

FYUGP/5th Sem/25(NEP)

2025

Four Year Under Graduate Programme (FYUGP)

5th Semester Examination (Under NEP)
(Session 2023-24)

PHYSICS (Major)

Paper Code : PHSMJ MC-09

(Solid State Physics)

Full Marks : 30

Time : Two Hours

The figures in the margin indicate full marks.

*Candidates are required to give their answers
in their own words as far as practicable.*

1. Answer any six questions : 1×6=6

- (a) Write down the number of nearest neighbours for monatomic sc and bcc structures.
- (b) How a single crystal differs from a polycrystalline material?
- (c) What physical quantity does the reciprocal lattice represent?
- (d) How does diamagnet and paramagnet differ on the basis of magnetic origin?

P.T.O.

(2)

- (e) State the value of molar specific heat predicted by Dulong–Petit law.
- (f) Define Curie constant.
- (g) According to the Kronig-Penny model, the formation of energy band gaps in solids is mainly due to which physical phenomenon?
- (h) Why the sign of Hall co-efficient is positive for p type semiconductor?

2. Answer any *three* questions : $3 \times 3 = 9$

- (a) A plane cuts the crystallographic axes at a , $2a$, $3a$. Determine the Miller indices of the plane.
- (b) Determine the relationships between the lattice parameter ' a ' and the atomic radius r for mono atomic simple cubic, bcc and fcc structures.
- (c) The Debye temperature of Diamond is 2230 K. Find the highest possible Debye frequency. Write down the relation between refractive index and polarizability. $2+1$
- (d) Distinguish between diamagnetic, paramagnetic, ferromagnetic materials.
- (e) Explain why intrinsic semiconductors show an increase in conductivity with increase in temperature.

3. Answer any *three* questions : $5 \times 3 = 15$

- (a) The lattice constant for a unit cell of aluminium is

4.05Å. What is the distance between planes with Miller indices (200)? Show that the lattice constant for a cubic crystal with n number of molecules per unit cell, molar mass M and density ρ is given by

$$\left(\frac{nM}{\rho N} \right)^{\frac{1}{3}}, \text{ where } N \text{ is the Avogadro number. } 2+3$$

- (b) Derive Curie's law of paramagnetism in the framework of Langevin's theory. Show that Bohr magneton represents the magnetic moment of an atomic dipole. 3+2
- (c) Draw the BH curve for a ferromagnetic material and identify the retentivity and coercive field on the curve. Prove that the energy loss per cycle is equal to the area of the hysteresis loop. 3+2
- (d) What is Hall effect? Deduce the expression of Hall coefficient in the case of a semiconductor. 2+3
- (e) Define Displacement vector $\mathbf{D}$ and show that for an isotropic dielectric $\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$ where $\mathbf{P}$ is the polarization vector. Show that electronic polarizability is proportional to the atomic volume. 2+3
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