# Midterm Exam #2

Open Book/ Open Notes
EE 3161 – Spring 2008
April 16, 2008

1) For the following diode, the bias voltage is taken from -100V to 5V.
   a) Qualitatively sketch the IV curve and label each bias region (e.g. ideal, breakdown, etc...)
   b) Quantitatively determine the bias voltage that transitions each region to another. Describe if any regions are missing from the sketch and why.

Silicon

$1\mu m$ $1 mm$

$N_D = 3\times10^{16}\ cm^{-3}$ $N_A = 5\times10^{12}\ cm^{-3}$
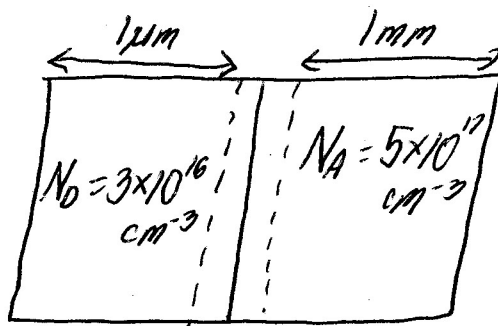
$T = 300K$

$\tau = .2\mu s$

$A = 10\mu m^2$

For simplicity, let the depletion width be constant at its $V_a = 0$ value.

2) Recall in a homework problem we split the emitter into two sections. Let's try the same thing except with the base as shown below. (Note that both sides of the base in parts a) and b) are fully electrically connected with a metal electrode that stretches around the BJT.) The transistor is set up in common emitter mode with $V_{CC} = 5V$ and the emitter grounded.
   a) If the base current is switched from 0 to I_{BB}, sketch the current i_c and the base charge versus time. What is β for the transistor?
   b) How do these curves differ from the case of a uniform base?
   c) If we had a series resistance between the base contact and a uniform τ_β base, instead of two separate base sections to the base, how would the plot (i_c versus time and base charge versus time) differ?

$N_d = 10^{18}$

$N_a = 10^{16}$

$\tau = .1\mu s$ $\tau = 1\mu s$

$N_d = 10^{15}$

R_L i_c

$W_B = .5\mu m$ (ignore x_{pE} & x_{pC})

$V_{cc} = 5V$

i_b

R_s