Practical No.15: Build and Test the performance of BJT in CB mode

I Practical Significance

Transistor is a basic building block of modern electronic circuits. Nearly every electronic circuit contains at least one or more types of transistors. A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. In this practical student will plot the characteristics of NPN transistor in input and output mode for CB configuration and calculate current amplification factorα.

II Industry / Employer Expected Outcome

This practical is expected to develop the following skill: **'Use electronic components and circuits in electrical equipment and systems'.**

III Course Level Learning Outcome

Use semiconductor transistors in different applications.

IV Laboratory Learning Outcomes

Test the performance of BJT in CB mode:

1. Build the circuit for BJT in common base configuration.
2. Plot input and output characteristics of common base configuration

V Relevant Affective Domain related Outcomes

1. Handle components and equipment with care.
2. Work in team.

VI Minimum Theoretical Background

Input Characteristics:

In common base configuration, Emitter is the input terminal and collector is the output terminal and base connected as a common terminal for both input and output. The CB configuration is used in applications where low input impedance is required.

This curve gives the relationship between input current (I_E) and input voltage (V_{EB}) for constant output voltage (V_{CB}) by varying V_{EB} for constant V_{CB} it may be noted that below knee voltage current is very small. Beyond the knee voltage, the emitter current (I_E) increases with small increase in emitter to base voltage V_{EB} for constant V_{CB}. As the collector to Base voltage is increased above 1V, the curve shifts upwards.

Input characteristics may be used to determine the value of common base transistor AC input resistance ri. It is the ratio of change in emitter to base voltage ($\blacktriangle V_{EB}$) to resulting change in emitter current (I_E) at a constant collector to base voltage (V_{CB}).

$$r_i = \frac{\blacktriangle V_{EB}}{\blacktriangle I_E \; V_{CB} = \text{.....}}$$

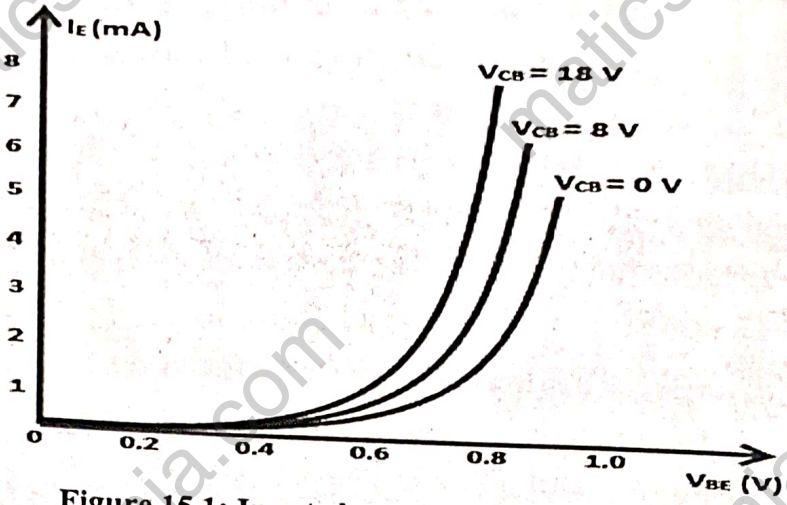


Figure 15.1: Input characteristics in CB

Output Characteristics:

This curve gives the relationship between output current (I_E) it and output voltage (V_{CB}) for a constant emitter current (I_E).

The output characteristics are divided into three regions:

Cut off region: Transistor act as OFF State switch

Saturation Region: Transistor act as ON State switch

Active Region: Transistor acts as amplifier.

Output characteristics may be used to determine the value of common base transistor a.c. output resistance r. It is the ratio of change in collector to base voltage ($\blacktriangle V_{CB}$) to resulting change in collector current ($\blacktriangle I_C$) at a constant emitter current (I_E).

$$r_o = \frac{\blacktriangle V_{CB}}{\blacktriangle I_C \; I_E = \text{.....}}$$

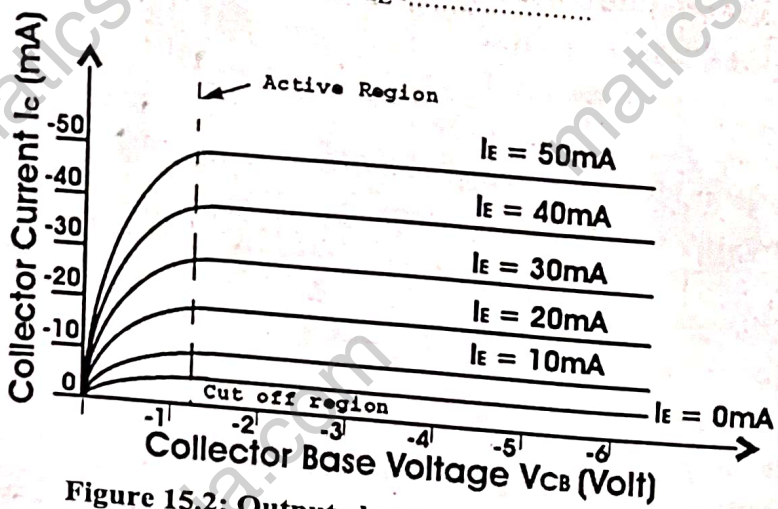


Figure 15.2: Output characteristics in CB

VII Practical setup in Laboratory

(a) Sample

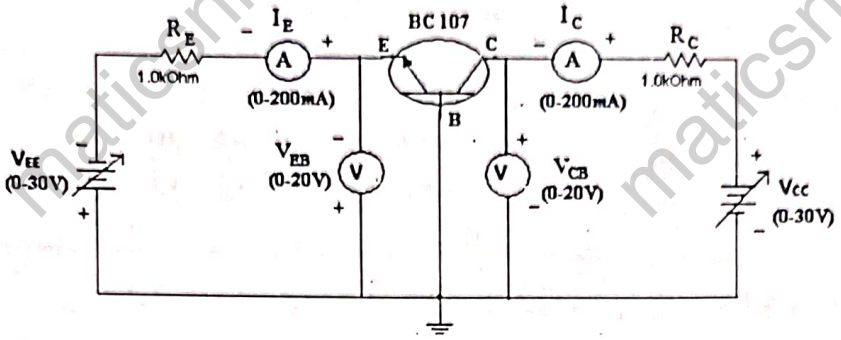
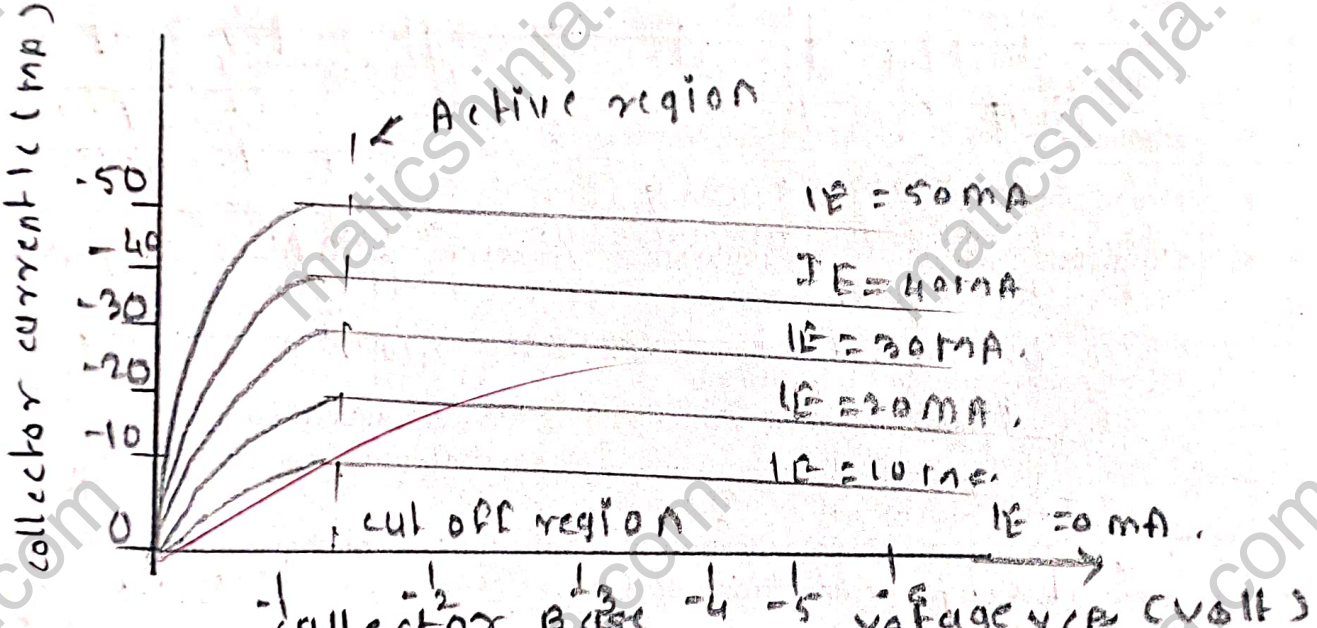
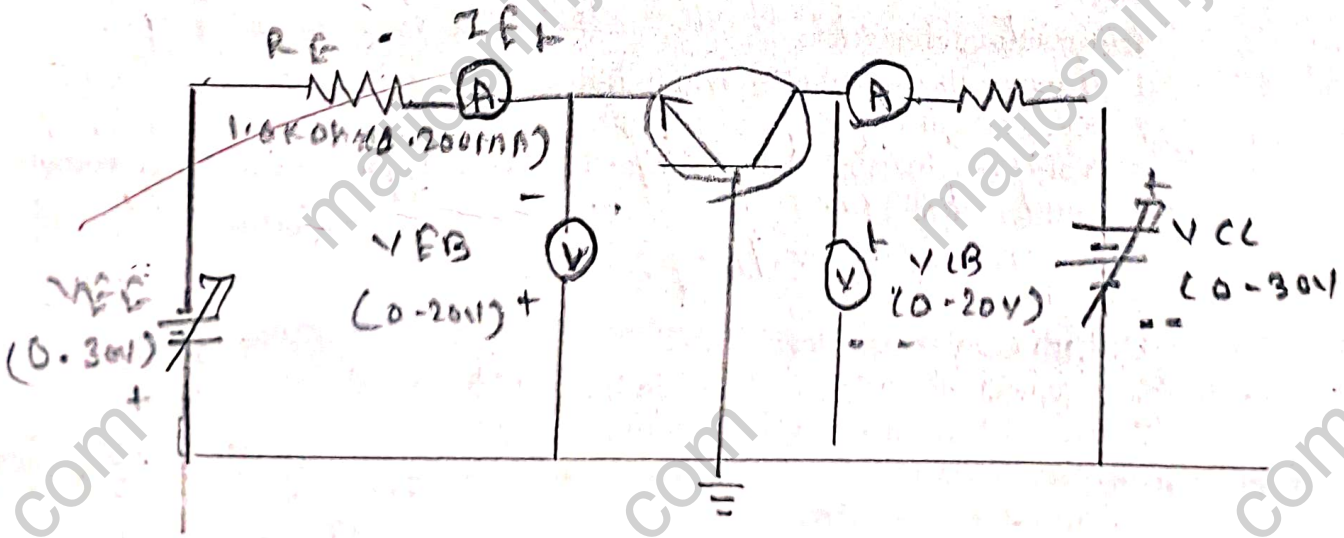


Figure 15.3: Circuit diagram of BJT in CB mode.

(b) Actual Circuit Diagram used in Laboratory



(c) Actual practical set up used in Laboratory



VIII Required Resources/apparatus/equipment with specifications

Sr. No	Instruments/Components	Specification	Quantity
1	Digital Multimeter	3 ½ -digit display with AC and DC voltage measurement and Current measurement facility and Diode testing facility.	1
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	2
3.	DC Voltmeter	0-20 V	2
4.	DC Ammeter	0 - 200 mA	2
5.	Transistor	BC107 or any other equivalent	1
6.	Resistor	1KΩ (0.5watts/0.25watts)	2
7.	Bread board	5.5 CM X 17CM	1
8.	Connecting wires	Single strand Teflon coating (0.6mm)	As per requireme

IX Precautions to be followed

1. Care should be taken while handling the terminals of components.
2. Select proper range and mode of Ammeter and voltmeter.
3. Connect wire tightly while building circuits.
4. Do not switch ON the power supply unless you have checked the circu connections as per the circuit diagram

X Procedure

Part I

Input characteristics:

1. Connect the circuit as shown in figure 15.3
2. Keep output voltage V_{CB}= 0V by varying Vcc.
3. Vary V_{EB} in step of 0.1V from Oto 1Vand note down the correspond emitter current I_E.
4. Repeat above procedure (step 3) for V_{CB}= 4V.

Part II

Output characteristics:

1. Connect the circuit as shown in figure 15.3
2. Keep input current I_E = 0 mA by varying V_{EE}.
3. Vary VCB in step of 1V from 1 to 10 V and note down the correspond collector current Ic.
4. Repeat above procedure (step 3) for I_E= 10 mA

XI Observation Table

Table 1: Input Characteristics

Sr. No.	V_{CB}=OV		V_{CB}=4V	
	V_{EB} (V)	I_E (mA)	V_{EB} (V)	I_E (mA)
1.	0	0	0.1	0
2.	0.1	0.00028	0.2	0.00025
3.	0.2	0.00015	0.3	0.00015
4.	0.3	0.000015	0.4	0.00014
5.	0.4	0.16.	0.5	0.15
6.	0.5		6	0.2

Table 2: Output Characteristics

Sr. No.	I_E (mA)=O		I_E (mA)=10mA	
	V_{CB}(Volts)	Ic(mA)	V_{CB} (Volts)	Ic(mA)
1.	0	0	0.1	0 .
2.	0.1	0.00028	0.2	0.00025
3.	0.2	0.00015	0.3	0.00015
4.	0.3	0.000015	0.4	0.00014
5.	0.4	0.16.	0.5	0.15
6.	0.5		6.	0.2

Calculations: *(from graph)*

1. Input resistance ri:
2. Output resistance ro:
3. Current amplification factor α. :

XII Results

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In this practical we observe as a amplifier.

XIII Interpretation of results

In this practical we learn about bit. Sepcification about amplifier.

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XIV Conclusions and Recommendation

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XV Practical related Questions

1. Repeat the same experiment using PNP transistor.
2. State the early effect. Have you observed early effect in your experiment

[Space for answers]

(1) - - - - - - - ?

→ A PNP transitor is a three terminal device that can be used as either and amplifier or a swich in amplifires, PNP transistors are used to increase the voltage or current of a signal, in swiches PNP transistor can be used to increase turn a circuit on or off.

(2) - - - - - - - ?

→ Early effect causes an increase in collector current are generally considered as current controlled current sources As emitter current increase, collector current increase as well early effect causes collector current to change in accordance with the collector voltage

XVI References / Suggestions for further Reading

1. https://www.electrical4u.com/transistor-characteristics/
2. https://www.youtube.com/watch?v=NMD4KECE-7I
3. https://www.electronicshub.org/common-base-amplifier/