

EITHER

5. (a) Explain Dulong and Petit's law for specific heat of a solid. Discuss the agreement of result with the experimental facts. 6
- (b) What are the assumptions of Einstein's theory of specific heat of solids? Derive relation for lattice heat capacity following Einstein's model. 8
- (c) What is Debye Temperature? 2

OR

- (p) Derive an expression for the lattice specific heat according to Debye model. 8
- (q) Discuss high and low temperature limits in Debye model and define Debye T^3 law. 6
- (r) Calculate the frequency of Einstein's oscillator for $\theta_E = 236$ K.
Given $K_B = 1.38 \times 10^{-23}$ J/K and $h = 6.6 \times 10^{-34}$ Js. 2

AQ-890**M.Sc. Semester—II (CBCS Scheme) Examination****PHYSICS****Paper—2-PHY-3****(Solid State Physics)**

Time : Three Hours]

[Maximum Marks : 80

EITHER

1. (a) What are primitive and nonprimitive unit cells? 4
- (b) Enlist the fourteen types of lattice in three dimensions. 4
- (c) Describe the possible point groups in 2D rectangular lattice. 4
- (d) Describe in detail roto-reflection and screw translation operations. 4

OR

- (p) Discuss in detail glide and roto inversion operations. 4
- (q) Show that packing fraction for FCC lattice is $\pi \frac{\sqrt{2}}{6}$. 4

- (r) Discuss the similarities and differences of primitive cell and unit cell. 4
- (s) Describe the meaning of each term in the space group P2, 2, 2. 4

EITHER

2. (a) Define and state the significance of :
- (i) Geometric structure factor. 4
- (ii) Form factor. 4
- (b) Discuss the rotating crystal X-ray diffraction method. 4
- (c) State and prove Bragg's law of X-ray diffraction and verify it for NaCl crystal from the following data.
- Bragg's angles : 11.8° , 23.5° , 36° . 8

OR

- (p) Describe Laue diffraction technique. 4
- (q) What are Miller indices ? Illustrate with example. 4
- (r) What is atomic scattering factor ? Derive expression for it. Explain its significance. 8

EITHER

3. (a) Show that bcc lattice is the reciprocal lattice of the fcc lattice. 8

- (b) Discuss electron diffraction in crystal and state its applications. 8

OR

- (p) Explain graphical method to analyze powder diffraction pattern. 8
- (q) Discuss Ewald's construction and derive Bragg's diffraction condition in terms of reciprocal lattice vector. 8

EITHER

4. (a) What are phonons ? Show that in acoustical branch, atoms of different masses move in same direction and the amplitude of vibration is independent of their masses. 8
- (b) Derive the relation for binding energy of ionic crystal in terms of Madelung constant. 8

OR

- (p) What are localized lattice vibrations ? Derive the relation for frequency associated with localized lattice vibrations. What is the significance of optical and acoustical branches of lattice vibrations ? 8
- (q) Derive dispersion relation for one dimensional diatomic lattice. What is the significance of optical and acoustical branches of lattice vibrations ? 8