

2026

Physics (Core)

Paper Code : PY-CE-6324

Paper Name : Condensed Matter Physics

Time : 2 hours

Full Marks : 50

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×4=4
 - a) "The electrons in valence band and electrons in the conduction band have same mobility". (State true or false)
 - b) State Wiedemann-Franz law.
 - c) Show graphically how electrical polarisability of a ferroelectric material varies with temperature.
 - d) Define Curie temperature.
2. Answer the following questions : 2×3=6
 - a) Define symmetry operation. How many Bravais lattices are there?
 - b) Draw (120) and (010) plane in a simple cubic unit cell.
 - c) Explain the significance of Hall coefficient ?
3. Answer the following questions (*any two*) : 5×2=10
 - a) What is atomic packing fraction ? Calculate packing fraction for a bcc unit cell. 1+4=5
 - b) A metal strip of 0.2 mm thick is used in a Hall effect experiment. If a magnetic field of 1 Tesla is applied and a current of 2A is passed, calculate the Hall voltage. Given Hall coefficient is $5 \times 10^{-10} \text{ m}^3/\text{C}$.

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- c) Calculate the electrostatic force and potential energy between Na^+ and Cl^- ion in a crystal lattice if the equilibrium separation distance is 0.28 nm.
- d) The magnetic susceptibility of a material is 1.25×10^{-2} at 300K. If the Curie temperature of the material is 100K, find the Curie constant and the susceptibility where the temperature is increased to 500K.
4. Answer the following questions (*any three*) : 10×3=30
- a) Deduce Bragg's law of X -ray diffraction in crystals. What is the necessity of X -rays to be used for analysis of crystal structure? A beam of X -rays incident on a NaCl crystal ($d=0.282$ nm). The 1st order Bragg reflection is observed at an angle of $8^\circ 35'$. What is wavelength of X -rays? At what angles would the 2nd and 3rd order Bragg's reflections occur? 5+2+3=10
- b) Discuss using proper plot, the different conclusions that can be drawn from Kronig Penny model. What are Brillouin Zones? Discuss how Brillouin Zone in 2D can be constructed. 5+1+4=10
- c) What is Hall Effect? Derive an expression for Hall coefficient. Describe a method to measure Hall coefficient. 1+4+5=10
- d) Deduce Einstein's theory of Specific heat. Show the variation of specific heat with temperature according to Einstein's theory. 8+2=10
- e) What is the significance of local field in case of dielectric polarization? Evaluate the local field for cubic structure. Define electric susceptibility. 2+6+2=10
- f) Define various dielectric polarizations. Derive Clausius-Mosotti relation for dielectric polarization 3+7=10

