**CMPE 314: Principles of Electronic Circuits**

**Dr. Yan**

**Lab 04 Report**

**Transistor Characteristics**

**Sabbir Ahmed**

**Yu Fu**

1. **Objective**

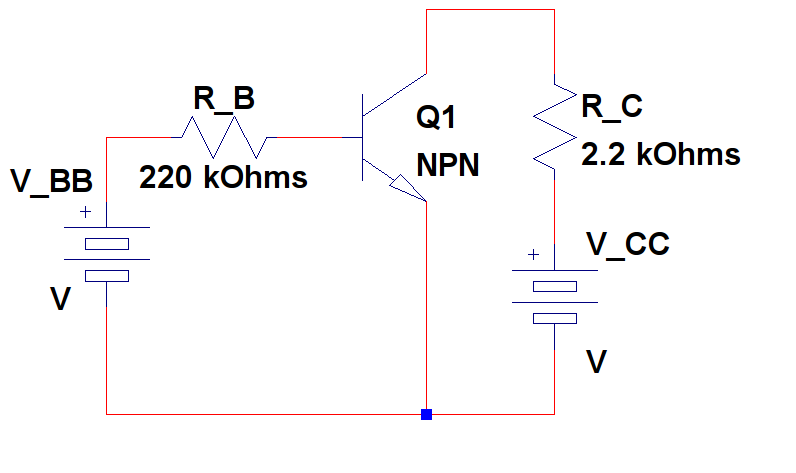
Construct a transistor circuit and measure basic transistor characteristics.

1. **Equipment**
   1. Resistors; 1 × 2.2 kΩ, 1 × 220 kΩ
   2. Transistor; 1 × 2N3904 NPN
   3. DC power supply, digital multi-meter(s), breadboard
2. **Background**

A bipolar junction transistor (BJT) is a three-terminal electronic device constructed of doped semiconductor material and may be used in amplifying or switching applications. The BJT consists of two very closely spaced PN-junctions (diodes) - the base-emitter junction and the base-collector junction. Under typical operating conditions (forward active mode), the base-emitter junction is forward biased while the base-collector junction is reverse biased. A BJT in the forward active mode can be thought of as a current controlled current source.

1. **Procedures**

**4.1 Part A. Forward Active Mode I-V Characteristics**

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**Figure 1: Common Emitter Circuit with an NPN Transistor**

* 1. Use the NPN transistor to construct the circuit from Figure 1.
  2. Increase the DC voltage from 0 V to 3 V with step of 0.5 V. For each step, increase from 0 V to 10 V with step of 0.25 V for and with step of 1 V for . Record the corresponding voltage and for each VCC input. Calculate corresponding and .
  3. Plot all the vs curves for a given on the same plot, which is called collector characteristic curves. Find the DC forward current gain .

**4.2 Part B. DC Analysis**

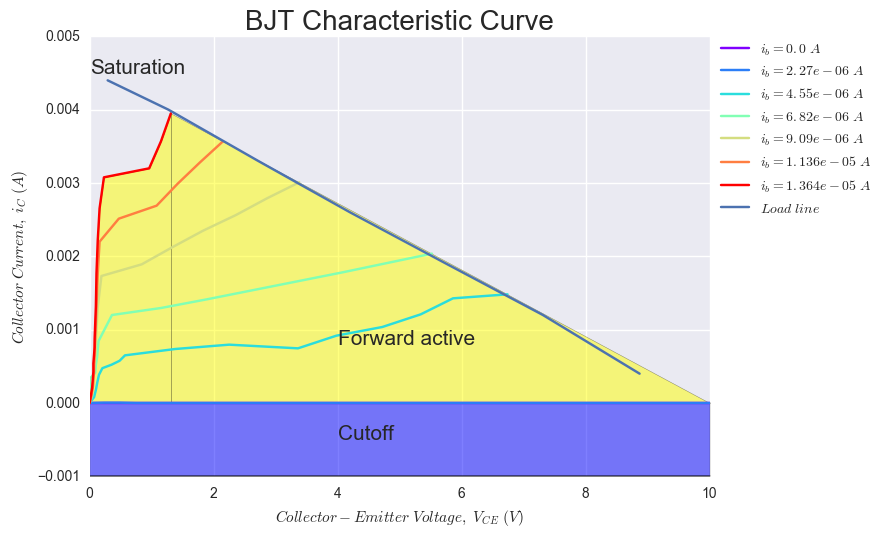
1. Set , and vary from 1 V to 4 V, with step of 0.5 V. Measure and .
2. Plot the vs loadline on the same plot with the I-V characteristics curves got in Part (A). Plot the theoretical vs loadline on the same plot. Identify the cutoff, saturation, and forward active regions on the plots.

**4.3 Part C. PSPICE Simulation**

1. Use PSPICE to simulate Part (A) and Part (B).
2. **Results**

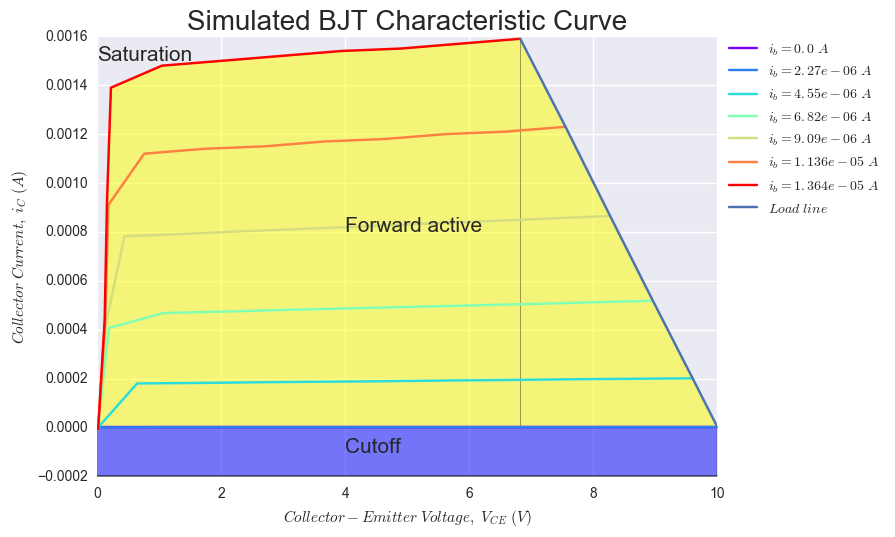
The circuit from Figure 1 was constructed and the outputs and were recorded. was computed with the relationship and through . The DC current gain was computed by taking the ratio of the average of to the average of , , which yielded as the gain.

The was plotted against , along with the cutoff, saturation and forward active regions indicated as shown below:



**Figure 2: I-V Characteristic Curves of the Transistor Used in the Circuit Constructed from Figure 1**

The transistor circuit was constructed on PSPICE, and the outputs and were dumped and plotted to create the following transistor characteristics curve plot.



**Figure 3: I-V Characteristic Curves of the Transistor Simulated on PSPICE**

1. **Conclusion**

The I-V characteristics curves plotted from the experiment have a large error from the one plotted from the simulated circuit on PSPICE. The of the curves from the measured data appear to be significantly larger than the simulated plot, and the seem to starting losing its data points after exceeds a certain threshold. The discrepancy of the plots might have been caused from inaccurate measurements of the very sensitive components used in the construction of the circuit.