23105176

# B.Sc DEGREE (CBCS) REGULAR / REAPPEARANCE EXAMINATIONS, MARCH 2023

## Sixth Semester

## CORE COURSE - PH6CRT12 - SOLID STATE PHYSICS

Common for B.Sc Physics Model I, B.Sc Physics Model II Applied Electronics, B.Sc Physics Model II Computer Applications & B.Sc Physics Model III Electronic Equipment Maintenance

2017 Admission Onwards

8847160C

Time: 3 Hours

Max. Marks : 60

### Part A

*Answer any **ten** questions.*

*Each question carries **1** mark.*

1. What is meant by a symmetry operation in a crystal? What is the most symmetric and least symmetric cubic crystal system?

2. Establish a relation between the radius and the interatomic distance for a face centered cubic crystal.

3. Discuss the NaCl structure.

4. Explain the covalent bonding in diamond.

5. Discuss the origin of metallic bonding.

6. What are the basic assumptions of free electron model?

7. What are donor and acceptor impurities? Why are they called so?

8. Define local field.

9. Mention any two characteristics of superconductors.

10. What are super currents?

11. What do you meant by Vortex state in Type II superconductors?

12. Explain the isotope effect in superconductors.

(10×1=10)

13. Calculate the interplanar spacing for (321) planes in scc lattice with lattice constant a = 4.12 Å.

14. Show that the reciprocal lattice for a bcc lattice is an fcc structure.

15. Determine the temperature at which we can expect a ten percent probability for the electrons in silver to have an energy which is one percent above the Fermi energy. Given, the Fermi energy is 5.5 eV.

16. In intrinsic GaAs, the electron and hole mobilities are $0.85$ and $0.04$ $m^2$/V-s respectively and the corresponding effective masses are $0.068$ m and $0.5$ m respectively, where m is the rest mass of the electron. Given the band gap of GaAs at 300 K as $1.43$ eV. Determine the intrinsic carrier concentration and conductivity.

17. 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.

18. The susceptibility of a paramagnetic substance at 300K is $1.2 \times 10^{-5}$. At what temperature will the susceptibility increases to $1.8 \times 10^{-5}$.

19. Consider a helium atom in its ground state. The mean radius in the Langevin formula may be approximated by Bohr radius 0.0529 nm. The density of helium is 0.178 $Kg/m^3$. Calculate the diamagnetic susceptibility of the helium atom. Given At. Wt of helium = 4.003, $\mu_0 = 4\pi \times 10^{-7}$ and mass of electron = $9.1 \times 10^{-31}$ Kg.

20. Discuss the Weiss theory of ferromagnetism.

21. What is the role of phonons in the formation of cooper pairs?

(6×5=30)

22. Describe the powder method for X-ray diffraction. Discuss the formation of X-ray diffraction pattern.

23. Explain Bloch theorem. Discuss qualitatively the origin of energy bands in solids based on Kronig-Penney model.

24. Distinguish between conductors, insulators and semi-conductors using suitable energy band diagrams.

25. Briefly explain a) Different sources of polarisability b) Clausius-Mossotti relation c) Piezoelectricity

$(2 \times 10 = 20)$