

Total No. of Printed Pages—4

.5 SEM TDC PHYH (CBCS) C 12

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(Nov/Dec)

PHYSICS

(Core)

Paper : C-12

(**Solid-State Physics**)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following : 1×5=5

(a) The nearest neighbour distance for bcc crystal structure is

(i) $\frac{a}{2}$

(ii) $\frac{a}{\sqrt{2}}$

(iii) $\frac{\sqrt{3}}{2} a$

(iv) $\sqrt{\frac{3}{2}} a$

(b) At very low temperature, Debye's theory shows that atomic heat is directly proportional to

(i) T

(ii) T^2

(iii) T^3

(iv) T^4

(2)

- (c) When a ferromagnetic material goes through a hysteresis loop, the magnetic susceptibility
- (i) has a fixed value
 - (ii) may be zero
 - (iii) may be infinity
 - (iv) may be negative
- (d) Ionic polarizability
- (i) increases with T
 - (ii) decreases with T
 - (iii) is independent of T
 - (iv) None of the above
- (e) The temperature coefficient of resistance of a pure semiconductor is
- (i) positive
 - (ii) negative
 - (iii) zero
 - (iv) None of the above
2. (a) Define unit cell and primitive cell. What do you mean by lattice? 2+1=3
- (b) Show that reciprocal lattice to fcc lattice is a bcc lattice. 3
- (c) Define geometrical structure factor. How is it related to atomic scattering factor? Write the structure factor for bcc crystal. 1+2+1=4

26P/479

(Continued)

(3)

Or

What is the lattice structure of sodium chloride crystal? Draw the schematic diagram showing the structure of NaCl. How many molecules are there in a unit cell of NaCl crystal?

3. (a) What is phonon? 1
- (b) What do you mean by lattice heat capacity? Give a comparative statement between Einstein's and Debye's theory of specific heat of solid. 1+2=3
- (c) Obtain the expression for the dispersion relation for a linear monoatomic linear lattice of mass m , spacing a and the nearest neighbour interaction c . 4

Or

Differentiate between optical and acoustical branches of diatomic linear lattice. Why are these branches named so?

4. (a) State the Curie law. 1
- (b) What is ferromagnetism? Discuss domain theory of ferromagnetism. 1+2=3
- (c) Draw the hysteresis curve for a ferromagnetic material. 2
5. (a) What do you mean by polarization and polarization vector? 2

26P/479

(Turn Over)

- (b) Obtain an expression for Lorentz field in dielectric material and hence derive the Clausius-Mossotti relation. 4

Or

What are the different modes of polarization that take place in dielectric material? Write the Langevin-Debye equation for total polarization.

- (c) What are piezoelectricity and pyroelectricity? Give two examples of each. Write some applications of piezoelectric and pyroelectric materials. 2+1+2=5
6. (a) What do you mean by mobility? Derive the expression for conductivity of intrinsic semiconductor. 1+2=3
- (b) What is Hall effect? Write the expression for Hall coefficient. 2
- (c) Give the qualitative interpretation of the band structure of electronic energy levels in a semiconductor. 3
7. (a) Define critical magnetic field in case of superconductivity. How does it vary with temperature? 2
- (b) Explain the Meissner effect in superconductivity. What do you mean by hard and soft superconductors? 2+1=3

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