

2071

M.Sc. (Physics) Fourth Semester
PHY-7052: Condensed Matter Physics - II

Time allowed: 3 Hours

Max. Marks: 60

NOTE: Attempt five questions in all, including Question No. IX (Unit-V) which is compulsory and selecting one question each from Unit I-IV.

x-x-x

UNIT - I

- I.
 - a) How does complex dielectric constant arise in insulator? Prove the result and discuss its physical significance.
 - b) What is piezoelectric effect? Explain its origin. Discuss the applications of piezoelectric crystals. (7,5)
- II.
 - a) Discuss Drude's theory of absorption of light in metals.
 - b) Explain the phenomenon of luminescence, fluorescence and phosphorescence with examples and applications. (7,5)

UNIT - II

- III.
 - a) What are spin waves? Obtain the dispersion relation for spin waves in a Ferromagnet in one dimension with nearest neighbor interactions.
 - b) What is Bloch wall? Calculate its thickness and energy per unit area, What limits the thickness of this wall? (7,5)
- IV.
 - a) Explain why do materials behave as diamagnet or paramagnet. Show that Pauli spin magnetization of conduction electron is independent of T for $k_B T \ll E_F$.
 - b) Describe the structure of Ferrites. Give an idea of calculation of magnetic moment of ferrites. (8,4)

UNIT - III

- V.
 - a) List the properties of type I and type II superconductors. Derive the London equations and discuss how they help in explaining the superconductivity.
 - b) Derive an expression for binding energy of Cooper pairs and hence explain their role in explaining the phenomenon of superconductivity. (7,5)
- VI.
 - a) Explain the phenomena of Josephson tunneling.
 - b) The penetration depth of mercury at 3.5 K is about 750 Å. Estimate the penetration depth at 0K. Also calculate superconducting electron density. (8,4)

P.T.O.

UNIT - IV

- VII. a) What are point defects? Derive an expression for temperature dependence of Frankel defects.
- b) Calculate the concentration of Schottky vacancies at 300K. Given that energy required to remove a sodium atom from inside of crystal to the boundary is 1 eV. (8,4)
- VIII. a) What are liquid crystals? Outline the classification of liquid crystals. Discuss applications of liquid crystals. (8,4)
- b) Define Burger vector. Differentiate between edge and screw dislocation. (8,4)

UNIT - V

- IX. Attempt any six of the following:-
- How do point defects affect the density of crystal?
 - How energy gap of superconductors is different than insulators?
 - Describe Ferro, Ferri and Antiferromagnetic ordering with the help of diagrams. How does J (exchange interaction) differ in these systems?
 - What are Ferrites?
 - What are inter band and intra band transitions?
 - What is Meissner effect?
 - What is Curie and Neel temperature in magnetism? (6x2)