(i) Printed Pages : 4] Roll No. .....

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

Exam. Code : 0 0 0 5

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

1127

PHYSICS

(Condensed Matter Physics–I)

Paper : A

Time : 3 Hours] **[Max. Marks : 44**

Note :– (i) Attempt *five* questions in all selecting two from each of Section–A and Section–B. Section–C is compulsory.

(ii) Each question of Section–A and Section–B carries 9 marks and Section–C question is of 8 marks.

(iii) The use of non-programmable calculator is allowed.

Section–A

1. (a) Explain the concept of Miller indices with suitable examples and derive an expression for perpendicular distance between planes with indices (hkl) in cubic crystals.

   (b) Show that reciprocal lattice of BCC is FCC. 6,3

2. (a) Derive the Laue's equations and hence obtain the Braggs' Law.

   (b) The Bragg angle for First order reflection from (III) planes in crystal is 30°. Wavelength of X-rays used is 2Å. Find interatomic spacing. 6,3

3. (a) Define Geometrical structure factor and how is it related to atomic form factor. Also give an account of missing (100) reflections in BCC crystal.

   (b) Discuss the NaCl crystal structure. 6,3

Section–B

4. (a) Discuss Kronig-Penney model and explain the formation of bands.

   (b) What is Bloch Theorem ? 7,2

5. (a) Derive expression for Fermi Energy for a free electron gas in one-dimension and discuss the result.

(b) Find Fermi energy of a metal of atomic number 70 and density 9000 kg/m^3 assuming that each atom contributes one electron to electron gas. 6,3

6. (a) Discuss variation of Fermi level with temperature for N-type semiconductors.

(b) Show that Fermi level for an intrinsic semiconductor lies exactly in the middle of valence band and conduction band. 5,4

Section–C

(Do any *eight*) 8×1

7. (i) Explain briefly Brillouin Zone.

(ii) Give characteristics of semiconductors which differentiates them from Insulators and Conductors.

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

(iv) Why X-rays are used for study of crystal structure and not ultraviolet radiations ?

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

(vi) Why N-type and P-type semiconductors are electrically neutral ?

(vii) Discuss Diamond structure briefly.

(viii) Find Miller indices of a plane that intercepts (a/2, a, 2a) in a simple cubic unit cell.

(ix) Explain the Wiedeman Frenz law.

(x) Define effective mass of an electron.