Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: M.Sc.I
Sub_Code: FPYE1004

10th Semester Regular Examination: 2024-25
SUBJECT: Condensed Matter Physics-II
BRANCH(S): M.Sc.I(AP)
Time: 3 Hours
Max Marks: 70
Q.Code: S101
Answer Question No.1 (Part-I) which is compulsory, any five from rest (Part-II)
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

- **a)** What is Neel temperature?
- **b)** What is diluted magnetic semiconductor?
- **c)** Plot the variation of susceptibility with temperature for paramagnetic and ferromagnetic materials.
- **d)** Can color of the crystal be affected due to defects? Give an example.
- **e)** Define Burgers vectors.
- **f)** What are Frenkel and Schottky defects?
- **g)** What is meant by magnon?
- **h)** Draw a labeled diagram for a Cooper pair.
- **i)** Write four applications of superconductivity.
- **j)** What is Cooper pair? Justify whether it is Fermion or Boson.

Part-II

Long Answer Type Questions (Answer Any five)

Q2 **a)** Describe the Weiss molecular field theory of ferromagnetism and derive the Curie-Weiss law. **(7 + 3)**

b) Explain what you mean by ferromagnetic domains.

Q3 **a)** Explain Polarization catastrophe for Ferroelectric crystals. **(5 + 5)**

b) Derive Bloch's $T^{3/2}$ Law.

Q4 **a)** Discuss the origin of internal field (Weiss-field) in ferromagnetic crystal. **(3 + 7)**

b) Describe the Heisenberg's exchange interaction. How does it explain ferromagnetism?

Q5 **a)** What do you mean by nano structured materials? Classify on the basis of dimensional confinement. **(6 + 4)**

b) What is the mechanism of colorations of a solid?

Q6 **a)** Give the formulation of AC and DC Josephson effect. **(7 + 3)**

b) Calculate the frequency of AC current produced when a DC voltage of 5 μV is applied across the Josephson junction.

Q7 **a)** Explain electron-phonon interaction. **(3 + 7)**

b) Write the BCS Hamiltonian. Starting from electron-phonon Hamiltonian, show that the two electrons can form a bound pair for superconducting state.

Q8 Write short notes on any two **(5 + 5)**

a) Pauli paramagentism
b) Quantum dots
c) SQUID