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Reg. No. : .....

Name : .....

Sixth Semester B.Sc. Degree Examination, April 2023

First Degree Programme under CBCSS

Physics

Core Course IX

PY 1641 : SOLID STATE PHYSICS

(2018 Admission onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions; each carries **1** mark.

1. What is a primitive cell?
2. What is rotation symmetry?
3. Define fermi sphere.
4. Give two applications of Hall effect.
5. What is an extrinsic semiconductor?
6. Define mobility of a charge carrier.
7. Define polarizability.
8. Define magnetic susceptibility.
9. What is diamagnetism.
10. What is isotope effect in superconductors?

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

Answer any **eight;** each carries **2** marks.

11. Distinguish between crystalline and amorphous solids.
12. Give two uses of x - ray diffraction methods.
13. Name five types of bonding in solids.
14. Give the expression for fermi energy and explain the symbols.
15. Give the difference between ferrimagnetism and anti-ferromagnetism.
16. Explain the concept of Brillouin zone.
17. Which are the sources of polarizability?
18. What is electronic polarisability. Give the expression.
19. Explain the term hysteresis and coercivity.
20. Obtain an expression for London penetration depth of a superconductor.
21. What are Cooper pairs? Explain.
22. Give three applications of superconductors.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six;** each carries **4** marks.

23. Determine the separation between lattice planes (2 1 1) and (0 0 1) in a simple cubic lattice.
24. A superconducting material has a critical temperature of 3.7K in zero Magnetic field and a critical field of 0.0306 Am^{-1} at 0K. Find the critical field at 2K.
25. The critical temperature T_C for mercury with isotopic mass 199.5 u is 4.185K. Calculate its critical temperature when its isotopic mass changes to 203.4 u.

26. The spacing between the principal plane of NaCl is 2.82 A°. First order Bragg reflection occurs at an angle of 10°. What is the wavelength of x - rays.

27. Show that average kinetic energy of electron is $\frac{3}{5}E_f$, where E_f is the Fermi Energy.

28. Derive the Clausius-Mossotti relation.

29. The penetration depth of mercury at 3.5K is about 750 A°. Estimate the penetration depth at 0K.

30. The applied magnetic field in Copper is $10^6 Am^{-1}$. If the magnetic susceptibility of Copper is 1.5×10^{-3}. Calculate the flux density and the magnetization in Copper.

31. Assuming the Polarisability of Kr atom is $2.18 \times 10^{-40} Fm^2$. Calculate its dielectric constant at $0°C$ and 1 atm.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two;** each carries **15** marks.

32. Explain Meissner effect? Obtain an expression for the London penetration depth for a superconductor.

33. Distinguish between dia, para and ferromagnetism. Derive an expression for the diamagnetic susceptibility on the basis of Langevin's classical theory.

34. Deduce Bragg's law in X ray diffraction. Describe Bragg's spectrometer and explain how it is used to determine wavelength of X - rays.

35. (a) Which are the three sources of polarisability.
    (b) Derive an expression for dipolar polarisability.
    (c) Draw a graph drawing frequency dependence of various contributions to polarisability.

(2 × 15 = 30 Marks)
