

CND-31

29/11/2023 (mon)

(i) Printed Pages : 3

Roll No.

(ii) Questions : 7

Sub. Code :

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Exam. Code :

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B.A./B.Sc. (General) 5th Semester

(2123)

PHYSICS

Paper-A : Condensed Matter Physics-I

Time Allowed : Three Hours]

[Maximum Marks : 44

Note :— Attempt **five** questions in all, selecting **two** questions from Section-A and two questions from Section-B. II. Section-C is compulsory.

SECTION—A

1. (a) Explain the concept of Miller Indices. How are they calculated ?
Find the Miller Indices for a plane which intercept the a, b and c axis at 3a, 2b and 2c. Also deduce the expression for the distance between two adjacent planes of a simple cubic lattice. 6
- (b) Explain crystal structure of diamond and calculate the packing fraction for Diamond. Also draw a plan view of NaCl structure. 3

2. (a) What is Reciprocal lattice ? Show that the fcc lattice is Reciprocal of BCC lattice with lattice constant $2\pi/a$. 6
- (b) Derive Laue's equation for X-ray diffractions by crystals. How do these lead to Bragg's equation ? 3
3. (a) Explain Ewald's construction for Reciprocal lattice. 6
- (b) Copper has fcc structure and the atomic radius is 1.278 Å. Calculate its density. Atomic weight of copper is 63.54. 3

SECTION—B

4. (a) Describe Kroning-Penny model and using it show that the energy band separated by Forbidden region. 6
- (b) What are direct band and indirect band semi conductors ? Explain with example. 3
5. (a) What is meant by free electron gas model of metals ? Derive an expression for Fermi energy of a free electron gas in three dimensions. 6
- (b) Metallic silver has 1 free electron per atom. Find the Fermi energy of density of silver is 10.5 gm cm^{-3} and atomic weight a 1.08 gm atom. 3

6. (a) What is Intrinsic and Extrinsic semiconductor ? Discuss the variation of Fermi level with temperature per n-type semiconductor. 6
- (b) What do you mean by Hall Effect ? Discuss in detail by giving its applications. 3

SECTION—C

(Compulsory)

7. Attempt any **eight** questions :

- (a) Why cannot visible light be used for Crystal diffraction ?
- (b) State Bloch theorem and what is Bloch function ?
- (c) What are brillouin zones ?
- (d) Give the diffraction condition for reciprocal lattice.
- (e) Show that packing traction of fcc structure is 0.74.
- (f) Show that crystal has not $2\pi/5$ or $2\pi/7$ fold symmetry.
- (g) What do you mean by effective mass of electron ?
- (h) What are energy bands in solids ? Discuss.
- (i) Draw the Positions of energy level in extrinsic semiconductor.
- (j) Which are most commonly used semiconductor and why ?

$8 \times 1 = 8$