Practical No.22: Test input/output characteristics of NPN Transistor in CB Configuration.

I Practical Significance:

A BJT Transistor is a semiconductor device used as an amplifier or switch electronic signals & electrical power. In this Practical students will plot the characteristics of NPN transistor in input output mode. CB configuration is commonly used for amplifiers that require low input impedance such as microphones.

II Industry/Employer Expected Outcome(s):

Amplifier circuits are necessary in all electronic equipment used in industries. Employee should be able to select suitable type of transistor and configuration for given application.

III Course Level Learning Outcome(s):

Use BJT and FET in various electronic circuits.

IV Laboratory Learning Outcome(s):

Check the operation of NPN Transistor under CB configuration.

V Relevant Affective Domain related outcome(s):

1. Handle components and equipment carefully.
2. Work in team

VI Relevant Theoretical Background (With diagrams if required):

Input characteristics for CB configuration:

The curve given in figure 1 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 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 used to determine the value of common base transistor AC input resistance r_i. It is the ratio of change in emitter to base voltage (ΔV_{EB}) to resulting change in emitter current (I_E) at a constant collector to base voltage (V_{CB}).

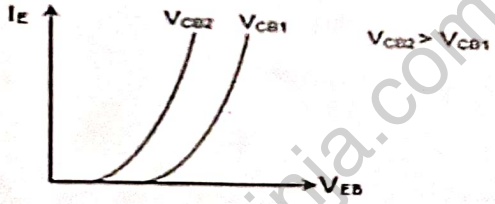


Figure 1: Input Characteristics for CB

XI Required Resources/apparatus/equipment with specifications:

S. No	Instruments/Components	Suggested broad specification	Quantity
1	digital multimeter	digital multimeter	2.
2	voltmeter	0-200V, 0-2V	1
3	Ammeter	10-200mA, 0-200μA	1.
4	Resistor	1KΩ	1

XII Actual procedure followed:

1. Connect the circuit as shown in figure 3.
2. keep output voltage V_{CB}=0V by varying Vcc.
3. Vary VEB in step of 0.1V from 0 to 1 & note down the corresponding emitter current IE.
4. Repeat above procedure (step 3) for V_{CB} = 4V.
1. Connect the circuit as shown in figure 3.
2. Keep input current IE = 0mA by varying VEE.
3. Vary VCB in step of 1V from 1 to 15V & note down the corresponding collector current IC.

XIII Observations and Calculations:

Table 1: Input Characteristics

S. No.	0.800V_{CB}=0V		V_{CB}=4V 0.7000	
	V_{EB} (V)	I_E(mA)	V_{EB} (V)	I_E(mA)
1	0.2000	1.8	0.2600	1.9
2	0.4000	2.1	0.4400	2.5
3	0.5200	2.3	0.6000	2.9
4	0.7000	2.8	0.7800	3.4
5	0.8400	3.2	0.9000	3.8
6	1.040	4.0	1.060	4.5

Table 2: Output Characteristics

S. No.	I_E(mA)=0 1.9		I_E(mA)=10 0.76	
	V_{CB} (Volts)	I_C (mA)	V_{CB} (Volts)	I_C (mA)
1	0.08000	0.6043	0.02000	0.01649
2	1.600	0.7823	0.9800	0.5701
3	3.040	1.880	1.780	0.7151
4	4.240	1.888	2.680	0.7499
5	5.440	1.889	3.480	0.7556
6	6.640	1.889	4.280	0.7567

Calculation:

1. Input resistance r_i:

$$r_i = \frac{\Delta V_{EB}}{\Delta I_E} \qquad \frac{1.040}{10} = 0.104$$

2. Output resistance r_o:

$$r_o = \frac{\Delta V_{CB}}{\Delta I_C} \qquad \frac{4.280}{0.7567} = 5.65$$

3. Current amplification factor α:

$$\alpha = \frac{I_C}{I_E} \qquad \frac{1.889}{1.9} = 0.99$$

XIV Results:

1. Input resistance r_i: 0.104 Ω
2. Output resistance r_o: 5.65 Ω
4. Current amplification factor α: 0.99

XV Interpretation of Results:

we have learn to input /output characteristics of NPN transistor in CB configuration.

XVI Conclusions & Recommendations:

hence we have to learned in this practical input/ output characteristics of N-P-N transistor in CB configuration.

XVII Practical Related Questions:

1. Define α and β.
2. Compare CB & CE configuration.
3. Explain why CE configuration is preferred for amplification.

[Space for Answers]

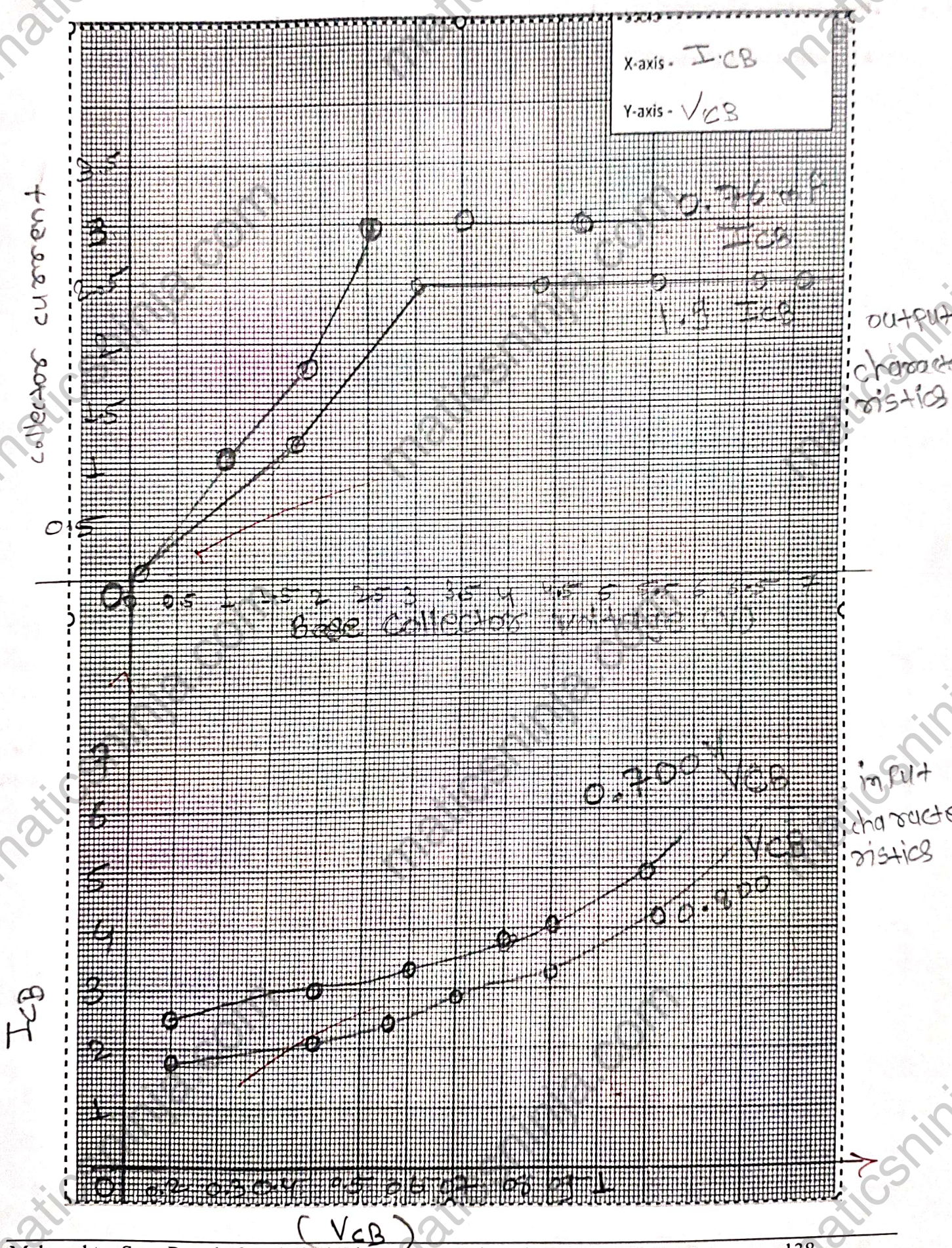
1. Alpha is a positively charged particle, while beta can be positively or negatively charged: the gamma particle on the other hand, has no charge & hence is neutral.

2. Common emitter configuration: offers high voltage gain & moderate current gain commonly used for amplification applications. common base configuration: provide high current gain & moderate voltage gain suitable for impedence matching & amplifier circuit.

3. circuit configuration because it offer both current & voltage gain resulting in higher power gain than in common base emitter configuration.

XVIII References/ suggestions for further reading ; includes websites:

1. https://www.electrical4u.com/transistor-characteristics/
2. http://nptel.ac.in/courses/117107095/11


X-axis - I CB
Y-axis - VCB
collector current
output characteristics
Base Collector
input characteristics
ICB
(VCB)