

**Master of Science (M.Sc.) Fourth Semester (C.B.C.S.) Physics Examination**

**SOLID STATE PHYSICS**

**Compulsory Paper—2**

**Paper—II**

Time : Three Hours]

[Maximum Marks : 80

**N.B. :—** (1) **ALL** questions are compulsory.

(2) All questions carry equal marks.

(3) Figures to the right indicate maximum marks.

**EITHER**

1. (A) Discuss the Kronig-Penny model for a linear lattice. How does it lead to formation of energy bands in solids ? 8
- (B) Describe tight binding approximation, show the formation of energy state of an electron in a solid. 8

**OR**

(E) Explain the difference between :

(i) Diamagnetism and paramagnetism.

(ii) Paramagnetism and ferromagnetism.

(iii) Ferromagnetism and antiferromagnetism.

(iv) Antiferromagnetism and ferromagnetism. 8

(F) Explain paramagnetism of free electron. Determine Pauli spin susceptibility of the electron gas. What is exchange interaction ? 8

**EITHER**

2. (A) Find the dispersion relation for a one dimensional crystal with two types of the atoms and discuss the nature of the optical and acoustic modes. 8
- (B) Write a note on periodic boundary condition. Discuss harmonic approximation. 8

**OR**

(E) Discuss the Debye theory of atomic heat and give its shortcomings. 8

(F) What is thermal expansion ? Explain why it is necessary to include anharmonic interaction to understand this phenomenon. 8

**EITHER**

3. (A) A particle moving in one dimensional potential, is given by :

$$V(x) = 0 \text{ for } x < 0$$

$$\text{and } V(x) = V_0 \text{ for } x \geq 0$$

Write down the Schrodinger wave equation for the particle and solve it. 8

(B) Explain quantum state and degeneracy. 8

**OR**

(E) Derive an expression relating the shift in the Fermi level and the carrier density in an intrinsic semiconductor. 8

(F) Derive the expression for mobility of charge carrier. Give the effect of temperature on the mobility of charge carrier. 8

**EITHER**

4. (A) Discuss the mechanism of Cooper pair. What is coherence length ? 8

(B) Derive the London equations and discuss how they help in explaining the superconductivity state. 8

**OR**

(E) Discuss the "importance of high temperature superconductors". Explain the Josephson junction. 8

(F) Give an account of experimental results which separate the superconducting state from the normal state of a metal. 8

5. All questions are compulsory :

(A) Discuss the extended and reduced zone schemes. 4

(B) Explain  $T^3$  Law. 4

(C) Write notes on :

(i) Seebeck effect

(ii) Thermionic emission. 4

(D) Discuss Ginzberg-Landau theory. 4