

U.G. 5th Semester Examination - 2021**PHYSICS****Course Code : BPHSCCHC502****Course Title : Solid State Physics**

Full Marks : 30

Time : 2 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.*

1. Answer any **ten** questions: $1 \times 10 = 10$
- Find the largest distance between two atoms in a cubic cell with lattice constant 6.38.
 - Write down the vector form of Bragg's law. specify the notations used.
 - Give the dispersion relation for 1-D monoatomic lattice.
 - Define fermi velocity.
 - Give the statement of Bloch theorem.
 - What do you mean by Meissner effect?
 - Write down the "Langevin-Debye" equation. What is its significance?

- Plot the inverse magnetic susceptibility with temperature for a ferromagnetic material.
- Find the packing fraction of an ideal fcc crystal.
- Show that Debye temperature has actually the unit of temperature.
- What is Brillouin zone?
- What are phonons?
- What is Fermi surface?
- What do you mean by the polarization of a solid?
- What is Hall effect?

2. Answer any **five** questions: $2 \times 5 = 10$
- The smallest distance between atoms in an fcc crystal is 0.2nm. Find the volume of the unit cube.
 - The Debye temperature for Diamond is 2230 K. Find the highest possible vibrational frequency.
 - Draw a schematic representation of fermi occupancy $[f(E)]$ with energy $[E]$ at $T=0$ and at $T \neq 0$.

- d) The critical temperature of lead, in the superconducting state, is 6.2 K at zero magnetic field. It has a critical field of 0.06 Tesla at 0K. Calculate the critical field at 3.1K.
- e) What is Piezoelectric effect? Differentiate between Piezoelectric effect and electrostrictive effect?
- f) Derive the Clasusius-Mossotti relation.
- g) What is effective mass? Can an electron possesses negative effective mass? Justify your answer.
- h) Draw the energy band diagrams for an insulator a semiconductor and a metal. Explain the diagrams.

3. Answer any **two** questions: 5×2=10

- a) Derive an expression for the lattice heat capacity of a solid according to Einstein model. Discuss the high temperature and low temperature behavior of specific heat . and compare it with experimental observations. 3+2
- b) Deduce the expression for electronic polarizability from the classical point of view. The optical index of refraction and dielectric constant of water are 1.33 and 8.1

respectively. calculate the percentage of ionic polarizability. 3+2

- c) State and explain Bragg's law for x-ray diffraction. Find out whether Bragg's reflection occurs for (110) planes in FCC crystal. Bragg found that (100), (110) and (111) planes of KCl crystal give strong reflections of an x-ray beam at angles $5^{\circ}23'$, $7^{\circ}37'$ and $9^{\circ}25'$ respectively. Show that it has a simple cubic structure. 2+1+2
