

12.12.18 (M)

This question paper contains 3 printed pages]

Roll No.

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S. No. of Question Paper : 108

Unique Paper Code : 32221502

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Name of the Paper : Solid State Physics

Name of the Course : B.Sc. (H) Physics

Semester : V

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any five questions. Question No. 1 is compulsory.

All questions carry equal marks.

1. Attempt any five of the following : $5 \times 3 = 15$

- (a) Draw P-E hysteresis loop for a ferroelectric material. Write mathematical statement of Curie-Weiss law for ferroelectric materials.
- (b) Differentiate between acoustical and optical phonons.
- (c) Explain the formation of Cooper pair in superconductors.
- (d) Write the primitive translational vectors of hexagonal lattice.

P.T.O.

- (e) Show that every reciprocal lattice vector \vec{G}_{hkl} is normal to the plane $(h k l)$.
- (f) Calculate the Hall coefficient of Na based on free electron model. Na has b.c.c structure and side of the cube is 4.28 Å.
- (g) Draw the variation of total polarizability with frequency of external electric field.
- (h) What is the difference between Phonon and Plasmon ?
2. (a) Derive Bragg's law in the reciprocal lattice. 8
- (b) In a simple cubic crystal, show that the first order reflection from $(n00)$ planes is equivalent (mathematically) to the n th order reflection from (100) plane ? 7
3. (a) Derive an expression for the specific heat of a solid on the Debye model and show that, at low temperature, it follows T^3 -law. 10
- (b) Derive the dispersion relation for a linear monoatomic lattice and show that the group velocity and phase velocity of a wave are equal in the long wavelength limit. 5
4. (a) Show that the classical paramagnetic susceptibility is given by $\chi = \frac{\mu_0 N}{3kT} \mu^2$, where symbols have their usual meanings. 10

- (b) How was the classical Langevin's theory of paramagnetism modified by Weiss ? 5
5. (a) Derive an expression for the electronic polarizability in a time varying electric field, and hence derive the Cauchy and Sellmeier relations. 12
- (b) Distinguish between normal and anomalous dispersion ? 3
6. (a) Explain the formation of allowed and forbidden energy bands for the motion of an electron in one-dimensional periodic potential in solids. 10
- (b) Prove that effective mass of electron is given by $m^* = \hbar^2 / (d^2 E / d^2 k)$. 5
7. (a) Explain how the *Meissner-effect* was explained by London. 6
- (b) What is *Isotope effect* ? 3
- (c) What do you understand by Piezoelectric effect, Pyroelectric effect & Electrostrictive effect ? 6
8. (a) Prove that reciprocal lattice of bcc is fcc and that of fcc is bcc. 10
- (b) Show that five-fold rotational symmetry does not exist ? 5