QP CODE: 21101108

21101108

Reg No : .....

Name : .....

B.Sc DEGREE (CBCS) EXAMINATION, APRIL 2021

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

840A8845

Time: 3 Hours Max. Marks : 60

Part A

*Answer any **ten** questions.*

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

1. Draw a neat figure illustrating the lattice parameters of a unit cell.
2. Which are the closest packed crystal structures?
3. Why zeroth order diffraction is not considered in X-ray diffraction?
4. Explain the nature of metallic bonding.
5. What do you mean by a free electron Fermi gas?
6. Draw the dispersion relation in the extended zone scheme.
7. What is the working principle of a photodiode.
8. What are piezoelectric materials?
9. What is exchange field?
10. Give the relation representing the effect of magnetic field in superconductors. Discuss the terms involved.
11. What is Meissner effect?
12. What are SQUIDs?

(10×1=10)

Part B

*Answer any **six** questions.*

*Each question carries **5** marks.*

13. Calculate the d-spacing for (110) plane in a rock salt crystal of a = 2.814 Å.

14. Explain the crystal structure of NaCl with a neat diagram.

15. Obtain the lowest energy of an electron confined to a three-dimensional box of side 0.5 Angstroms.

16. The electron and hole mobilities in a pure Germanium samples are 0.135 and 0.048 m^2/V.s. Determine the conductivity of the material at 300K if the intrinsic carrier concentration is 1.5×10^{16} atoms/m^3. The sample is then doped with 10^{23} Arsenic atoms/m^3. Determine the equilibrium hole concentration and the conductivity.

17. What is the number density of impurity atoms that is to be added to a pure Germanium crystal to make it 10^{-1} ohm m n-type germanium? Given that the electron mobility is 0.15 m^2/Vs.

18. Calculate the Polarisation density of helium gas when it is placed in a field of $5x10^5$ V/m. The atomic polarisability of helium is $0.18x10^{-40}$ F m^2 and the concentration of helium atom is 4×10^{25} /m^3. Also calculate the separation between positive and negative charges in each atom.

19. An iron rod of 0.7 m in length has a coil of 300 turns wound over uniformly. If a current of 4 A is passed through it, Calculate the magnetising field (H), intensity of magnetisation (M), magnetic flux density (B) and dielectric constant.

20. Write a note on Type II superconductors. Give two examples of Type II superconductors.

21. Explain the concept of BCS ground state.

(6×5=30)

Part C

*Answer any **two** questions.*

*Each question carries **10** marks.*

22. With diagram describe two dimensional and three dimensional lattice types.

23. Derive an expression for the binding energy of an ionic crystal and obtain an expression for the Madelung constant. Evaluate the Madelung constant for a linear ionic crystal.

24. Obtain an expression for the effective mass of an electron in a crystal. Explain the reason for the negative effective mass.

25. Explain the origin of diamagnetism in materials. Obtain an expression for diamagnetic susceptibility using Langevin's theory.

(2×10=20)