2016

M.Sc. 2nd Seme. Examination

PHYSICS

PAPER—PHS-202

Full Marks : 40

Time : 2 Hours

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Use separate Answer-scripts for Group-A & Group-B

Group—A

1. Answer any *two* of the followings : 2×2

(a) What is super conductivity and how it differ from perfect conductivity ?

(b) Describe the effect of magnetic field on super conductivity ?

(c) Show that total magnetic flux threding a closed resistance less circuit cannot change so long as the circuit remains resistanceless.

2. Answer any *two* of the followings : 2×3

(a) For a specimen of V_3Ga, the critical fields are 1.4×10^5 and 4.2×10^5 ampere/metre respectively for 14K and 13K. Calculate the transition temperature.

(b) Explain polarizability of atoms and molecules. Discuss what are its sources.

(c) Calculate the value of the London penetration depth λ_0 at 0K for lead whose super electron density is $3.29 \times 10^{28}/m^3$.

3. Answer any *one* of the followings : 1×10

(a) Prove that the current density in a super conductor can be expressed as

$$\vec{j} = -\frac{\vec{A}}{\wedge_s c} + \frac{\hbar}{q \wedge_s} \nabla\theta$$

where, $\vec{A}$ is the vector potential

$$\wedge_s = \frac{q^2 n_s^*}{m}$$

q is the charge of electron

n_s^* and m are the density

and mass of copper pairs respectively.

θ is the phase

Hence derive the London equations from the above super current equation.

Draw the variation of resistivity with temperature for a perfect metal, normal metal and a superconductor.

4+4+2

(b) Describe dipolar polarizability. Derive the expression for Debye equations.

What is the physical significance of Claussius.-Mossotti relation ? 2+6+2

Group—B

Answer Q. No. *1* and *2* and any *one* from the rest.

1. Answer any *two* questions: 2×2

(a) For an intrinsic semiconductor with a gap width of 1ev. Calculate the position of the Fermi level at T = 300K.

Given, $m_h^* = 6m_e^*$.

(b) Find an expression of barrior potential of a p-n function under equilibrium condition ?

(c) Find an expression of decay of carriers in a semiconductor under Quadratic Recombination ?

2. Answer any *two* questions: 2×3

(a) Show how the Fermi level vary for a p-type semiconductor from low temperature to high temperature. Find an expression of depletion temperature for such semiconductor. $1\frac{1}{2}+1\frac{1}{2}$

(b) A 0.46 μm-thick sample of GaAs is illuminated with monochromatic light of $h\nu$ = 2ev. The absorption coefficient α is 5×10^4 cm^{-1}. The power incident on the sample is 10 mW.

Find the rate of excess thermal energy given up by the electron to the lattice before recombination (Assuming based gap of GaAs is 1.43 ev) ? 3

(c) Explain what is meant by ohmic contact. 3

3. (a) What is meant by linearly graded junction ?

(b) Find an expression of junction capacitance for linearly graded junction.

(c) What is Varactor. 2+6+2

4. (a) Explain the mechanism of Generation of Photocurrent in a solar cell.

(b) Find an expression of efficiency for a solar cell.

(c) Why CdTc has maximum efficiency for a solar cell ?

2+6+2