Rajiv Gandhi University of Knowledge Technologies

Weekly Test 3- Semiconductor Devices

Date: 1.09.2012 **Time:** 30 Min

Course: E2Sem1_ ECE **Max Marks:** 10

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1. Which of the following set of the consequences due to heavy doping of semiconductors are correct
   A) The Fermi level approaches the band
   B) Band gap narrowing takes place
   C) The carrier freeze-out phenomena will not be observed
   D) Band gap widening will takes place
   E) Fermi level should be forbidden region only

a) A, C & D b) A ,B & C c) b) B ,C & E d) D,C & E e) A & B only f) B & C only g) A & D only h) none of these

2. The Fermi level in n-type silicon at T = 300 K is 245 meV below the conduction band and 200meV below the donor level. (Assume g=2)
   Probability of finding an electron in the donor level

a) 6.85×10^{-6} b) 7.95×10^{-4} c) 7.65×10^{-7} d) 2.15×10^{-5} e) 8.25×10^{-2} f) 3.21×10^{-2} g) 8.85×10^{-4} h) 8.15×10^{-3}

3. Use the data in the above problem, Probability of finding an electron in a state in the conduction band kT above the conduction band edge.

a) 2.85×10^{-6} b) 5.95×10^{-4} c) 6.65×10^{-7} d) 3.15×10^{-5} e) 3.95×10^{-2} f) 3.11×10^{-3} g) 2.87×10^{-5} h) 7.15×10^{-3}

4. Which of the following set of relations are completely correct for the Fermi level in extrinsic semiconductors?
   A) $E_f - Ev = KT \ln (N_v / p_0)$
   B) $Ev - Ef = KT \ln (Nv / p_0)$
   C) $E_{fi} - Ef = KT \ln (p_0 / n_i)$
   D) $E_f - Ev = KT \ln (N_v / N_a)$
   E) $E_f - Ev = KT \ln (N_a / N_v)$

   a) A , C & E b) A ,C & D c) B , C & D d) B ,D & E e) E & A only f) B and D only g) B only h) none of these

5. Which of the following set of relations are completely correct for the Fermi level in extrinsic semiconductors?

A) $E_C - Ef = KT \ln (n_o / N_c)$

B) $E_C - Ef = KT \ln (N_c / n_o /)$

C) $E_{fi} - E_f = KT \ln (n_{0/} n_i)$

D) $E_f - E_{fi} = KT \ln (n_{0/} n_i)$

E) $E_c - E_f = KT \ln (N_d / N_c)$

a) A , C & E b) B ,C & E c) A , D & E d) B ,D & E e) A & C only f) B and D only g) B & E only h) D and E only

6.Silicon at room temperature having N_a= 5 X10^{15} cm^{-3} , the Fermi level is 0.215 eV below the conduction band edge , what is the donor atom concentration to be added to make the compensated semiconductor.(m_h^* =.56 m_0, m_e^* =1.08 m_0)

a)1.2 x 10^{15} cm^{-3} b) 1.9 x10^{16} cm^{-3} c) 1.2 x 10^{16} cm^{-3}d) 2.4x10^{16} cm^{-3}e) 3.8x10^{16} cm^{-3} f) 5.52x 10^{15} cm^{-3} g) 5 x10^{14} cm^{-3} h) 1.6 x 10^{13} cm^{-3}

7. A sample of silicon at T= 450 k having Na= 1.5 x 10^{15} cm^{-3}, N_d= 8 x 10^{14} cm^{-3} the thermal equilibrium hole concentration is

a)7x 10^{14} cm^{-3} b) 7.9 x10^{16} cm^{-3} c) 6.2 x 10^{16} cm^{-3}d) 2.4x10^{16} cm^{-3}e) 3.8x10^{16} cm^{-3}
f) 5.52x 10^{15} cm^{-3} g) 5 x10^{17} cm^{-3} h) 1.6 x 10^{19} cm^{-3}

8. The thermal equilibrium electron concentration for the above problem is

a) 5.23x 10^{13} cm^{-3} b) 5 x10^{12} cm^{-3} c) 4.23x 10^{11} cm^{3}) 9.24x$10^{10}$$cm^{-3}$e) 3.8x$10^{15}$ cm^{-3}
f) 5.52x 10^{5} cm^{-3} g) 2.1 x$10^{19}$$cm^{-3}$ h) none of these

9. For a particular semiconductor at room temperature, Eg= 1.5 eV, m_h^* =10 m_n^* , the position of the intrinsic fermilevel is

a) .0417 meV below the midgap energy
b) .025 meV below the midgap energy
c) .025 meV above the midgap energy
d) 44.7 meV above the midgap energy
e) 19.8 meV below the midgap energy
f) 19.8 meV below the midgap energy
g) 44.7 meV below the midgap energy
h) None of these

10. For the above question, what is the impurity concentration is added so that it becomes p- type semiconductor such that the fermilevel is 0.215 eV below the conduction band edge

a) 1.71x 10^{8} cm-^{3} b) 1.67 x10^{11} cm^{-3} c) 1.83x 10^{14} cm^{3} d) 1.27x$10^{10}$$cm^{-3}$e) 3.8x$10^{11}$ cm^{-3}
f) 5.52x 10^{9} cm^{-3} g) 1.97 x$10^{13}$$cm^{-3}$ h) none of these

KEY
1. e
2. g
3. g
4 .b
5. f
6. c
7. a
8. h
9. d
10.g