(i) Printed Pages : 3 Roll No. .....

(ii) Questions : 7 Sub. Code : 1 7 4 4 8

Exam. Code : 0 0 0 5

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

(2124)

PHYSICS

Paper : A Condensed Matter Physics—I

Time Allowed : Three Hours] **[Maximum Marks : 44**

Note :— Attempt *five* questions in all, including Q. No. 7 (Section-C) which is compulsory and selecting *two* questions each from Section-A and Section-B.

SECTION—A

1. (a) Explain Miller indices. Find the expression for separation between planes in terms of Miller indices. 6

   (b) Calculate the density of Copper in its FCC structure. Given radius of Cu atom = 1.278 Å and atomic weight of Cu = 63.54 g. 3

2. (a) Derive geometrical structure factor. How is it related to atomic scattering factor ? 5

   (b) Bragg's reflection at (111) planes of a crystal is observed at an angle of 60° in the first order. Find the value of interplanar spacing, given $\lambda_{x\text{-ray}}$ = 1.8 Å. 4

3. (a) Explain the crystal structure of NaCl (sodium chloride). Draw a sketch of sodium chloride lattice and write down the coordinates of the atoms and number of sodium ions in a unit cell of NaCl. 5

(b) What do you men by reciprocal lattice ? Show that reciprocal lattice to a body centered cubic (BCC) lattice is FCC lattice. 4

SECTION—B

4. (a) Obtain an expression for the Fermi energy, total energy and density of states for a free electron gas in one dimension. Also show the variation of density of states with energy. 6

(b) Obtain the value for the Fermi energy of a free electron in lithium at absolute zero temperature. Given atomic weight of Li = 6.939 a.m.u. Density of Li = 534 kg/m^3. 3

5. (a) What is an extrinsic semiconductor ? Discuss the variation of the Fermi level with temperature for an n-type semiconductor. 5

(b) Explain the phenomena of Hall Effect and obtain an expression for Hall coefficient. 4

6. Discuss Kronig-Penny model for electron energy in solids and show how it explains forbidden bands. 9

SECTION—C

7. Attempt any ***eight*** parts of the following :—

(i) State Bloch theorem.

(ii) What is Hall Effect ?

(iii) Define packing fraction. What is packing fraction for BCC ?

(iv) State Wiedemann-Franz law.

(v) Give diffraction condition for reciprocal lattice.

(vi) Define relaxation time.

(vii) What is the reason for failure of free electron theory ?

(viii) What is Fermi gas ?

(ix) What are extrinsic semiconductors ?

(x) n-type or p-type semiconductors are electrically neutral. Explain. $8 \times 1 = 8$