North South University

Department of Electrical & Computer Engineering

LAB REPORT

Fall 2020

Course Code: EEE 111

Course Title: Analog Electronics

Section: 3

Experiment Number: 5

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

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Experiment Date: 12/23/2020

Date of Submission: 1/06/2020

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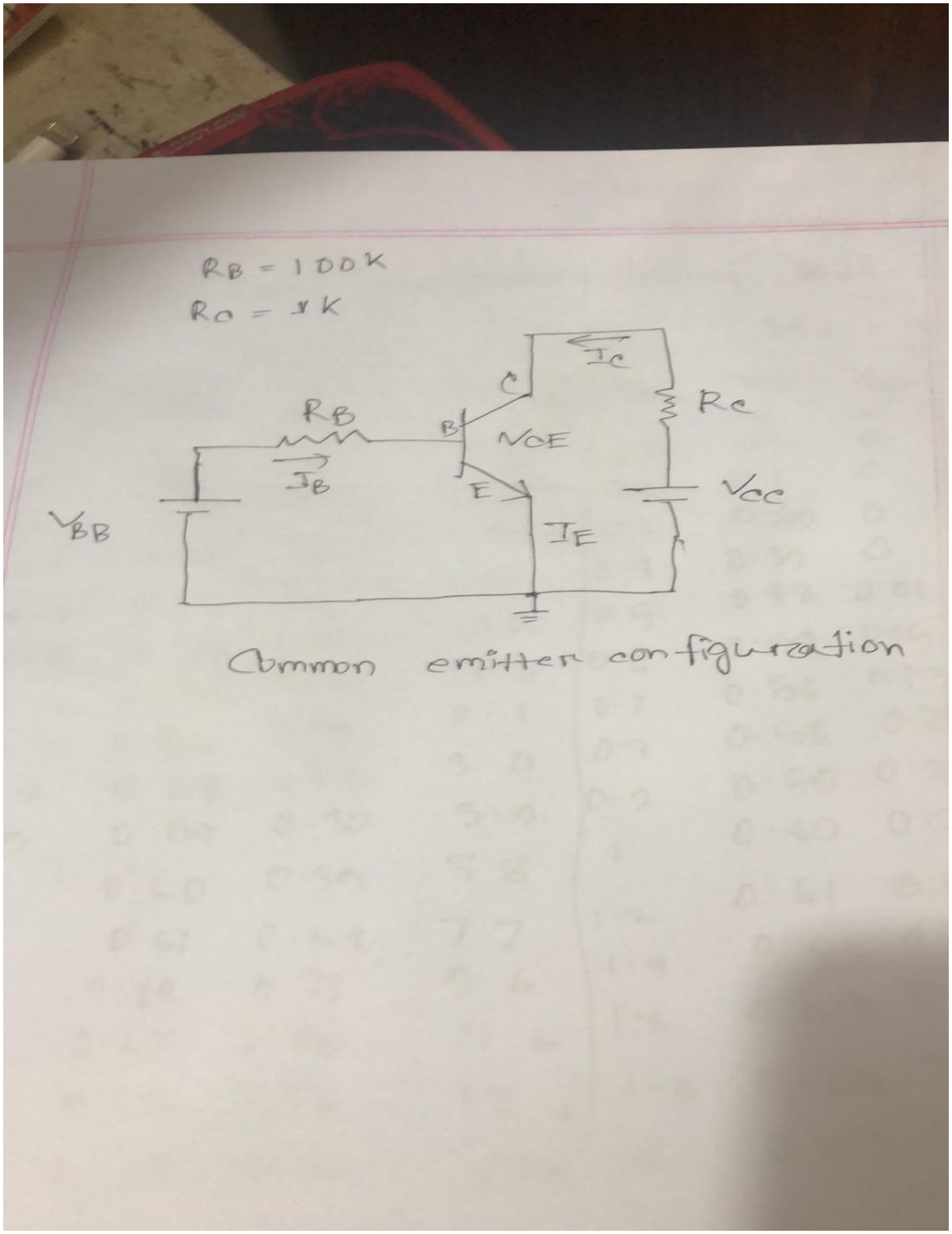
Name of the Experiment: The Input-Output characteristics of CE (common emitter) configuration of BJT.
Objective: Study of the input-output characteristics of CE (common emitter) configuration of BJT.
Theory: Unlike the diode, which has two doped regions, a transistor hasthree doped regions. They are as follows –

a) Emitter, b) Base and c) Collector.

These three doped regions form two junctions: One between the emitter and base and other between
the collector and the base. Because of these it can be thought as combination of two diodes, the emitter and the base form one diode and the collector and base form another diode. The emitter is
heavily doped. Its job is to emit or inject free majority carrier (electron for NPN and hole for PNP)
into the base. The base is lightly doped and very thin. It passes the most of the emitter-injected electron (for NPN) into the collector. The doping level of the collector is between emitter and base.
Input Characteristics Curve: Input characteristics is defined as the set of curves between input current (IB) vs. input voltage (VBE) for the constant output voltage (VCE). It is the same curve that is found for a forward biased diode.
Output Characteristics Curve: Output characteristics is defined by the set of curves between output
current (IC) vs. output voltage (VCE) for the constant input current (IB). The curve has the following features –
▪ It has three regions namely Saturation, Active and Cutoff region.
▪ The rising part of the curve, where VCE i s between 0 and approximately 1 volt is called saturation region. In this region, the collector diode is not reversed biased.
▪ When the collector diode of the transistor becomes reverse biased, the graph becomes horizontal. In this region, the collector remains almost constant. This region is known as the active region. In applications where the transistor amplifies weak radio and TV signal, it will always be operation in the active region.
▪ When the base current is zero, but there is some collector current. This region of the transistor curve is known as the cutoff region. The small collector current is called collector cutoff current.
▪ For different value of base current (IB) an individual curve can be obtained.

Equipment & Components:
Serial Component Details Specification Quantity
1. Transistor BC 548 1 piece
2. Resistor 100kΩ, 1KΩ, 1 piece each
4. Trainer Board 1 unit
5. DC Power Supply 1 unit
6. Digital Multimeter 1 unit
7. Chords and wire as required

Circuit:


RB = 100K
RC = 1K
Ic
C
RB
B
VCE
Rc
IB
E
VCC
VBB
IE
Common emitter configuration

Data collection;

T-1 : Input characteristics of BJT

V_{CE} = 1V

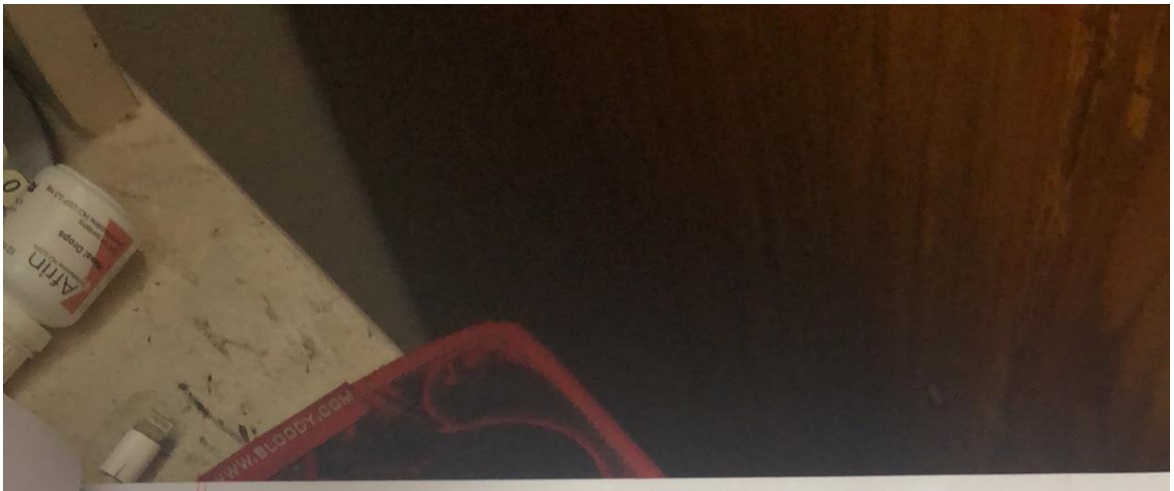
V_{BB} (V)	V_{BE} (V)	V_{RB} (V)	$I_B = \frac{V_{RB}}{R_B}$ (μA)
0.1	0.1	0	0
0.2	0.19	0	0
0.3	0.29	0	0
0.4	0.39	0	0
0.5	0.48	0.01	0.5
0.6	0.54	0.05	1.3
0.7	0.56	0.13	2.1
0.8	0.58	0.21	3.0
0.9	0.59	0.30	3.9
1	0.60	0.39	5.8
1.2	0.61	0.58	7.7
1.4	0.62	0.77	9.6
1.6	0.63	0.96	11.6
1.8	0.63	1.16	12.4
2	0.63	1.36	13.6

V_{CE} = 5V

V_{BB} V	V_{BE} V	V_{RB} V	$I_B = \frac{V_{RB}}{R_B}$ μA
0.1	0	0	0
0.2	0.1	0	0
0.3	0.29	0	0
0.4	0.39	0	0
0.5	0.48	0.01	0.1
0.6	0.54	0.05	0.5
0.7	0.56	0.13	1.3
0.8	0.58	0.21	2.1
0.9	0.59	0.30	3.0
1	0.60	0.39	3.9
1.2	0.61	0.58	5.8
1.4	0.62	0.77	7.7
1.6	0.63	0.96	9.6
1.8	0.64	1.60	16
2	0.69	1.25	13

Output characteristics curve:

I_B = 10 μA				I_B = 60 μA		
V_{CC}	V_{CE}	V_{RC}	$I_C = \frac{V_{RC}}{R_C}$	V_{CE}	V_{RC}	$I_C = \frac{V_{RC}}{R_C}$
0.1	0.04	0.05	0.05	0	0.07	0.07
0.2	0.06	0.13	0.13	0.02	0.16	0.16
0.3	0.08	0.21	0.21	0.03	0.26	0.29
0.4	0.09	0.30	0.30	0.04	0.34	0.34
0.5	0.11	0.38	0.38	0.05	0.44	0.44
0.6	0.12	0.47	0.47	0.05	0.53	0.53
0.7	0.13	0.52	0.56	0.06	0.63	0.63
0.8	0.14	0.65	0.69	0.06	0.72	0.72
0.9	0.15	0.74	0.74	0.07	0.82	0.82
1	0.16	0.83	0.83	0.09	1.10	1.10
1.2	0.2	0.9	0.9	0.07	1.11	1.11
1.45	0.41	1.08	1.08	0.09	1.40	1.40
1.9	0.86	1.13	1.13	0.10	1.89	1.89
2.5	1.31	1.18	1.18	0.11	2.38	2.38
3	1.76	1.24	1.24	0.12	2.87	2.87
5	3.56	1.43	1.43	0.17	4.82	4.82



2. $\beta = \frac{I_C}{I_B} = \frac{1.18\ mA}{10\ \mu A}$ ~~= 1.18 mA~~

$= 118$

$\beta = \frac{1.24}{0.01} = 124$

$\beta = \frac{1.93}{0.01} = 193$

$\beta = \frac{1.43}{0.01} = 143$

$\beta = \frac{2.43}{0.01} = 243$

$\beta = \frac{2.93}{0.01} = 293$

3. $V_{CE} = V_{CC} - I_C R_C$

$\Rightarrow 0 = I_B - I_C$ [when $V_{CE} = 0$

$I_C = I_B$

$V_{CE} = V_{CC} - I_C R_C$

$V_{CE} = I_B$ [when $I_C = 0$]

Q point out $I_B = 50\,\mu A$

$I_{Da} = 4.0\,mA$

$V_{Da} = 1.0\,V$

Discussion:

Finally able to build circuit.