

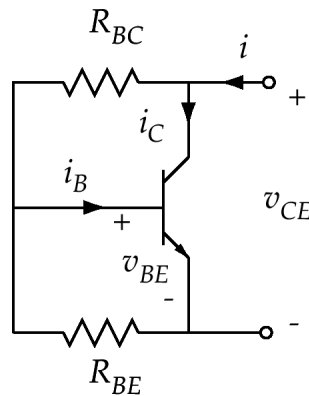
Inter American University of Puerto Rico
Bayamón Campus
School of Engineering
Department of Electrical Engineering

ELEN 3311 – Electronics I

Problem Set 4

Due Wednesday, April 27.

Problem 1: In this problem, you will analyze the v_{CE} - i characteristic of the circuit shown below. *Do not use any approximations until they are specified.*



- (A) Find the v_{CE} - i characteristic of the circuit assuming operation of the bipolar junction transistor (BJT) in the forward active region (FAR), where:

$$i_C = \beta i_B$$
$$v_{BE} = 0.7 \text{ V}$$

- (B) Find the range of operation of the BJT in the FAR in terms of v_{CE} or i . Recall that for operation in the FAR, $v_{CE} \geq 0.2 \text{ V}$ and $i_B \geq 0$.

- (C) Find the v_{CE} - i characteristic of the circuit assuming operation of the bipolar junction transistor (BJT) in the saturation region, where:

$$v_{CE} = 0.2 \text{ V}$$

$$v_{BE} = 0.7 \text{ V}$$

- (D) Find the range of operation of the BJT in the saturation region in terms of v_{CE} or i . Recall that for operation in saturation, $0 \leq i_C \leq \beta i_B$.

- (E) Find the v_{CE} - i characteristic of the circuit assuming operation of the bipolar junction transistor (BJT) in the cut-off region, where:

$$i_B = 0$$

$$i_C = 0$$

- (F) Find the range of operation of the BJT in the cut-off region in terms of v_{CE} or i . Recall that for operation in cut-off, $v_{BE} \leq 0.7 \text{ V}$ or $v_{CE} \leq 0.2 \text{ V}$. *Recall that for operation in the cut-off region it is not necessary for both conditions to be true, i.e., as long as either condition is true, the BJT will be in cut-off.*

- (G) Graph the v_{CE} - i characteristic of the circuit showing clearly any breakpoints.

- (H) Assume $\beta \gg 1$ and $R_{BC} \gg R_{BE}$. Revisit the v_{CE} - i characteristic of the circuit assuming operation of the bipolar junction transistor (BJT) in the FAR, that is, rewrite the expression for the characteristic and redraw the characteristic. In this region, what element can this circuit replace?