

(i) Printed Pages : 3 Roll No.

(ii) Questions : 7 Sub. Code :

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**B.A./B.Sc. (General) 5th Semester
(2125)**

PHYSICS

Paper-A : Condensed Matter Physics-I

Time Allowed : Three Hours] [Maximum Marks : 44

Note :— Attempt **FIVE** questions in all, selecting at least **TWO** questions each from Section-A and Section-B. Section-C is compulsory to attempt. Use of non-programmable calculator is allowed.

SECTION—A

1. (a) What do you understand by Miller indices? Deduce the expression for the distance between two adjacent planes of a simple cube crystal. 6
- (b) What do you mean by reciprocal lattice? Give its physical significance and show that FCC lattice is the reciprocal of BCC lattice. 3
2. (a) Derive Laue's equation of diffraction for X-rays and obtain the Bragg's conditions for them. 6
- (b) Draw and explain the crystal structure of diamond. Also find the value of its packing fraction. 3

3. (a) Explain Geometrical structure formula and derive the expression for SCC, BCC and FCC lattice. 6
- (b) The Bragg's angle for the order reflection from (111) Plane in a crystal is 60° . Calculate the inter-atomic spacing if X-ray of a wavelength 1.8×10^{-10} m is used. 3

SECTION—B

4. (a) What are intrinsic and extrinsic semiconductors? Discuss the variation of the Fermi level, carrier concentration and conductivity of intrinsic semiconductor. 6
- (b) Explain the concept of effective mass of electron. What is its significance? 3
5. (a) Describe Kroning-Penney Model and using it show that energy spectrum of electron consists of number of allowed energy bands separated by forbidden region. 6
- (b) Explain the phenomenon of Hall Effect and obtain the expression for Hall-coefficient. 3
6. (a) Obtain an expression of Fermi Energy, Total Energy and density of states for a free electron gas in one-dimension. Show the variation of density of states with energy. 6
- (b) Metallic Silver has one free electron per atom. Find Fermi energy if density of Silver is 10.5 g cm^{-3} and atomic weight is 108 g/m atom. 3

SECTION—C (Compulsory)

7. Attempt any **eight** questions in **all** :

- (a) What are Brillouin zones?
- (b) State Bloch theorem.
- (c) Show that Packing fraction of FCC structure is 0.74.
- (d) Draw and explain the structure of NaCl.
- (e) What do you mean by atomic Scattering factor?
- (f) What are direct and indirect band gap Semiconductors?
- (g) Explain energy band formation of Si lattice as a function of inter-atomic spacing.
- (h) Show that Five-fold axis symmetry does not exist.
- (i) Copper has fcc structure and atomic radius is 1.278 Å. Calculate density. Atomic weight of Cu is 63.54.
- (j) Draw the plane (111) and (110). 8×1=8