`TRY

1. A Si step juntion operated at 300k with $N_A = 10^{17} cm^{-3}$ and $N_D 10^{14} cm^{-3}$;

Calculate the Fermi level poisitions in the pand n regions

a) Draw the band diagram for the junction
b) Determine the contact potential V_o or V_{bi}
c) If the depletion into p-side is 2.27 x$10^{-3} \mu$m, find the depletion on the n-side.

2. What is the hole diffusion constant in a sample of silicon with μ_p =410cm^2/V-s

PHYSICAL CONSTANTS

q	Electronic Charge	$1.602 \times 10^{-19} C$
ε_o	Permittivity of free space	$8.854 \times 10^{-14} F/cm$
μ_o	Permeability of free Space	$1.2566 \times 10^{-8} \frac{H}{cm}$
k	Boltzmann Constant	$1.38 \times 10^{-23} J/K$
h	Planck Constant	$6.626 \times 10^{-34} J.s$
m_o	Electron Rest Mass	$9.11 \times 10^{-31} kg$
eV	Electron Volt	$1.602 \times 10^{-19} J$
c	Speed of Light	3×10^{8} ms^{-1}
kT/q	Thermal Voltage	0.025 V

SOME PROPERTIES OF SILICON

n_i	Intrinsic Carrier Concentration	$1.5 \times 10^{10} cm^{-3}$
N_c	Effective Density of Stated (CB)	$2.8 \times 10^{19} cm^{-3}$
N_v	Effective Density of States	$1.04 \times 10^{19} cm^{-3}$
E_G	Band Gap	1.12 eV
ε_s	Dielectric Constant	11.8
ε_{ox}	Dielectric Constant	3.6
γ	Electron affinity	4.05 V

QUIZ 2- EEE, CE, REE 200

Answer all questions

1. An abrupt Si p-n junction has the following properties at 300K:

P side	N side
$N_A = 10^{15} cm^{-3}$	$N_D = 10^{17} cm^{-3}$
$\tau_n = 10\mu s$	$\tau_p = 0.1\mu s$
$\mu_n = 1300 cm^2/V.s$	$\mu_n = 700 cm^2/V.s$
$\mu_p = 450 cm^2/V.s$	$\mu_p = 250 cm^2/V.s$

$A = 10^{-4} cm^2$

   a. Draw the equilibrium band diagram for this junction, including numerical values for the fermi level position relative to the intrinsic level on each side.
   b. Calculate the contact potential
   c. Calculate the depletion width on each side
   d. Calculate the maximum electric field.
   e. Calculate the minority carrier concentrations at the depletion-layer edges under thermal equilibrium

2. Consider a p-n Si diode with $N_A = 10^{18} cm^{-3}$ and $N_D = 10^{16} cm^{-3}$. The hole diffusion coefficient in the n-side is $10 cm^2/s$ and $\tau_p = 10^{-7} s$. The device area is $10^{-4} cm^2$. Calculate the reverse saturation current and forward current at a forward bias of 0.7 V at 300K.

[kT= 0.026 V, $n_i = 1.5 \times 10^{10} cm^{-3}, q = 1.6 \times 10^{-19} C, \varepsilon_s = 11.8, \varepsilon_o = 8.854 \times 10^{-14} F/cm$]

I_n

CENG 207: SOLID STATE ELECTRONIC DEVICES

QUIZ 1- EEE, CE 200

Answer all questions

1. An abrupt Si p-n junction has $N_D = 2 \times 10^{18} cm^{-3}$ on one side and $N_A = 5 \times 10^{16} cm^{-3}$ on the other.
   a) Calculate the fermi level positions at 300K in the p and n regions
   b) Draw an equilibrium band diagram for the junction and determine the barrier potential from the diagram
   c) If the depletion on the p side is 14.65μm, calculate the depletion width on the n-side
2. A homogenously doped semi-conductor material has donors $1 \times 10^{17} cm^{-3}$. The particles are observed to move 0.1 m in 100μs. If a potential of 10 V is applied across the material, Calculate
   a) Mobility
   b) Diffusion coefficient of electrons

[kT= 0.026 V, $n_i = 1.5 \times 10^{10} cm^{-3}, q = 1.6 \times 10^{-19} C, \varepsilon_s = 11.8, \varepsilon_o = 8.854 \times 10^{-14} F/cm$]

$\frac{D_n}{\mu} = \frac{KT}{q}$

$J_n =$

$m^2 s^{-1}$

$E = \frac{V}{L} = \frac{10}{0.1}$

$Vel = \frac{L}{t} = \frac{0.1}{100 \times 10^{-6}}$

$\mu = \frac{Vel}{E}$