

(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) 5<sup>th</sup> 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  $2\text{\AA}$ ,  $3\text{\AA}$  &  $4\text{\AA}$  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  $9000 \text{ kg/m}^3$  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  $a$ .  $8 \times 1 = 8$