PSC: Assignment on BJTs

.1 (a) In a bipolar transistor biased in the forward-active region, the base current is $i_B = 6.0\,\mu A$ and the collector current is $i_C = 510\,\mu A$. Determine β, α, and i_E. (Note that $i_E = i_C + i_B$.) (b) Repeat part (a) if $i_B = 50\,\mu A$ and $i_C = 2.65$ mA.

.2 A silicon npn bipolar transistor is uniformly doped and biased in the forward-active region. The neutral base width is $x_B = 0.8\,\mu m$. The transistor doping concentrations are $N_E = 5 \times 10^{17}$ cm^{-3}, $N_B = 10^{16}$ cm ^{3}, and $N_C = 10^{15}$ cm^{-3}. *(n)* Calculate the values of p_{E0}, n_{B0}, and p_{C0}. (b) For $V_{BE} = 0.625\ V$, determine n_B at x = 0 and p_E at x' = 0. (c) Sketch the minority carrier concentrations through the device and label each curve.

.3 A uniformly doped silicon pnp transistor is biased in the forward-active mode. The doping concentrations are $N_E = 10^{18}$ cm^{-3}, $N_B = 5 \times 10^{16}$ cm^{-3}, and $N_C = 10^{15}$ cm '. (a) Calculate the values of n_{E0}, p_{B0}, and n_{C0}. (b) For $V_{EB} = 0.650\ V$, determine p_B at $x = 0$ and n_E at $x' = 0$. (c) Sketch the minority carrier concentrations through the device and label each curve.

.4 An npn silicon bipolar transistor at **7** = 300 K has uniform dopings of $N_E = 10^{19}$ cm^{-3}, $N_B = 10^{17}$ cm^{-3}, and $N_C = 7 \times 10^{15}$ cm^{-3}. The transistor is operating in the inverse-active mode with $V_{BE} = -2$ V and $V_{BC} = 0.565$ V. (a) Sketch the minority carrier distribution through the device. (b) Determine the minority carrier concentrations at $x = x_B$ and $x'' = 0$. *(c)* If the metallurgical base width is $1.2\,\mu m$, determine the neutral base width.

.5 The following currents are measured in a uniformly doped npn bipolar transistor:

I,,, = 1.20 mA	I,,, = 0.10 mA
I_{nC} = 1.18 mA	I_R = 0.20 mA
I_G = 0.001 mA	I_{pc0} = 0.001 mA

Determine *(a)* a. (b) γ, (c) α_T, (d) δ, and (e) β.