Reg. No .... Name **22U644**

B. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2022

SEMESTER 6 : PHYSICS

COURSE : **19U6CRPHY12: SOLID STATE PHYSICS**

(For Regular - 2019 Admission)

Time : Three Hours Max. Marks: 60

PART A

Answer any 8 (2 marks each)

1. What do you meant by a crystal lattice?
2. Name different crystal systems?
3. What are grain and grain boundary?
4. Discuss the law of mass action.
5. Examine degenerate semiconductors?
6. Briefly discuss the origin of covalent bonding?
7. Why the electronic specific heat capacity of a free electron gas deviates from the classical expression?
8. Describe the Josephson effect underlying a SQUID. Discuss applications of SQUID.
9. Explain how the electron-phonon interaction helps to produce the Cooper pairs.
10. How does the total polarisability depend on frequency?

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. Determine the relationships between the lattice parameter a and the atomic radius r for monoatomic Sc, bcc and fcc structures.
12. In a tetragonal lattice a=b=(1/2) nm and c=(1/3) nm. Determine the lattice spacing between (111) planes?
13. An intrinsic sample of gallium arsenide has a hole density of 10^{13} per cm^3 at room temperature. When doped with bismuth, the hole density decreases to 10^{11} per cm^3 at the same temperature. What is the majority carrier density?
14. An electric field of 100 V/m is applied to a sample of n-type semiconductor whose Hall co-efficient is -0.0125 m^3/coulomb. Determine the current density. Given, the electron mobility is 0.36 m^2/V-s.
15. 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.
16. A magnetic material has a magnetization of 3300 ampere/metre and flux density 0.0044 weber/metre^2. Determine the magnetizing field intensity and relative permeability.
17. Determine the value of electric filed in a material for which the electric susceptibility is 3.5 and polarization 2.3 x 10^{-7} coulomb m^{-2}.
18. The critical temperature of a super conductor at zero magnetic field is Tc. Determine the temperature at which the critical filed becomes half of its value at 0K.

(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. Derive expression for density of free electrons and holes in an intrinsic semiconductor. Show that the Fermi level lies halfway between the valence band and the conduction band.

21. Distinguish between the characteristic features of diamagnetism, paramagnetism, ferromagnetism, antiferromagntism and ferrimagnetism. Give an example of each type of material. Comment on the temperature variation of susceptibility for all types of materials.
22. Give a qualitative description of the BCS theory. How does it account for the superconducting state?

(10 x 2 = 20)