

**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**



**B.Sc. DEGREE EXAMINATION – PHYSICS**

**SIXTH SEMESTER – APRIL 2018**

**PH 6610– SOLID STATE PHYSICS**

Date: 10-05-2018

Dept. No.

Max. : 100 Marks

Time: 01:00-04:00

**PART-A**

**Answer ALL Questions**

**(10x2=20)**

1. What is a point group?
2. Copper has fcc structure and its atomic radius is 1.273 Å. Find the lattice parameter.
3. State Bragg's law of X-ray diffraction.
4. Mention any two advantages of neutron diffraction technique.
5. Define specific molar heat capacity. Give its unit.
6. The Debye temperature of Diamond is 2230 K. Calculate the highest possible vibrational frequency of it.
7. State Wiedemann- Franz law.
8. What is Hall field? Give the expression for Hall coefficient.
9. What is Meissner effect?
10. What is a vortex state?

**PART-B**

**Answer ANY FOUR Questions**

**(4x7.5=30)**

11. Name the seven types of crystal systems together with the relation between lattice parameters and the angles between the axes of a unit cell.
12. What are Laue equations of X-ray diffraction? Explain the significance of these equations.
13. Obtain an expression for the coefficient of thermal conductivity of a solid.
14. Derive an expression for the electrical conductivity of a metal on the basis of Sommerfeld theory.
15. Discuss a.c. Josephson's effect. Show that current oscillates with frequency,  $\omega = \frac{2eV}{\hbar}$ . **(1.5+6)**

**PART-C**

Answer **ANY FOUR** Questions :

**(4x12.5 = 50)**

- 16.i) What are Miller indices? **(1.5)**
- ii) Explain the stepwise procedure for finding Miller indices of a given plane. **(4)**
- iii) In an orthorhombic crystal, a lattice plane makes intercepts of lengths  $3a$ ,  $-2b$  and  $3c/2$  along three axes. Deduce the Miller indices of the plane if  $a$ ,  $b$ ,  $c$  are primitive vectors of the unit cell. **(5)**
- iv) Draw the plane with the indices  $(010)$  in a cubic unit cell. **(2)**
17. i) Explain the powder crystal method of studying crystal structure. **(9)**
- ii) A beam of X-rays with wavelength  $0.8420 \text{ \AA}$  is incident on NaCl crystal. Calculate the interplanar spacing of NaCl crystal if the first order Bragg's reflection takes place at a glancing angle of  $8^\circ 35'$ . **(3.5)**
18. Derive an expression for the specific heat capacity of solids based on Einstein theory. Explain its behavior in high and low temperature regions. **(8.5+4)**
19. Derive an expression for the Fermi energy of a free electron gas in 3 dimensions and deduce an expression for density of states. **(10+2.5)**
20. i) What is superconductivity? **(1.5)**
- ii) distinguish between type I and type II superconductor. **(5)**
- iii) Briefly outline BCS theory of superconductivity. **(6)**

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