**Set :1**

**a). Choose oping densities for the N and P regions (with thickness of I region being zero). Calculate the Vbi, and W the depletion region width analytically. Simulate the structure, observe the band diagram and compare the analytical solution with numerical simulations. Repeat the same for different combinations of doping densities.**

Temp 300K thickness i =0 p type:2\*10^15 n type 1\*10^15/cm3 material si eº11.2

W

3.77-2.66=0.89um da

4.44-2.09 =1.3 um

Both are same in potential

0.6129 v

P type :2\*10^17 n type :2\*10^17

3.02-2.94um = 0.08um da

3.14-2.88 = 0.26um

**0.869v**

P type :10^18 n type :1\*10^16

0.833v

3.33-2.99=0.34um for da

3.50-2.95=0.55um

**Result:**

As we increase Na & Nd w falls.this is justified as w is proportional to to 1/n

Depletion approximation has no effect on voltage

Due to depletion approximation the calculated width is less than actual width (through simulation )

**b). Simulate a PIN structure. Estimate the Vbi and compare with part (a) above for similar doping densities.**

P type :2\*10^17 n type :2\*10^17 intrinsic region 1um

Potential =0.869 v

Approx same

P type :10^18 n type :1\*10^16 intrinsic length 1um

0.833v

Temp 300K thickness i =0 p type:2\*10^15 n type 1\*10^15/cm3 material si eº11.2

0.613v

**Result:**

Vbido not change due to adding a intrinsic region in between

**c). For a PN junction diode, what would be the variation of "W" with temperature? First, obtain an analytical estimate and then check by performing numerical simulations.**

P type :10^17 n type :1\*10^16 intrinsic length =0

**300K** w= 3.3 -2.96=0.33

3.5-2.87=0.63

**400K w**=3-2.96=0.33

3.50-2.87=0.63

**200K** w= 3.32-2.97=0.35

3.5 -2.89=0.61

**100K** w= 3.3 -2.96 =0.34

3.5-2.87 = 0.63

**Set 2**

**1). Analytically estimate Jo, the reverse saturation current, for different combinations of Na and Nd, the doping densities (using Ideal diode equation). Compare them with the corresponding values obtained through numerical simulations.**

Temp 300K thickness i =0 p type:2\*10^17 n type 2\*10^17/cm3 material si eº11.2 v -2

6.975\*10^-5 a /cm2

**2). Explore the voltage dependence of reverse bias current through numerical simulations. Compare and discuss the trends with the results of ideal diode model.**

**3). Estimate the temperature coefficient of diode IV characteristics (i.e., rate of change of current per K). Compare it with analytical estimates.**

P type :10^17 n type :1\*10^16 intrinsic length =0 v =+2v

300K jo = 3510.1 A

400K jo = 2248.78 A

200K jo = 6013.82A

100K jo = 9085.41 A

**4). Explore the split in quasi-Fermi levels as a function of applied voltage. Is the assumption of "law of junction" (i.e., np=ni^2\*exp(qV/kT) ) valid?**

v=0.42 n= 4.2x10^17 p =