MCC/18/M.Sc./Sem.II/PHS/1

Second Semester Examination-2018

M.Sc. PHYSICS

Paper Code: PHS 202

Full Marks: 40 **Time: 2 Hours**

Use Separate scripts for Group A & Group B

Group A

(Solid State II)

Answer Question no 1 and any One from the rest.

1. **Answer any two questions from the following:** **2×2=4**

   i) Assuming electronic polarigibility derive clausius mostti relation of a solid.

   ii) Clearly distinguish Type I & Type II superconductor with neat diagrams of Variation of magnetisatum with magnetic field.

   iii) Calculate the value of London penetration depth λ_o at OK for lead whose super electron density is $3.29\times 10^{28}/m^3$.

2. **Answer any two questions from the following:** **2×3=6**

   i) Show that transition from superconducting state to normal state at $T = T_c$, is second order.

   ii) What is Meissner effect? Show how London's equation leads to this effect?

   iii) The optical index of refraction and the dielectric constant for water are 1.33 and 8.1 respectively. Determine the percentage of ionic polarizibility.

3. What is single particle tunneling explain. Explain DC Josephson effect in details and find an expression of current density. What is meant by flux quantization? **2+6+2=10**

4. Derive the expression for $\epsilon'(w)$ *and* $\epsilon''(w)$ for electronic polarizibility in presence of ac field. Show the variation of $\epsilon'(w)$ *and* $\epsilon''(w)$ with frequency for electronic polarizibility.

   A Superconducting Tin has a critical temperature of 3.7k in zero magnetic field and a critical field of 0.0306T at 0k. Find the critical field at 2k.

   What is difference between perfect conductor and superconductor (Draw necessary diagram). **3+2+3+2= 10**

Group B

(Semiconductor Physics)

Answer Question no 1 and 2 & any One from the rest.

1. **Answer any two questions:** **2×2= 4**

   i) An intrinsic si bar is doped uniformly with 10^{21} atoms of antimony per m^3. Calculate the value of resistivity.

   Given: n_i $1.5\times10^{+10}cm^{-3}$, $\mu_n=0.13m^2/v\text{-sec}$,

   $\mu_n=0.05m^2/v\text{-sec}$.

   ii) A pure semi-conductor has an energy gap of 1ev. For temperature of 0k and 300k respectively, calculate the probability of an electron occupying a state near bottom of the conduction band.

   iii) Find the expression of Fermi level of an intrinsic semi-conductor.

2. **Answer any two questions:** **2×3= 6**

   i) Drive expression for potential barrier in a P-n junction when there is no external bias.

   ii) The minority carrier lifetime in P-type material is 10^{-7} second. The mobility of electron in si is $0.15m^2v^{-1}s^{-1}$ at 300k. If 10^{20} electron/m^3 are injected at x=0, what is the diffusion current density just at the junction?

   iii) Explain what is meant by relaxation time?

   Show from the growth and recombination of carrier, the photoconductive decay can be expressed as $\Delta n=\Delta n_s e^{-t/\zeta}$ provide the light is made off.

3. **Answer the following questions:** **6+4=10**

   i) Derive expression for current in a p-n junction diode under forward bias condition.

   ii) Describe operation of a semiconductor Laser.

4. **Answer the following questions:** **6+1+3=10**

   i) Derive an expression of density of states in the conductor bond and hence find the concentration of electron in a non-degenerate semi-conductor.

   ii) In an n type semi-conductor, the Fermi level lies 0.3ev below the conduction bond at 300k. If the temperature is increased at 330k, find the new position of Fermi level.