Experiment 6
Adwait Naravane 19MS151

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Aim

- Study of characteristics of an n-p-n bipolar junction transistor (BJT).
- Study of Common Emitter (CE) Amplifier using an n-p-n BJT.

Results

CE input characteristics

Here the V_{CE} is kept constant and V_{BE} is varied. The values of V_{BE} and I_B are recorded for $V_{CE} = 2, 3, 4V$.

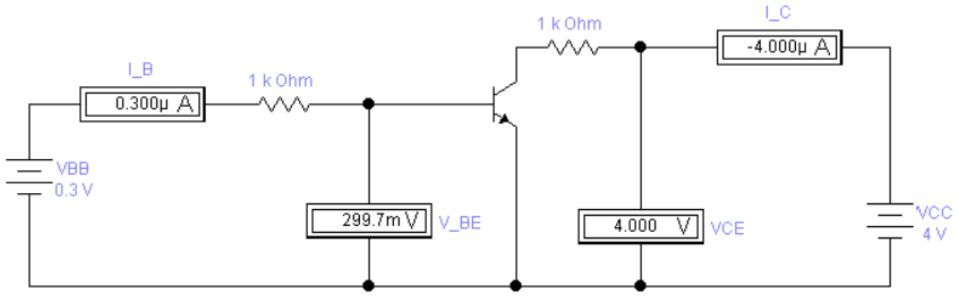
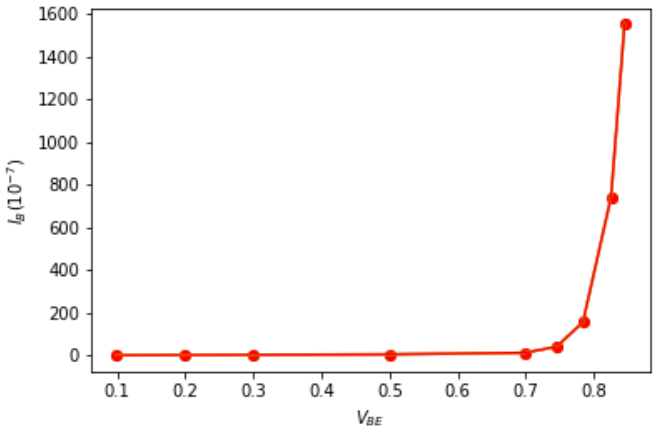


Figure 1: CE input characteristics circuit

V_{BB}	$V_{CE} = 2V$		$V_{CE} = 3V$		$V_{CE} = 4V$	
	V_{BE}	$I_B(10^{-7})$	V_{BE}	$I_B(10^{-7})$	V_{BE}	$I_B(10^{-7})$
0.1	0.099	1	0.099	1	0.099	1
0.2	0.1998	2	0.1998	2	0.1998	2
0.3	0.2997	3	0.2997	3	0.2997	3
0.5	0.4995	5	0.4995	5	0.4995	5
0.7	0.6988	12.4	0.6988	12.4	0.6988	12.4
0.75	0.7453	40.9	0.7453	40.9	0.7453	40.9
0.8	0.784	156	0.784	156	0.784	156
0.9	0.8253	742	0.8253	742	0.8253	742
1	0.845	1550	0.845	1550	0.845	1550



The values above for all values of V_{CE}, overlap. This is probably because we have used an ideal transistor.

CE output characteristics

Here I_B is set at a constant value and V_{CE} is varied. V_{CE} and I_C values are recorded for I_B values of $10, 20, 30, 40\mu A$. In order to keep I_B constant, a constant DC current source has been used.

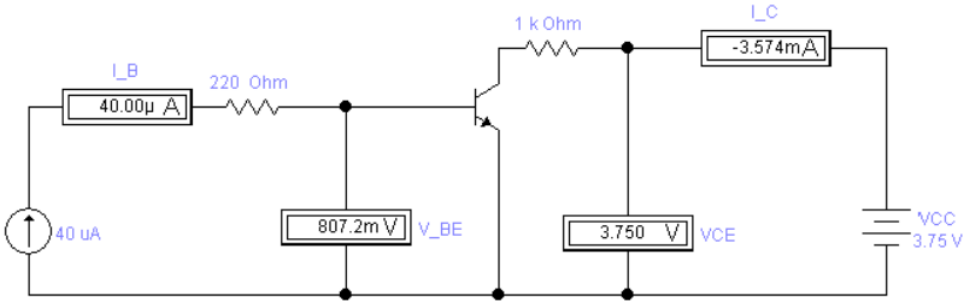
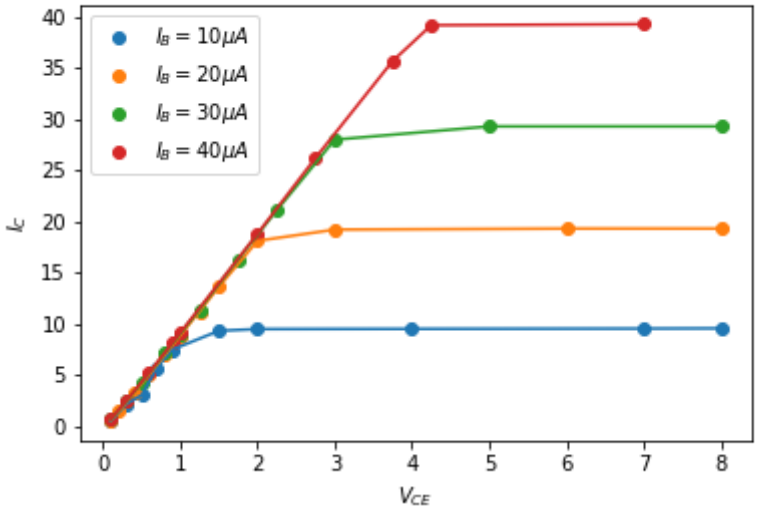


Figure 2: CE output characteristics

$I_B = 10\mu A$		$I_B = 20\mu A$		$I_B = 30\mu A$		$I_B = 40\mu A$	
V_{CE}	$I_C(10^{-4})$	V_{CE}	$I_C(10^{-4})$	V_{CE}	$I_C(10^{-4})$	V_{CE}	$I_C(10^{-4})$
0.1	0.481	0.1	0.578	0.1	0.628	0.1	0.68
0.3	2.12	0.2	1.4	0.3	2.38	0.3	2.44
0.5	3	0.4	3.2	0.5	4.24	0.6	5.24
0.7	5.7	0.6	5.06	0.8	7.09	0.9	8.14
0.9	7.47	0.8	6.95	1	9.01	1	9.11
1.5	9.3	1	8.85	1.25	11.4	2	18.8
2	9.47	1.5	13.6	1.75	16.3	2.75	26.2
4	9.49	3	19.2	2.25	21.1	3.75	35.7
7	9.52	6	19.3	5	29.3	4.25	39.2
8	9.54	8	19.3	8	29.3	7	39.3

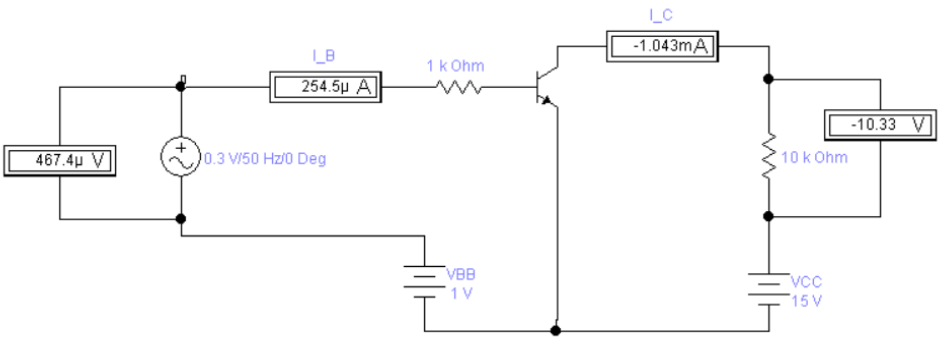


We can see that there is a rapid increase in collector current until the end of saturation region where the current plateaus. The region where the current plateaus is called the active region.

We can calculate the value of β for this circuit at $V_{CE} = 5$ where all curves plateau.
For $I_B = 10\mu A$, $\beta = \frac{I_c}{I_B} = 95$.
For $I_B = 20\mu A$, $\beta = \frac{I_c}{I_B} = 96.5$.
For $I_B = 30\mu A$, $\beta = \frac{I_c}{I_B} = 97.67$.
For $I_B = 40\mu A$, $\beta = \frac{I_c}{I_B} = 98$.

npn Transistor as an Amplifier in CE Configuration

The transistor acts as the amplifier in the active region.



We can see that the input voltage of $467\mu V$ gets amplified to $-10.33V$. The input signal is applied at the base-emitter junction and the output is taken through the load in emitter-collector junction. There is also an application of DC voltage in the input circuit for amplification. A small change in signal voltage results in the change of emitter current which is mainly due to the low resistance in the input circuit. The output is taken across the load connected on the output side. The high load resistance leads to a high voltage drop. Therefore, we can amplify a weak signal in the collector current.