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

(ii) Questions : 9 Sub. Code : 3 2 3 8

Exam. Code : 4 7 4

M.Sc. 3rd Semester

1125

PHYSICS

Paper - Phy-7004 : Condensed Matter Physics–I

Time Allowed : Three Hours] [Maximum Marks : 60

Note :– Attempt **five** questions in all by selecting **one** question each from Units I to IV. Q. 9 of Unit V is compulsory.

UNIT–I

1. (a) Define and derive the structure factor. Is it a real quantity ? Find out the structure factor of fcc lattice.

   (b) Calculate the spacing 'd' between adjacent Bragg planes in NaCl. Molecular weight of NaCl is 58.5 k mol and crystalline density is 2.16×10^3 Kg/m^3. Avogadro number is 6.02×10^{26} molecules/k mol. 7,5

2. (a) What features of lattice vibrations get overlooked when one considers harmonic theory ? Discuss the origin of thermal expansion by considering harmonic effects.

   (b) Describe the electric properties of an isotropic body and hence derive elastic stiffness constants for a cubic crystal. 6,6

UNIT–II

3. (a) Describe the Kronig Penney model and hence list important features of the corresponding energy spectrum.

   (b) Write a short note on OPW method and pseudopotential method employed to carry out the band structure calculations. 8,4

4. (a) Starting from the Bloch form of wavefunction for a crystal, find an expression for energy bands in Tight binding approximation.

   (b) Distinguish between Metals, Insulators and Semiconductors on the basis of band theory. 7,5

UNIT–III

5. (a) Obtain an expression for electrical conductivity using Sommerfeld theory. Explain why the relaxation time of electrons occur only at the Fermi level in the conductivity.

   (b) A Cu strip 4.0 cm wide and 1 mm thick is placed in a magnetic field with $B = 2.5$ wb/m^2 perpendicular to strip. If 300 amp current is set up in the strip, what Hall potential difference appears across the strip ? Atomic weight of Cu is 64 gm/mole and density is 9.0 gm/cm^3. 7,5

6. (a) Explain Magnetoresistance. If the applied magnetic field is H, show that the change in resistance of a crystal is proportional to H^2.

   (b) Derive an expression for conductivity of semiconductors demonstrating their dependence of Temperature. 6,6

UNIT–IV

7. (a) Analyze the dielectric property of a harmonic oscillator. Also, discuss the case of weak damping.

   (b) How is dielectric constant measured for different frequency ranges ? 7,5

8. Describe the theory of ferroelectricity and hence analyze the ferroelectric phase transitions. 7,5

UNIT–V

9. (1) Define Madelung Constant and give its physical significance.

   (2) For n atoms in the primitive cell, write abut the characteristic features of the phonon dispersion relation.

   (3) Explain the concept of effective mass.

   (4) Define mobility. How is it related to relaxation time ?

   (5) Demonstrate the linear dependence of Peltier coefficient on temperature.

   (6) Explain the phenomena of antiferroelectricity. 2×6