TB206555W **Reg. No :.....**

Name :.....

B. Sc. DEGREE (C.B.C.S.) EXAMINATION, MARCH 2023

(2020 Admission Regular, 2019, 2018 Admissions Supplementary)

SEMESTER VI - CORE COURSE (PHYSICS)

PH6B12B18 - CONDENSED MATTER PHYSICS

Time : 3 Hours **Maximum Marks : 60**

Part A

I. Answer any Ten questions. Each question carries 1 mark **(10x1=10)**

1. How does a crystal differ from a lattice?
2. Distinguish between primitive and non primitive translation vectors.
3. How is a direct lattice vector related to its corresponding reciprocal lattice vector?
4. Explain the significance of Fermi distribution function.
5. Mention the major drawbacks of free electron model.
6. Explain the variation of conductivity with temperature in a semiconductor.
7. Define donor and acceptor impurities.
8. Distinguish between thermoplastic and thermosetting polymers
9. Give the graphical representation of temperature dependence of magnetization in ferromagnets.
10. List the uses of piezoelectric crystals.
11. Superconducting state is more ordered that normal state. Justify this result based on the results of entropy measurements.
12. Discuss briefly the principle employed in the working of SQUIDs.

Part B

II. Answer any Six questions. Each question carries 5 marks **(6x5=30)**

13. Discuss the construction of a Wigner-Seitz cell and mention its significance.
14. The distance between adjascent atomic planes in a calcite crystal is 0.3 nm. Find the smallest angle of Bragg scattering for 0.03 nm X-rays.
15. Apply the quantum free electron model to explain the discrepancy observed in the specific heat of metals.
16. Prove that, for a one dimensional crystal, the average kinetic energy is one third of the Fermi energy.
17. The electron and hole mobilities in a Si sample are 0.135 and 0.048 m^2/Vs respectively. Determine the conductivity of intrinsic Si at 300K if the intrinsic carrier concentration is $1.5 \times 10^{16} atoms/m^3$. If the sample is doped with 10^{23}phosphorous $atoms/m^3$, determine the equilibrium hole concentration and conductivity.
18. Explain the effect of temperature on polymers.
19. Illustrate electronic , ionic and dipolar Polarizability.
20. Explain the transition in the structure of Barium titanate according to the temperature and how does it behave as a ferroelectric crystal.
21. What is the frequency of the electromagnetic wave radiated by a Josephson junction across which a voltage of 1mV is applied?

Part C

III. Answer any Two questions. Each question carries 10 marks **(2x10=20)**

22. Calculate the packing fractions of close packed and loosely packed crystal structures.
23. Discuss the concept of effective mass and also explain its significance. Show that the effective mass of an electron in a crystal is inversely proportional to the second derivative of the E-k curve.
24. Explain the significance of Hall effect and obtain an expression for Hall voltage.
25. Define the term polarizability of a molecule. Discuss the different sources of polarizability comparing their contributions in different types of materials.