

**B. Sc. DEGREE END SEMESTER EXAMINATION : MARCH 2024****SEMESTER 6 - PHYSICS****COURSE : 19U6CRPHY12 - SOLID STATE PHYSICS***(For Regular 2021 Admission and Supplementary 2020/2019 Admissions)*

Time : Three Hours

Max. Marks: 60

**PART A****Answer any 8 (2 marks each)**

1. Infer the type of superconductors, which does not follow the Meissner effect Strictly?
2. Define the Fermi level in a semiconductor.
3. What do you mean by hexagonal close packing?
4. Show the variation of Fermi-Dirac distribution function versus energy at absolute temperature and at two temperatures above it.
5. Distinguish between crystalline and amorphous solids?
6. Draw the structure of CsCl crystal?
7. Write down Curie law for paramagnetic substances.
8. What are donors and acceptors? Give two examples of each.
9. Recall diamagnetism. Why diamagnetic materials have negative susceptibility?
10. Describe the working principle of an LED?

**(2 x 8 = 16)****PART B****Answer any 6 (4 marks each)**

11. A paramagnetic substance has  $10^{28}$  atoms/m<sup>3</sup>. The magnetic moment of each atom is  $2 \times 10^{-23}$  Am<sup>2</sup>. Determine the paramagnetic susceptibility at 300K.
12. The band gaps of diamond and silicon are 5.4 and 1.1 eV respectively. Estimate the temperature at which diamond has the same conductivity as Si at 27°C.
13. The lattice constant of a cubic crystal is  $6.23 \text{ \AA}$ . What is the interplanar spacing between the (111) planes?
14. Describe direct and indirect band gap semiconductors with the help of energy band diagrams.
15. What is the frequency of the electromagnetic wave radiated by a Josephson junction across which a dc voltage of 1 milli volt is applied?
16. The conductivity of intrinsic Si is  $4.17 \times 10^{-5}$  and  $4 \times 10^{-4} (\Omega\text{-m})^{-1}$  at 0°C and 27°C respectively. Determine the average band gap of Si.
17. For a simple cubic lattice, find the ratio, d<sub>100</sub>:d<sub>110</sub>:d<sub>111</sub>?
18. The transition temperature of an element with an average mass of 200 amu is 4 K. Determine the transition temperature of its isotope having the atomic mass 206 amu.

**(4 x 6 = 24)****PART C****Answer any 2 (10 marks each)**

19. Derive Bragg's law in crystal diffraction? Explain the Powder method of X-ray diffraction?
20. Give an account of the Weiss theory of ferromagnetism. Discuss the temperature variation of saturation magnetisation. Explain hysteresis and Curie point on the basis of this theory.

21. Discuss the essentials of free electron theory. Write down the Schrödinger equation for a free electron gas in one dimension. Obtain the eigen functions and the eigen values?
22. Show that the product of electron and hole concentrations in a semiconductor is constant at a given temperature.

**(10 x 2 = 20)**