Name:_____

Student ID #:_____

**ECE 113A**
**Homework #4**
**Due 10 A.M. Wednesday, November 5, 2003**

Please *staple* this sheet to the front of your homework.

| 1a | 1b | 1c | 2a | 2b | 2c | 3a | 3b | 3c | 3d | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| /10 | /10 | /10 | /10 | /10 | /10 | /10 | /10 | /10 | /10 | /100 |

1) For Si at 300 K, with no light, and under steady state conditions, with $N_A = 10^{18}$ cm$^{-3}$, and zero electric field:
   a. Find $\Delta n_p(x)$ from 0 to infinity if $\Delta n_p(0)=10^{15}$ cm$^{-3}$; $\Delta n_p(\text{infinity})=0$. (Use $\tau=1$ μs).
   b. Find n(x) under same conditions.
   c. Find p(x) under same conditions.

2) For Si at 300 K, with no light, and under steady state conditions, with $N_D = 10^{15}$ cm$^{-3}$, and zero electric field:
   a. Find $\Delta p_n(x)$ from x=0 to x=1 μm if $\Delta p_n(0)=10^{10}$ cm$^{-3}$; $\Delta p_n(x=1\ \mu m)= 10^{8}$ cm$^{-3}$. (Use $\tau=1$ μs).
   b. Find p(x) under same conditions.
   c. Find n(x) under same conditions.

   *For both problems, remember, you can only apply diffusion equation solutions to minority carriers. Also remember, if low-level conditions prevail as discussed on page 112 (do they?) then the majority carrier concentration is essentially unperturbed from its equilibrium value.*

3) For a Si p-n diode at 300 K, with no applied voltage, with $N_A = 10^{15}$ cm$^{-3}$, and $N_D = 10^{18}$ cm$^{-3}$
   a. Calculate $V_{bi}$ in units of V
   b. Calculate $x_p$ in units of μm
   c. Calculate $x_n$ in units of μm
   d. Calculate $W = x_n + x_p$ in units of μm