

UNIVERSITY OF CALIFORNIA **ECE 132**
Electrical and Computer Engineering Department

Problem Set No. 5
Fall 2007

Issued: October 25, 2007

Revised due date: November 1, 2007

Reading Assignment: Streetman, Finish Chapter 4, Read Chap 5 → 5.4

PROBLEMS

1. A Silicon (Si) p+-n junction has a donor doping of $1E+16\text{cm}^{-3}$ on the n-side and a cross-sectional area of $1E-3\text{cm}^2$. If the hole minority carrier lifetime is 1 microsecond and $D_p = 10\text{cm}^2/\text{sec}$, calculate the forward current with a forward bias of 0.5 volts at 300K.

2. **p-n Junctions**

A junction is made in **Germanium (Ge)** by using a p-type region, an intrinsic region (with no doping) and an n-type region in a manner sketched below. This structure is called a pin diode. The doping in the p and the n regions are equal in magnitude ($N_a = N_d = 5 \times 10^{17} \text{cm}^{-3}$).

Calculate:

- i. The built in voltage of the junction.
- ii. The electric field distribution in the structure.
- iii. The breakdown voltage if the maximum electric field at breakdown is 10^5V/cm .
- iv. DRAW the band diagram, the electric field profile, depletion regions, and the charge distribution in the structure at zero bias.

