

B.Sc. (General) 5<sup>th</sup> Semester

(1129)

## PHYSICS

## Paper—A : Condensed Matter Physics—I

Time Allowed : Three Hours]

[Maximum Marks : 22

- Note :—** (1) Attempt **five** questions in all, selecting two questions each from Unit—I and Unit—II. Unit—III is compulsory.
- (2) Use of log tables and non programmable calculator is allowed.

## UNIT—I

- I. (a) What are Miller indices ? How can Miller indices be used to explain the set of crystal planes ? Draw the crystal planes of cubic crystal with Miller indices (100). 3
- (b) Explain why is five-fold symmetry of crystals is not possible. 1½
- II. (a) What is a reciprocal lattice ? Show that the fcc lattice is reciprocal lattice of bcc lattice with lattice constant  $\frac{2\pi}{a}$ . 3
- (b) Prove that Bragg's diffraction condition in terms of reciprocal lattice is  $2\vec{k} \cdot \vec{G} + G^2 = 0$ . 1½

- III. (a) Find the geometrical structure factor for bcc and explain the cause of absence of (100) reflection. 3
- (b) The structure of silver (mass number = 108) is fcc. Calculate the density of silver if it has a lattice constant  $4.077 \text{ \AA}$ . 1½

### UNIT—II

- IV. (a) Obtain the expression for fermi energy, total energy and density of states for a free electron gas in one dimension. Also show variation of density of states with energy. 3
- (b) Show that the average kinetic energy of three-dimensional free electron is  $\frac{3}{5}$  times the fermi energy. 1½
- V. (a) Discuss Kronig-Penny model and also show that how the energy band formation takes place in solids. 3
- (b) Derive an expression for the effective mass of an electron. 1½
- VI. (a) Explain the need of doping of a pure semiconductor. Name the various types of n-type and p-type impurities. Derive an expression for the electrical conductivity of an intrinsic semiconductor. 3
- (b) Explain Hall effect and write expression for Hall coefficient. 1½

### UNIT—III

- VII. Attempt any **eight** questions. Each question carries ½ mark.
- (a) What is meant by coordination number ?
- (b) What is Wigner-Seitz cell ?
- (c) Why cannot light waves be used for crystal diffraction ?

- (d) State the Bragg's condition and mention some of its characteristics.
- (e) What do you mean by atomic scattering factor ?
- (f) Semiconductors have negative temperature coefficient of resistance. Explain.
- (g) State Bloch theorem.
- (h) Explain Wiedemann-Frenzel law.
- (i) What do you mean by density of states ?
- (j) Write any two conclusions drawn from Kronig-Penny model.

$$8 \times \frac{1}{2} = 4$$