**MASSACHUSETTS INSTITUTE OF TECHNOLOGY**
*Department of Electrical Engineering and Computer Science*

# 6.012 ELECTRONIC DEVICES AND CIRCUITS

Problem Set No. 2

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**Issued:** September 12, 2003 **Due:** September 19, 2003

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**Reading Assignments:**

Lecture 2 (9/9/03) - Chap. 3 (all *except 3.3.2*), App. B **Note change (italicized)**
Lecture 3 (9/11/03) - Chap. 4 (all)
Lecture 4 (9/16/03) - Chap. 5 (all)
Lecture 5 (9/18/03) - Chap. 6 (all)
Lecture 6 (9/23/03) - Chap. 7 (7.1,7.2)
Lecture 7 (9/25/03) - Chap. 7 (7.3, 7.4.1a)

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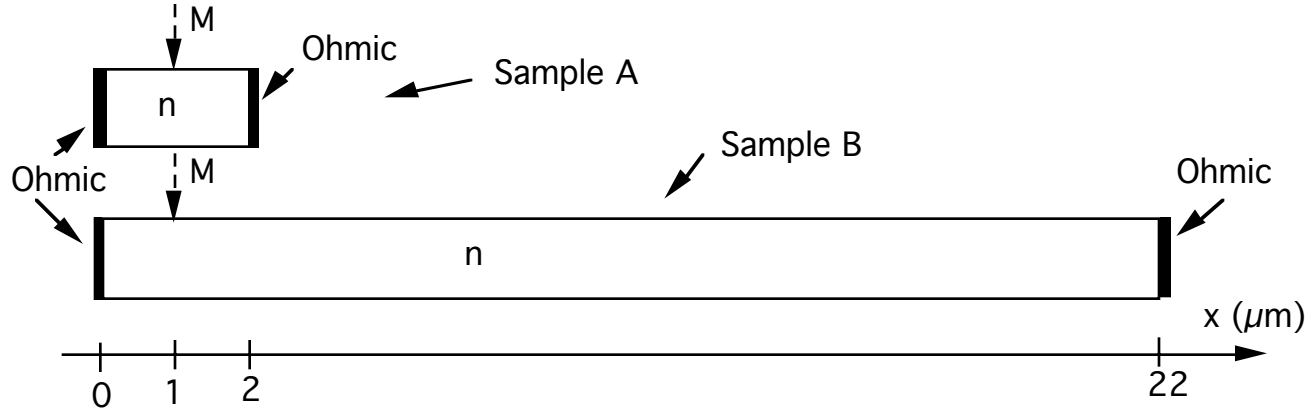
Problem 1 - Do Problem 3.13 in the course text.

Problem 2 - Do Problem 5.7 in the course text. Note: Part (a)(i) should read "... *R* will **decay** as..."

Problem 3 - This question concerns the two samples illustrated below. Both are n-type silicon samples with a net donor concentration, $N_D$, of $10^{16}$ $cm^{-3}$; electron mobility, $\mu_e$, of 1600 $cm^2/V\text{-}s$; hole mobility, $\mu_h$, of 600 $cm^2/V\text{-}s$; and minority carrier lifetime, $\tau_{min}$, of $10^{-6}$ s. One bar, Sample A, is 2 $\mu$m long; the other, Sample B, is 22 $\mu$m long. Both samples are illuminated with light which generates qM hole-electron pairs $cm^{-3}\text{-}s^{-1}$ uniformly across the plane at x = 1$\mu$m.




a) What are the minority carrier diffusion coefficient, $D_h$, and the minority carrier diffusion length, $L_h$, in these samples?

b) Sketch the excess minority carrier profiles in the two samples. Assume $L_h >> 22$ $\mu$m, inspite of what you may have calculated in Part (a). You need not calculate p'(1 $\mu$m).

c) i) In Sample A, what fraction of the injected hole-electron pairs recombine at the ohmic contact at x = 0?

ii) In Sample B, what fraction of the injected hole-electron pairs recombine at the ohmic contact at x = 0?

d) In which sample, A or B, if any, is p'(1 $\mu$m), the excess hole concentration at x = 1 $\mu$m, larger? Explain your answer.

Problem 4 - Do Problem 5.2 in the course text.

Problem 5 - Do Problem 5.9 in the course text.