

Ref. No: Ex/SC/PHY/UG/CORE/12/2024(S)

B. Sc PHYSICS SPECIAL SUPPLEMENTARY EXAMINATION, 2024

(3rd year 1st semester)

PHYSICS

Paper: Core 12

(Solid State Physics)

Time : **Two hours**

Full Marks: **40**

Group - A

Answer any 2 questions

1.

- a) Why Einstein theory of specific heat fails to describe low temperature behaviour of specific heat.
- b) Consider a linear chain of an array of N similar atoms, separation between nearest neighbours being a . Derive the specific heat of the system on the basis of the Debye approximation and determine the low temperature behaviour of the specific heat.

(2 + 5 + 3)

2.

- a) Show that reciprocal vector of a fcc lattice is an bcc lattics.
- b) Define Millar indices. Determine the Miller indices of a plane that makes intercepts of $4\text{\AA}$, $3\text{\AA}$ and $8\text{\AA}$ on the coordinate axes of an orthorhombic lattice with the ratio of the axial lengths as: $a : b : c = 2 : 3 : 1$

(5 + 5)

3. In a crystalline solid, electron density $\rho(r)$ is a periodic function of r . Shown that we can obtain large scattering amplitude only when the scattering vector is equal to the reciprocal vector. Hence derive the Bragg's law.

(5 + 5)

[Turn over

Group - B

Answer any 2 questions

- 4.
- a) What are diamagnetic, paramagnetic and ferromagnetic materials? Give examples. Discuss the temperature variation of diamagnetic, paramagnetic and ferromagnetic susceptibilities of materials. (3+3)
 - b) Discuss the domain structure in ferromagnetic materials. What is meant by hysteresis in magnetic materials? Also explain the hysteresis curve on the basis of the domain theory. (2+1+1)
- 5.
- a) Define critical magnetic field. How does the critical magnetic field vary with temperature in Type I and Type II superconductors? Explain Meissner effect. (1+3+2)
 - b) Give the salient features of BCS theory of superconductors. Write some applications of superconductors. (2+2)
- 6.
- a) Explain what is meant by polarization in dielectrics. Establish the relation between the dielectric constant and atomic polarizability. (2+2)
 - b) Write the characteristics of ferroelectric materials. How does the dielectric constant of a ferroelectric material vary with temperature? (3+3)