

2018**M.Sc. 2nd Semester Examination****PHYSICS****PAPER—PHS-202****Subject Code—33***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) "Perfect diamagnetism is a more fundamental property of superconductor in comparison to perfect conductivity" — justify the statement.
- (b) Given the maximum wavelength of photon to break up cooper-pair in tin is 1.08×10^{-3} m. Calculate the energy gap.

(Turn Over)

- (c) Find the magnetic field strength necessary to destroy superconductivity in a sample of lead at 4.2K. The critical magnetic field at 0K is 0.8 tesla and the critical temperature is 7.2K.

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

- (a) Determine the percentage of ionic polarizability in the sodium chloride crystal which has the optical index of refraction and the static dielectric constant as 1.5 and 5.6 respectively.
- (b) Derive London equations from the current density of a superconductor

$$\vec{J} = -\frac{A}{\Lambda_s c} + \frac{\hbar}{q \Lambda_s} \nabla \theta$$

where the symbols have their usual meaning.

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

3. Answer any *one* of the followings :

- (a) Derive the expression for Debye equation in connection with dipolar polarizability. Show that the value of $\frac{\hbar}{2e}$ can be measured from a.c Josephson effect. 7+3

- (b) What is superconductivity? Explain the term critical magnetic field in a superconductor. How does it vary with temperature?

Consider the relation

$$S_N - S_S = -\frac{B_c}{\mu_0} \frac{dB_c}{dT}$$

derive Rutger's formula for specific heat.

Prove that the total magnetic flux threading a closed resistance less circuit cannot be changed.

2+1+2+3+2

Group--B

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

1. Answer any *two* bits: 2×2
 - (a) Find the expression of depletion temperature from impurity to intrinsic conductivity in a p-type semiconductor.
 - (b) What is meant by diffusion length?
 - (c) Find an expression of barrier potential in a p-n junction under equilibrium condition.

2. Answer any *two* bits: 2×3
- (a) Show that Fermilevel remains invariant in p-n junction under equilibrium condition. 3
- (b) What is meant by quadratic recombination? Find an expression of excess carrier at any time when light is off in such recombination event? 1+2
- (c) What is meant by diffusion capacitance & find an expression of this capacitance?
3. Find an expression of density of states in the conduction band of a semiconductor. Find the carrier concentration for degenerate semiconductor. How do you distinguish non-degenerate and degenerate semiconductor. 5+3+2
4. Explain the mechanism of operation of solar cell. Find an expression of efficiency of a solar cell. How the efficiency vary with band gap? 3+6+1
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