Nepal College of Information Technology

**Assessment**

Fall 2012

Program : CE/ELX Time : 3 hrs

Semester : Fall (III) FM : 100

Subject : Electrical Engineering Materials PM : 50

* *Candidates are requested to give their answer as far as practicable in their own words.*
* *The figure in the margin indicates the full marks*
* ***Attempt ALL question***

1. a) Define density of state function. Obtain an expression for it to show that the number of available energy levels increases parabolically with increasing energy. 8

b) The density of states related effective masses of electrons and holes in silicone are approximately 1.08me and 0.56me respectively. The electron and hole drift motilities at room temperature are 1350 and 450 cm2V-1S-1 respectively. Calculate intrinsic concentration and intrinsic resistivity of silicon. Take the energy band gap for silicon as 1.1eV. 7

OR

A semiconductor crystal is characterised by following energy band diagram at 300k.



i) Find the type of dopant and doping level.

ii) Calculate the conductivity of semiconductor at room.

iii) If it is desired that the Fermi-level is to be raised to 0.1 eV above intrinsic Fermi-level. What type of dopant is to be used? Determine its doping level. 7

a) Derive time independent Schrodinger’s equation. Starting with classical wave equations y = A sin2Π (ft- x/λ), where the notations have their usual meanings. 8

b) In the photoelectric experiment, green light with a wavelength of 522 nm is the longest wavelength radiation that can cause photoemission of electron from a clean sodium surface. Calculate the threshold value of sodium. If an ultraviolet radiation with wavelength of 250 nm and another red light with wavelength 700 nm are incident to the sodium surface, is there emission of electrons. Justify. If emission, calculate the velocity of photo-emitted electrons. 7

3. a) Define the polarization. Show that "there will be no polarization if the dielectric constant is equal to zero. 7

b) Derive the relation for effective mass of an electron as , where the nations have their usual meanings. 8

4. a) What is ionic conduction? Derive the relation for ionic conductivity as exp [-Q/KT]. 8

b) For an electron confined to an infinite potential well of width 0.1nm, determine the uncertainty in momentum and kinetic energy. 7

5. a) Derive the relation for effective density state at the conduction band edge. 9

b) With necessary derivation, show that the Fermi level in intrinsic semiconductor lies between the conduction band and valance band. 6

6. a) A heavily doped p-side with acceptor concentration of 1018 cm-3 is connected to n-side with donor concentration of 1016 cm-3. Calculate the built in potential, depletion width in n-side and p-side and overall depletion width. Assume, T = 300K and intrinsic concentration (ni)=1.45×1010 cm-3. 7

b) An electron is confined to an infinite potential well of size 0.1nm. Calculate the ground energy of the electron and radian frequency. How this electron can be put to the third energy level? 8

7. Write short notes on (Any Two): 5\*2=10

a) SCC and FCC structures

b) ferro-electricity

c) thermo-ionic emission