HACETTEPE UNIVERSITY
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
ELE 112 INTRODUCTION TO ELECTRICAL ENGINEERING LABORATORY

EXPERIMENT #6

EXAMINING BASIC CHARACTERISTICS OF A TRANSISTOR IN DC CIRCUITS

Objective: To examine DC analysis of bipolar junction transistors (BJT).

Theory: If we join together two individual diodes back-to-back, this will give us two PN-junctions connected together in series that share a common P or N terminal. The fusion of these two diodes produces a three layer, two junction, three terminal device forming the basis of a Bipolar Junction Transistor, or BJT for short.

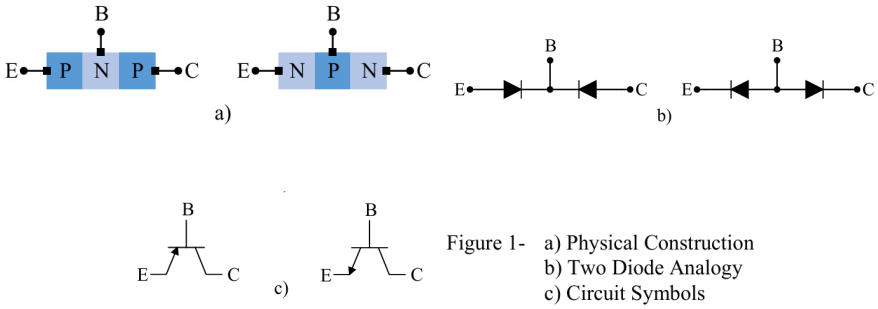

Figure 1- a) Physical Construction
b) Two Diode Analogy
c) Circuit Symbols

The BJT physical construction block diagrams are shown on Figure 1-a). The three terminals of the BJT are called Base (B), Collector (C) and Emitter (E). The BJT is fabricated with three separately doped regions. The npn device has one p region between two n regions and the pnp device has one n region between two p regions. The BJT has two junctions (boundaries between the n and the p regions). These junctions are similar to the junctions we saw in the diodes and thus they may be forward biased or reverse biased. By relating these junctions to a diode model the pnp and npn BJTs may be modeled as shown on Figure 1-b). As a result of different possible states of each junction (forward or reverse bias) the BJT will have different modes of operation which are given below:

Mode of Operation	Emitter-Base Junction	Collector Base Junction
Cut-Off	Reverse	Reverse
Active	Forward	Reverse
Saturation	Forward	Forward

The transistor's ability to change between these states enables it to have two basic functions: "switching" (digital electronics) or "amplification" (analogue electronics). Then bipolar transistors have the ability to operate within three different regions:

Active Region – the transistor operates as an amplifier and $I_C = \beta \times I_B$.
Saturation – the transistor is operating as a switch and $V_{CE} = V_{CE,\,SAT}$.
Cut-off – the transistor is "Fully-OFF" operating as a switch and $I_B = I_C = 0$.

For a detailed background please refer to the **ELE110 Introduction to Electrical Engineering** course notes.