This question paper contains 3 printed pages]

Roll No. ☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : **957**

Unique Paper Code : **222603**   **E**

Name of the Paper : **Solid State Physics (PHHT-621)**

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : **VI**

Duration : **3 Hours**   Maximum Marks : **75**

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

Attempt *Five* questions in all.

Question No. **1** is compulsory.

All questions carry equal marks.

1. Attempt any *five* questions of the following :   5×3=15

    (*a*) Differentiate between covalent and van der Waal bonding with examples.

    (*b*) Calculate the glancing angle on the cube (100) of a rock salt crystal ($a = 2.84$ Å) corresponding to second order diffraction maximum for X-ray of wavelength 0.710 Å.

    (*c*) Explain B-H curve of a ferromagnetic substance on the basis of domain theory.

    (*d*) Lead in superconducting state has critical temperature 6.2° K at zero magnetic field and a critical field of 0.064 T at 0° K. Determine the critical field at 4° K.

                                                                                        P.T.O.

(e) Discuss the frequency dependence of total polarizability.

(f) Give the significance of law of mass action in semiconductors.

(g) What do you understand by Hall effect in semiconductors ? Give its *two* advantages.

(h) How are the materials classified into conductors, semiconductors and insulators on the basis of E vs K graph ?

2. (a) What is a reciprocal lattice ? Prove that the volume of a unit cell in reciprocal lattice is inverse of the volume of a unit cell in direct lattice.   7

(b) Discuss the significance of Brillouin Zone.   8

3. (a) Derive the dispersion relation for a linear mono-atomic lattice. Calculate the number of normal modes of vibration for a monoatomic lattice.   10

(b) What are phonons ? Describe the characteristics of acoustical and optical phonons with reference to dispersion curves of linear diatomic lattice.   5

4. (a) State the assumptions of Einstein's theory of specific heat of solids.   3

(b) Discuss Einstein's theory of specific heat and explain how far it agrees with the experimental results in low and high temperature limits. How did Debye modify it ?   9,3

5. (a) What are the major differences between diamagnetic, paramagnetic and ferromagnetic substances ? Give an example of each. 5

   (b) Give quantum theory of paramagnetism and explain how it overcomes the shortcomings of classical Langevin's theory. 10

6. (a) Derive the expression for electronic polarizability in a time varying electric field. 10

   (b) Distinguish between normal and anomalous dispersion. 5

7. (a) Discuss the Kronig Penny model for the motion of an electron in a periodic potential. 10

   (b) Obtain an expression for effective mass of an electron in a metal. 5

8. (a) Derive London's equations for a superconductor and obtain an expression for the penetration depth. 10

   (b) The transition temperature of mercury with an average atomic mass of 200.59 amu is 4.153°K. Determine the transition temperature of one of its isotope $^{204}_{80}Hg$. 5