

Roll No.....

Total No. of Printed Pages: [01]

Total No. of Questions: [09]

B. Sc. (Hons.) Physics (Semester – 4th)

SOLID STATE PHYSICS

Subject Code: BPHYS1402

Paper ID: [19131521]

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A

(2 marks each)

Q1. Attempt the following:

- a. Calculate the packing fraction for a SC structure.
- b. What a geometrical structure factor?
- c. What is Dulong and Petit's law?
- d. What is a phonon? Which statistics does it follow?
- e. What is ferroelectricity? Give the names of some ferroelectric substances.
- f. Differentiate between Curie's law and Curie-Weiss law.
- g. What is electrostriction?
- h. The critical temperature for *Hg* with isotopic mass 199.5 is 4.185K. Calculate its critical temperature when its isotopic mass changes to 203.4.
- i. Define the concept of band gap in semiconductors, and mention its value for *Si*, *Ge* and *GaAs*.
- j. Differentiate between type-I and type-II superconductors.

Section – B

(5 marks each)

- Q2. What is a reciprocal lattice? Show that the reciprocal lattice for a bcc crystal is fcc.
- Q3. The lattice constant of a cubic lattice is 'a'. Calculate the spacing between (011), (101), (112), (111) and (100) planes.
- Q4. Derive the vibrational modes of a monatomic linear lattice.
- Q5. What is piezo-electric effect? Explain its origin and discuss its applications.
- Q6. The resistivity of a doped semiconductor is 8.9×10^3 ohm m and the Hall coefficient is 3.6×10^{-4} m³/C. Assuming single carrier concentration, find the mobility and concentration of charge carriers.

Section – C

(10 marks each)

- Q7. Discuss Einstein's theory of lattice heat capacity and explain why it is not capable of giving correct behavior at low temperatures.
- Q8. Give an account of the quantum theory of paramagnetism and derive an expression for the susceptibility.
- Q9. Derive the London's equations and discuss their physical significance.