ECSE-2210 Microelectronics Technology
Homework 8

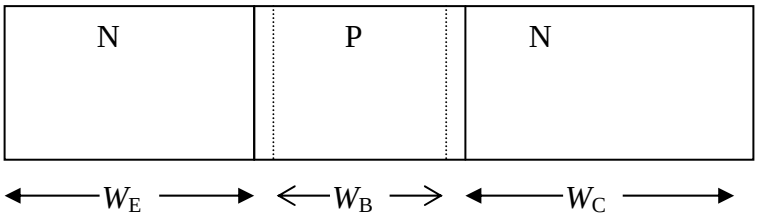
Reading List: Chapter 10, Chapter 11 (pages 389 - 403)

1. Consider an npn transistor with doping concentration and dimensions shown below.

   Answer the following questions.

a. If $V_{BC} = 0$, and $I_C = 1$ mA, what is value of V_{BE}?
b. With the transistor biased as in (a), what is the component of the base current due to recombination in the base region?
c. With the transistor biased as in (a), what is the component of the base current due to injection of holes into the emitter region?
d. What is the value of the emitter injection efficiency, γ?
e. What is the value of the base transport factor, α_T?
f. What is the value of the common emitter current gain, β_{dc}?
g. If V_{BE} is held constant at the value found in (a), and the collector-to-base voltage is increased so as to reduce the width of the neutral base region, W_B, to 10^{-4} cm, what is the common emitter current gain, β_{dc} now? Note that this is called "base width modulation" (also called "Early effect") which is common in narrow base-width transistors.

Area A = 1 cm^2



	Emitter	Base	Collector
Doping conc. (cm^{-3})	5×10^{18}	10^{16}	5×10^{18}
W (μm)	10	2	10
Lifetimes (s)	10^{-9}	10^{-7}	10^{-9}
Elect. mobility (cm^2/Vs)	120	1000	120
Hole mobility (cm^2/Vs)	75	300	75