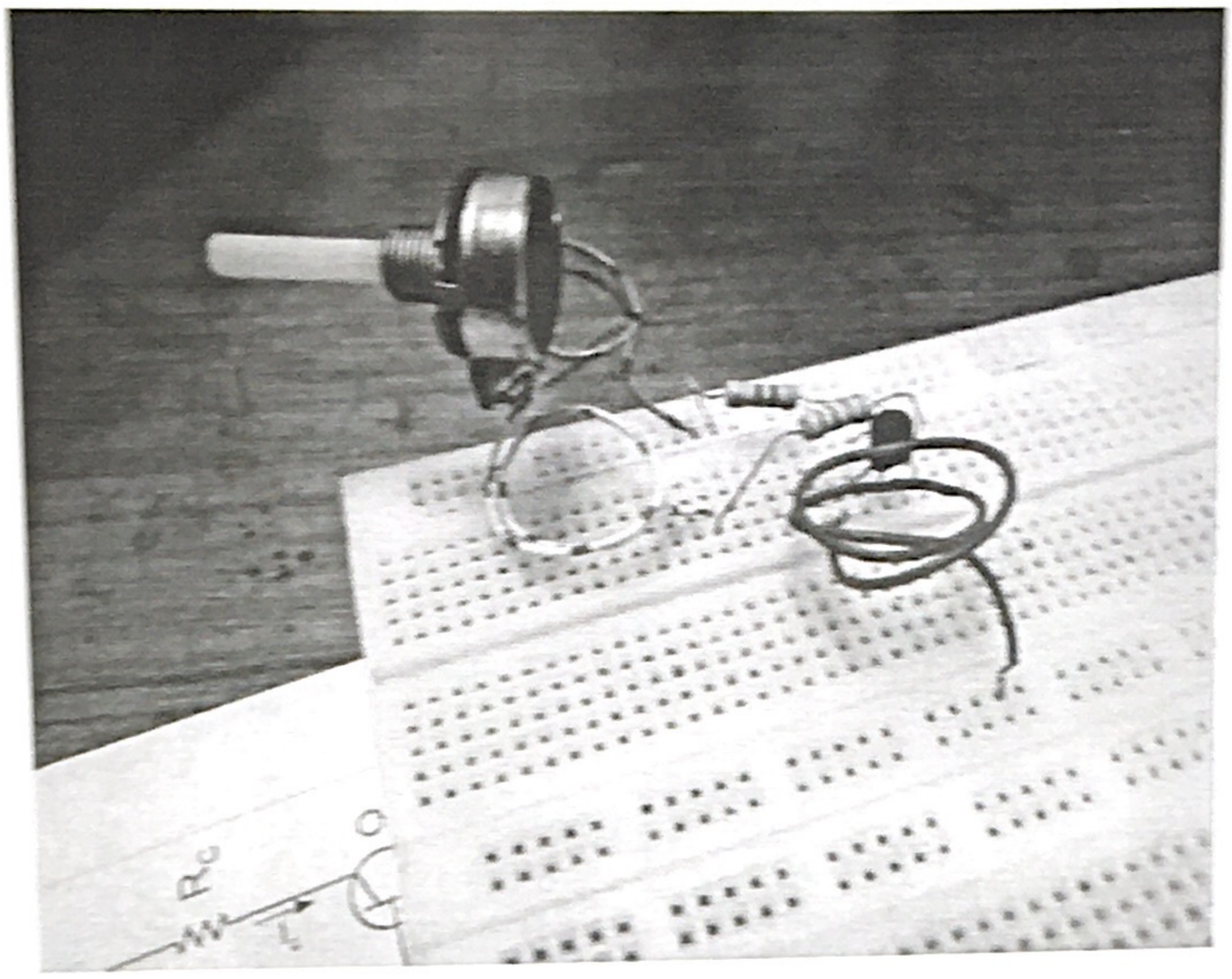

XMM2
XMM1
XMM3
R2
554 Ω
R1
Q1
V2
15 V
2N2222
XMM5
V1
15 V

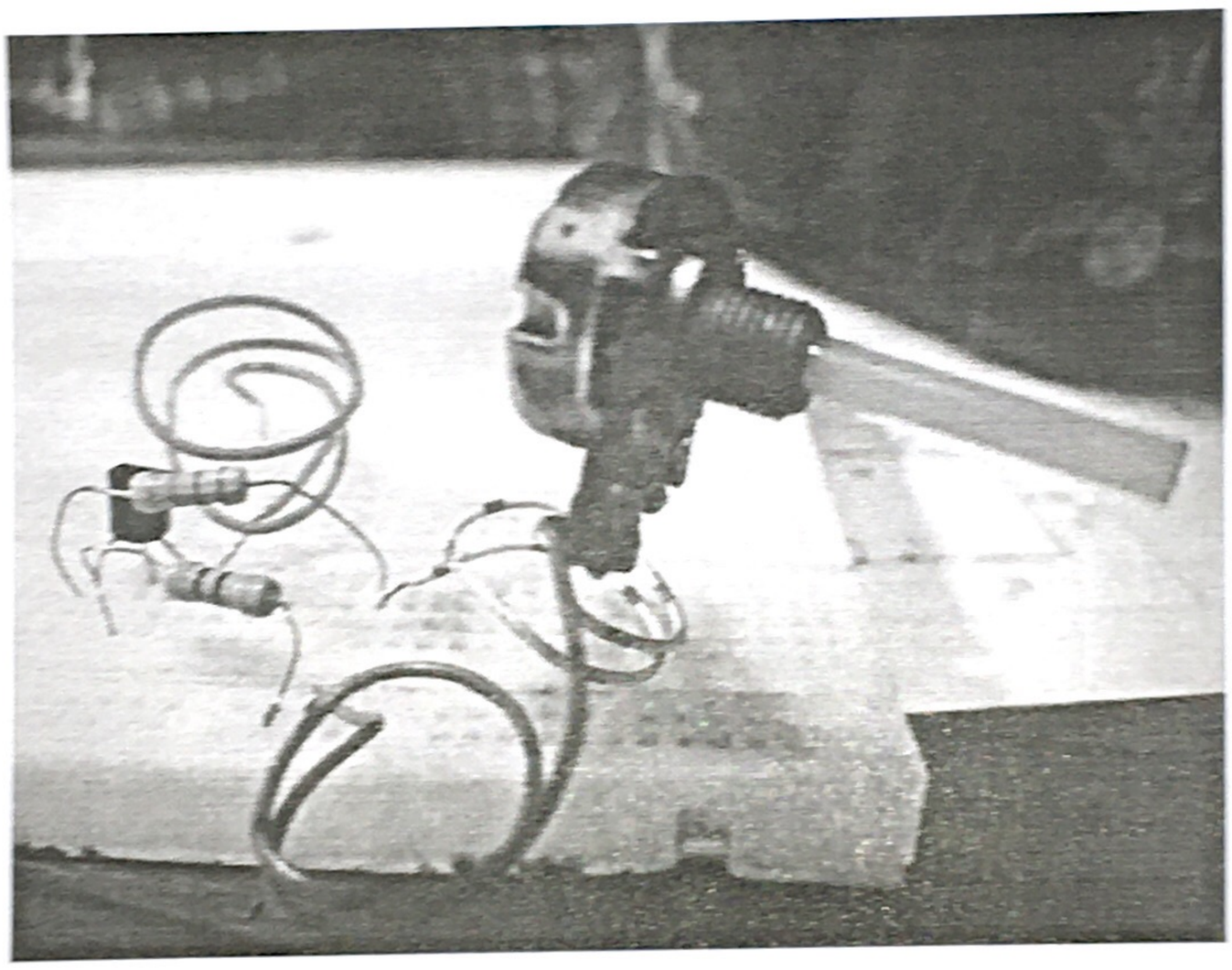

RC
554 Ω
Q1
V2
12 V
R
19.03kΩ
2N2222
RB1
10kΩ
R5
1kΩ
RE
1kΩ
V1
12 V

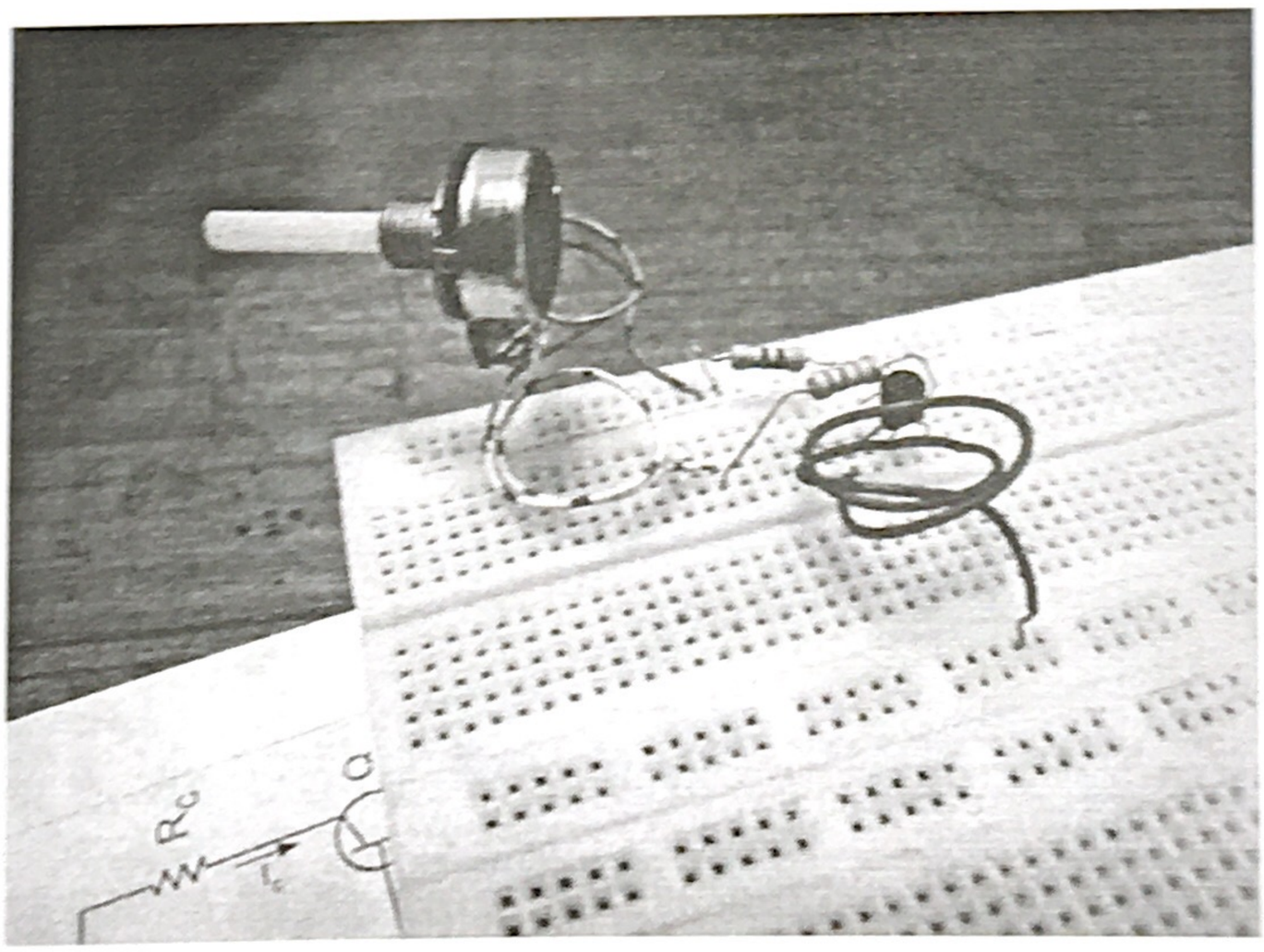

XMM2
XMM1
XMM3
R2
554 Ω
R_Variable
Q1
V2
15 V
XMM4
2N2222
XMM5
R3
1kΩ
V1
15 V


RC
554 Ω
Q1
V2
15 V
R
19.03kΩ
2N2222
R5
1kΩ
V1
15 V


XMM2
XMM1
XMM3
R2
554 Ω
R_Variable
Q1
V2
15 V
XMM4
R1
10kΩ
XMM5
2N2222
R3
1kΩ
V1
15 V







Question For Report Writing:

1 Answer: Biasing makes the output circuit more stable for different values of β.

2. Answer: From the table it is clear that the 1. change of the labeled values is less for 1(b) than 1(a). Hence, stability of circuit 1(b) is more than 1(a). With rise in β, V_{CE} rises while V_{BE} and V_{RC} decrees.

3. Answer: From the table above it is clear that the 1. change for the values are less with 2(b) being more stable than 2(a) and rise in β causes increase in V_{CE} while V_{BE} and V_{RC} decreases same as 1(a) an 1(b)

4 Answer: Compared to fixed-biased, self biased circuit are more stable as the 1. differences in values are seen to be less for 2(a) an 2(b) than for 1(a) and 1(b). This is due to the presence of an emitter resistor.

5 Answer: Stability refers to less changes in values of B-Q point means more stable circuit. Q point stands for quiescent point which is merely the DC operating point of the circuit.

Discussion and Conclusion:

1. All apparatus were chaked before the start of the experiment. We avoid short connections can produce heat which can be harmful for the components and damage the component.

2. The experimental results were slightly different from the simulated result which could happen due to improper connection, contact resistance and variation of source power

3. From the data it can be concluded that self biased circuit are more stable then fixed-biased circuit.

References:

1. American International University-Bangladesh (AIUB) Electronic Device Lab manual.

2. A.S. Sedra, K.C. Smith, Microelectronic Circuits, Oxford University Press (1998)

3. J. Keown, ORCAD PSpice and Circuit Analysis, Prentice Hall Press (2001)

4. P. Horowitz, W. Hill, The Art of Electronics, Cambridge University Press (1989)