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

(ii) Questions : 7 Sub. Code : 0 4 4 8

Exam. Code : 0 0 0 5

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

(2122)

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 Sections A and B. Section-C (Question No.7) is compulsory. Use of non-programmable calculator is allowed.

SECTION—A

1. (a) Derive the Laue's equations and hence obtain the Bragg's law. 6

   (b) Determine the Miller Indices of plane that makes an intercept of 2Å, 3Å & 4Å on the coordinate axes of an orthorhombic crystal with a:b:c = 4:3:2. 3

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

   (b) Prove that crystals cannot have five-fold symmetry. 4

3. (a) Explain the crystal structure of diamond. Draw it. Also, give its packing fraction. 5

(b) What is reciprocal lattice ? Show that BCC lattice is the reciprocal of the FCC lattice. 4

SECTION—B

4. (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

5. (a) Discuss the Kronig Penny model and explain how it distinguishes the conductors from insulators and semiconductors. 6

(b) What is effective mass of an electron ? Under what conditions the effective mass of an electron becomes positive, negative and infinity ? 3

6. (a) Determine the expressions 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. 7

(b) Find Fermi energy of a metal of atomic weight 70 and density 9000 kg/m^3 assuming each atom contributes one electron to electron gas. 2

SECTION—C

7. Attempt any **eight** parts :

(i) What is Fermi gas ?

(ii) What are Brillouin zones ?

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

(iv) State Wiedemann-Franz law.

(v) Give diffraction condition for reciprocal lattice.

(vi) What do you understand by density of states ?

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

(viii) State Bloch theorem.

(ix) What is doping ?

(x) Find the spacing between (111) planes in cubic lattice with lattice constant a. $8 \times 1 = 8$