NORTH SOUTH UNIVERSITY

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Experiment No: 05

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 has three 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. Figure 5.1 shows the biased NPN transistor.

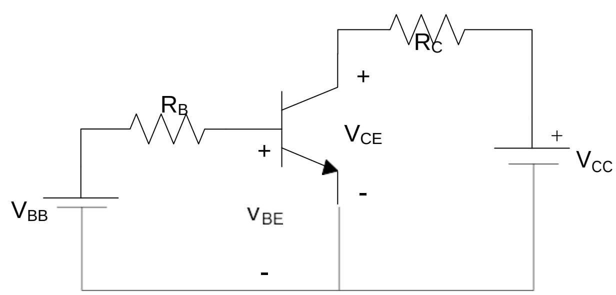


Figure 5.1: Biasing of an NPN transistor.

If the V_{BB} is greater than the barrier potential, emitter electron will enter base region. The free electron can flow either into the base or into the collector. As base lightly doped and thin, most of the free electron will enter into the collector.
There are three different current in a transistor. They are emitter current (I_E), collector current (I_C) and the base current (I_B) are shows in figure 5.2.

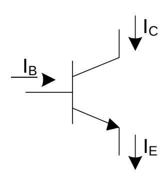


Figure 5.2 : Different current in transistor.

Here, $I_e = I_c + l_b$ and current gain, $B = I_c / I_b$

The characteristics of a transistor is measured by two characteristics curve.

a) Input characteristics curve.
b) Output characteristics curve.

Input Characteristics Curve: Input characteristics is defined as the set of curves between input current (I_B) vs. input voltage (V_{BE}) for the constant output voltage (V_{CE}). 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 (I_C) vs. output voltage (V_{CE}) for the constant input current (I_B). The curve has the following features –

- It has three regions namely Saturation, Active and Cutoff region.
- The rising part of the curve, where V_{CE} is 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 (I_B) an individual curve can be obtained.

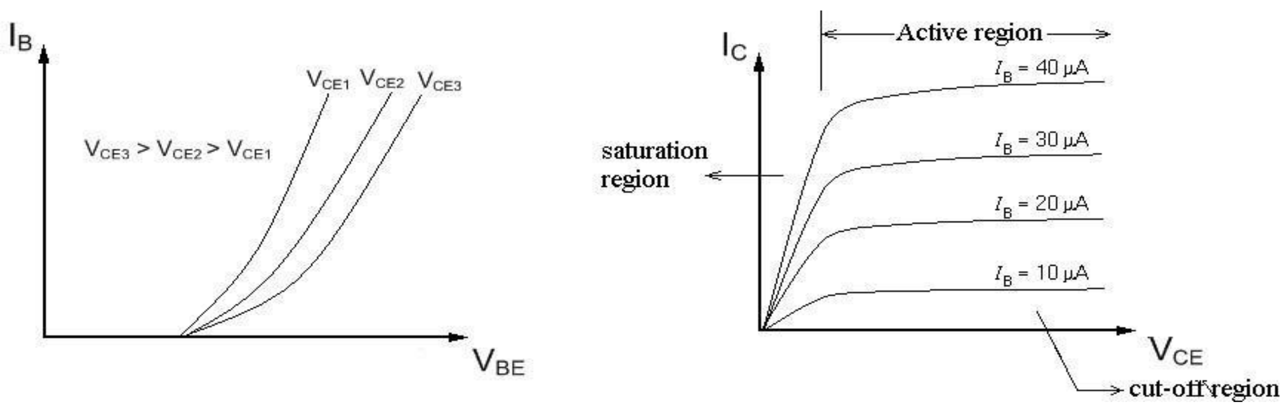
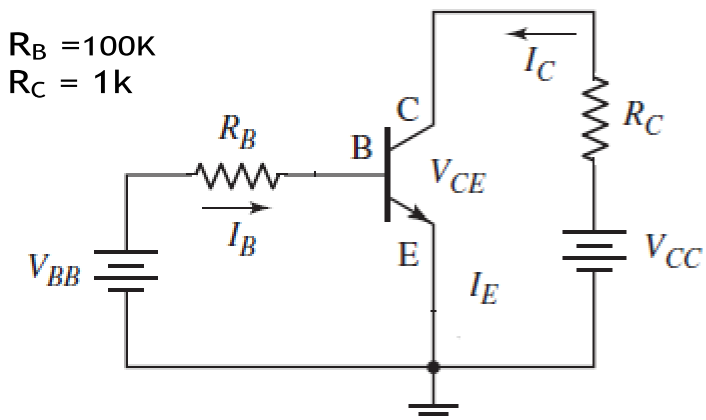


Figure 5.3: (a) Input Characteristic, (b) Output Characteristic of NPN transistor.

Equipment & Components:

Serial	Component Details	Specification	Quantity
1	Transistor	C828	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 Diagram:



Procedure:

Input Characteristics:

1. Connect the circuit as shown in the circuit diagram.
2. By varying V_{CC}, make $\mathbf{V_{CE}}$ = 1V.
3. Varying $\mathbf{V_{BB}}$ gradually, measure $\mathbf{V_{RB}}$ and base-emitter voltage $\mathbf{V_{BE}}$. Calculate $\mathbf{I_B} = \frac{V_{RB}}{R_B}$.
   Complete Table 1.
4. Step size is not fixed because of non-linear curve. Initially vary $\mathbf{V_{BB}}$ in steps of 0.1V. Once the current starts increasing vary $\mathbf{V_{BB}}$ in steps of 1V up to 12V.
5. Repeat above procedure (step 3) for $\mathbf{V_{CE}}$ = 5V.

Output Characteristics:

1. Connect the circuit as shown in the circuit diagram.
2. By varying $\mathbf{V_{BB}}$, make $\mathbf{V_{RB}}$ = 1V. This makes $\mathbf{I_B}$ = 10μA.
3. Varying $\mathbf{V_{CC}}$ gradually in steps, measure Collector-Emitter Voltage, $\mathbf{V_{CE}}$ and $\mathbf{V_{RC}}$. Calculate $\mathbf{I_C} = \frac{V_{RC}}{R_C}$. Fill up Table-2.
4. Repeat above procedure (step 3) for $\mathbf{I_B}$ = 50µA [V_{RB} = 5V]

Data Collection: *Signature of instructor:*

Experiment: 3,
Performed by Group# ______

Table 1: Input Characteristics of BJT

V_{CE} = 1 V				V_{CE} = 5V			
V_{BB} **(Volts)**	V_{BE} **(Volts)**	V_{RB} **(Volts)**	$I_B = V_{RB}/R_B$ **(µA)**	V_{BB} **(Volts)**	V_{BE} **(Volts)**	V_{RB} **(Volts)**	$I_B = V_{RB}/R_B$ **(µA)**
0.1							
0.2							
0.3							
0.4							
0.5							
0.6							
0.7							
0.8							
0.9							
1.0							
1.2							
1.4							
1.6							
1.8							
2.0							

Table 2: Output Characteristics of BJT

	I_B = 10 **µA**			I_B = 50 **µA**		
V_{CC} **(Volts)**	V_{CE} **(Volts)**	V_{RC} **(Volts)**	$I_C = V_{RC} / R_{BC}$ (**mA)**	V_{CE} **(Volts)**	V_{RC} **(Volts)**	$I_C = V_{RC} / R_{BC}$ (**mA)**
0.1						
0.2						
0.3						
0.4						
0.5						
0.6						
0.7						
0.8						
0.9						
1.0						
1.2						
1.5						
2.0						
2.5						
3.0						
5.0						
10.0						
15.0						
20.0						

Report:

1. Plot $\mathbf{I_B}$ **vs.** $\boldsymbol{V_{BE}}$ for different values of $\mathbf{V_{CE}}$ **.**
2. Plot $\mathbf{I_C}$ **vs** $\boldsymbol{V_{CE}}$ for different values of $\mathbf{I_B}$**.** Show different regions of operations.
3. Find β for the each $\mathbf{I_B}$ [for active region only]
4. For V_{cc}= 15V, draw the load line and write the coordinates of the Q-point.
5. Which region of operation does your Q-point cut?
6. Explain whether your transistor performed as an amplifier or not.