Electrical and Computer Engineering Department

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ECE 2200L:

Experiment Number 5

Bipolar Junction Transistor Current-Voltage Characteristics
Represented to

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Background Information:

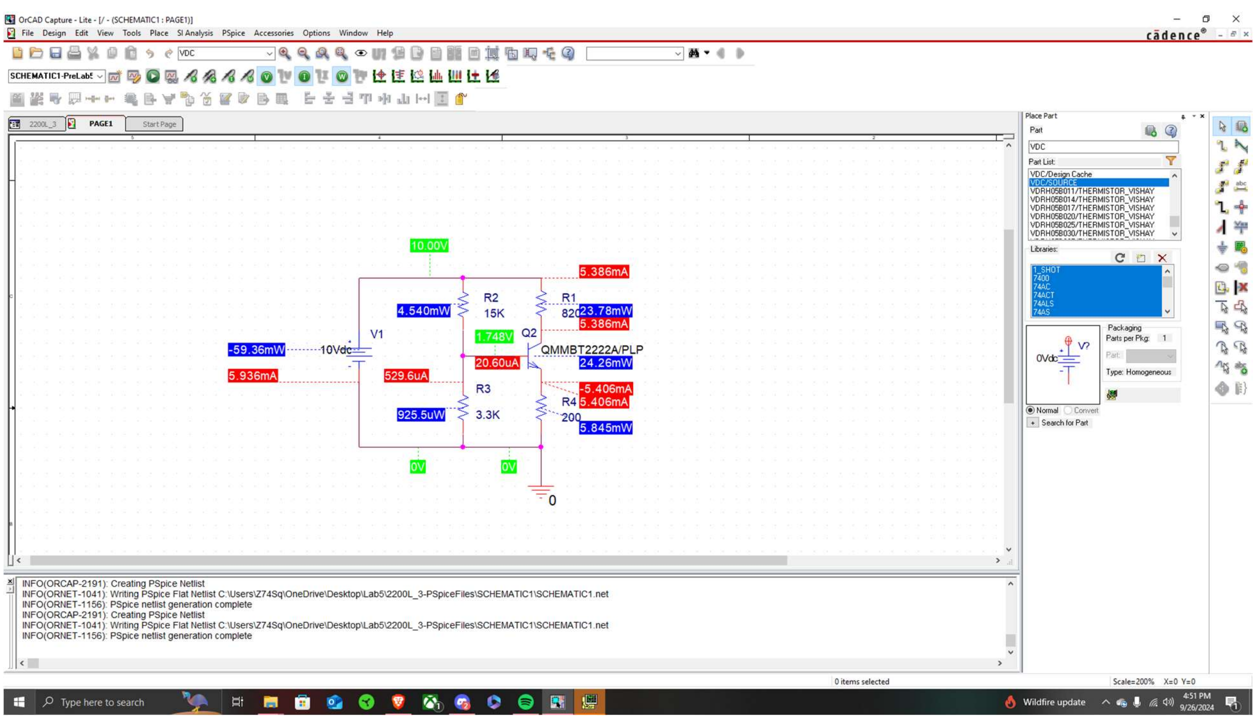
A PNP transistor, which is a type of Bipolar Junction Transistor (BJT), is widely used in various applications, with one of its primary uses being the amplification of AC signals. To maintain stable performance, it needs to be properly biased, ensuring consistent operation regardless of the β (beta) value.

Objective:

To study the current-voltage relationships of the bipolar junction transistors through laboratory experimentation.

Pre-Lab:

1) For Figure #3, using Spice (Bias Point Simulation), model the DC operating or Quiescent-Point (Q-Point) for the circuit. For the transistor, assume the device a 2N2222 (PHIL_BJT: QMMBT2222A).



Lab Report:

1. ***Figure 1:***

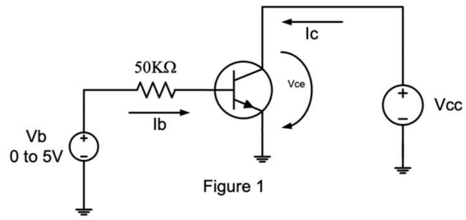
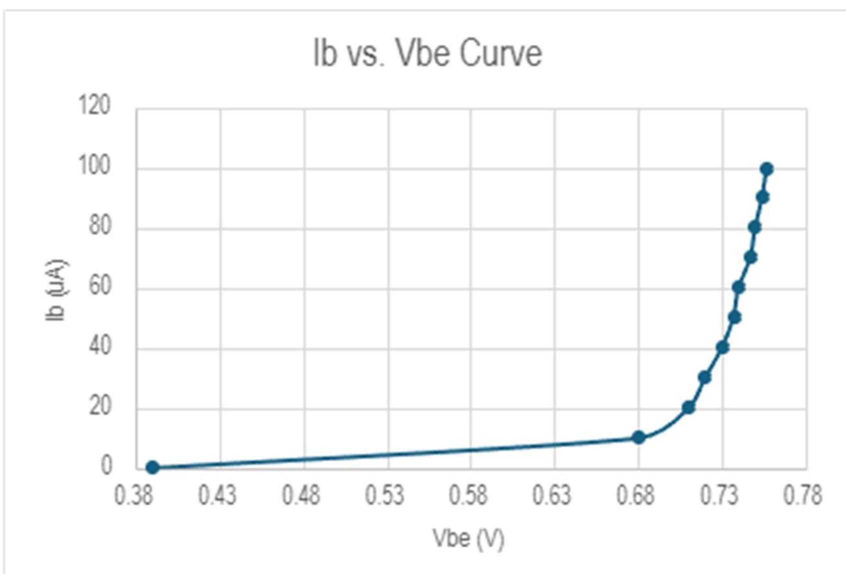


Figure 1

Table of Data:

Vbe	Ib(uA)
0.39	0
0.68	10
0.71	20
0.72	30
0.73	40
0.737	50
0.74	60
0.747	70
0.75	80
0.754	90
0.757	100

Plot $I_B\ vs\ V_{BE}$:



2. ***Figure 2:***

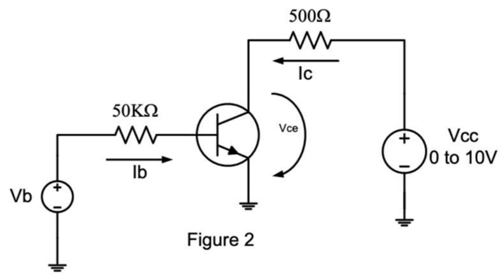


Figure 2

Table of Data $@I_B = 20\mu A$:

Vcc	Vce	Ic(mA)
0	4.00E-03	-7.94E-03
2	0.604	2.77E+00
4	2.58	2.82E+00
6	4.54	2.90E+00
8	6.52	2.94E+00
10	8.49	3.00E+00
12	10.46	3.06E+00
15	13.17	3.63E+00

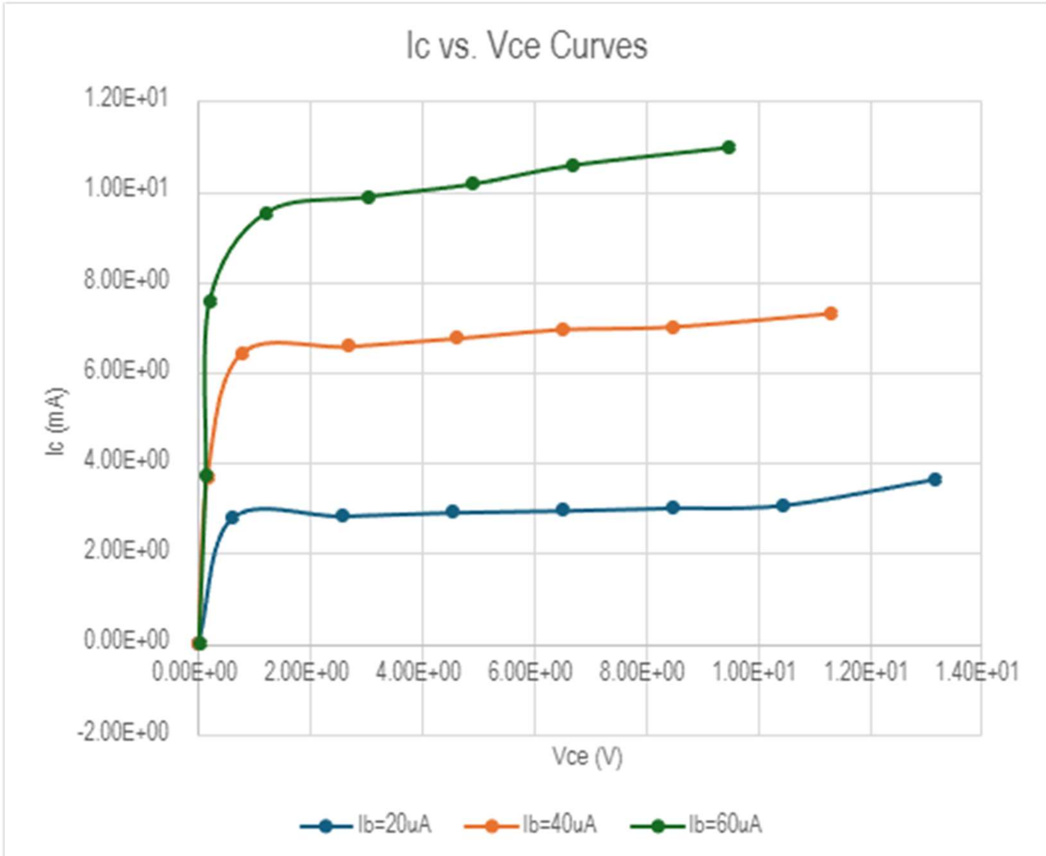
3. Table of Data $@I_B = 40\mu A$:

Vcc	Vce	Ic(mA)
0	8.30E-03	-1.65E-02
2	0.16	3.65E+00
4	0.768	6.41E+00
6	2.69	6.57E+00
8	4.6	6.75E+00
10	6.5	6.94E+00
12	8.47	7.00E+00
15	11.32	7.30E+00

Table of Data $@I_B = 60\mu A$:

Vcc	Vce	Ic(mA)
0	1.10E-02	-2.18E-02
2	0.135	3.70E+00
4	0.198	7.54E+00
6	1.2	9.52E+00
8	3.02	9.88E+00
10	4.88	1.02E+01
12	6.67	1.06E+01
15	9.47	1.10E+01

Plot $I_c \ vs \ V_{ce}$:



4. Using the above Graph and knowing that $I_B = 40\mu A$. At $V_{CE} = 5V, I_C \approx 5.7\ mA$

   This means that $\beta = \frac{I_C}{I_B} = \frac{5.7mA}{40\mu A} = 142.5$

Conclusion:

In this Experiment, we build the three circuits physically in the lab. We incremented the input voltage for the first two circuits to measure $I_B\ and\ I_C$ respectively. We also plotted $I_C\ vs\ V_{CE}$ at different I_B values. We can clearly see how each value for I_B gives us a new graph which behaves the same way as the other but shifted depending on the value of I_B.

5. Figure 3: