20100438

QP CODE: 20100438

Reg No : .....

Name : .....

BSc DEGREE (CBCS) EXAMINATION, MARCH 2020

Sixth Semester

Core course - PH6CRT12 - SOLID STATE PHYSICS

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

2017 Admission Onwards

10D153F5

Time: 3 Hours

Marks: 60

Part A

*Answer any **ten** questions.*

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

1. Distinguish between primitive and non-primitive unit cells.
2. Calculate the packing factor for a face centered cubic.
3. Write down the coordinates of the basis of a diamond lattice. What is its packing fraction?
4. Give an expression for the Madelung constant.
5. Write down the normalized wave function for a free electron in a one-dimensional box.
6. Draw the nature of the potential used in Kronig-Penney model.
7. Give an expression for the Fermi energy of an intrinsic semiconductor.
8. What is ionic polarisation?
9. Mention two features of ferrimagnetic materials.
10. What is superconductivity?
11. What are Type II superconductors?
12. What is meant by virtual phonon?

(10×1=10)

Part B

*Answer any **six** questions.*

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

13. In the powder method to obtain the crystal structure, an X-ray of wavelength 1.54 Å gives rise to first order reflection by (322) planes at an angle 56°. Determine the lattice constant of the unit cell.

14. Prove that the reciprocal lattice to a sc lattice is sc.

15. Calculate the Fermi energy at 0 K for copper with electron concentration 2×10^{28} m^{-3}.

16. The resistivity of a pure specimen of germanium at 300 K is 0.47 ohm m and the electron and hole mobilities are 0.38 and 0.18 m^2/V-s. Calculate the number density of temperature generated charge carriers.

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. A solid elemental dielectric with 3×10^{28} atoms/m^3 shows an electronic polarisability of 10^{-40} F-m^2. Assuming the internal electric field to be a Lorentz field, calculate the dielectric constant of the material.

19. The magnetic field strength in silicon is 1000 A/m. If the magnetic susceptibility is -0.25×10^{-5}, calculate the magnetization and flux density in silicon.

20. Describe Meissner effect.

21. A Josephson junction having a voltage of 8.50 μV across its terminals, then calculate the frequency of the alternating current. [Planck's constant = 6.626×10^{-34} J-sec]

(6×5=30)

Part C

*Answer any **two** questions.*

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

22. What are symmetry operations? Describe the principal symmetry operations applicable to a 3D lattice. Show that the five fold rotational axis is not permissible in case of lattices.

23. Write short note on the origin of (a) covalent bonding (b) metallic bonding (c) hydrogen bonding and (d) van der waals bonding.

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

25. Describe the Langevin's theory of paramagnetism and obtain an expression for paramagnetic susceptibility.

(2×10=20)