

Reg. No. : .....

Name : .....

**Sixth Semester B.Sc. Degree Examination, April 2024**

**First Degree Programme under CBCSS**

**Physics**

**Core Course IX**

**PY 1641 — SOLID STATE PHYSICS**

**(2018 Admission Onwards)**

Time : 3 Hours

Max. Marks : 80

**PART – A**

Answer **all** questions in **one** or **two** sentences; each question carries **1** mark.

1. What do you mean by amorphous solid?
2. What are different symmetry operations of a lattice?
3. Define unit cell.
4. Explain electrical conductivity.
5. What is an extrinsic semiconductor?
6. What is the relation between electric susceptibility and dielectric constant?
7. What do you mean by plasmon?

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8. What is the significance of Fermi energy?
9. Draw hysteresis curve.
10. Define critical magnetic field.

(10 × 1 = 10 Marks)

### PART – B

Answer **any eight** questions, not exceeding a paragraph; each question carries **2** marks.

11. What are the characteristics of a crystal lattice?
12. What are Miller indices? How do you calculate Miller indices?
13. Explain Brillouin zones.
14. Explain the basic assumption of Kronig Penney model.
15. Explain the principle of Hall effect.
16. What are the failures of free electron model?
17. Explain Bloch theorem.
18. Explain electric susceptibility of dielectric material.
19. What are the limitations of Curie-Weiss law?
20. Distinguish between type-I and type-II superconductors.
21. Explain Meissner effect.
22. Give the salient features of BCS theory.

(8 × 2 = 16 Marks)



### PART – C

Answer **any six**, each question carries **4** marks.

23. Write down the miller indices for planes in 3a, 3b, 2c intercepts.
24. What is the length of primitive translation vector if the cube edge  $a = 3.56\text{\AA}$ ?
25. Copper has fcc structure and atomic radius  $1.278\text{\AA}$ . Calculate its density.
26. Find the, total polarizability of  $\text{CO}_2$  if its susceptibility is  $0.985 \times 10^{-3}$ . Density of  $\text{CO}_2$  is  $1.977\text{kg/m}^3$  and its molecular weight is 44.
27. The atomic radius of sodium is  $1.86\text{\AA}$ . Calculate the Fermi energy of sodium at absolute zero.
28. An oxygen atom produces a dipole moment of  $0.5 \times 10^{22}\text{Cm}$ . If the distance of the center of negative charge cloud from the nucleus is  $4 \times 10^{-17}\text{m}$ , calculate the polarizability of oxygen atom.
29. Estimate the order of the diamagnetic susceptibility of copper by assuming that only one electron per atom makes the contribution. The radius of the copper atom is  $1\text{\AA}$  and the lattice parameter is  $3.608\text{\AA}$ .
30. Approximately how large must be the magnetic induction for the orientation energy to be comparable to the thermal energy at room temperature. Assume  $\mu_m = 5\mu_B$ .
31. A super conducting tin has a critical temperature of  $3.7\text{K}$  in zero magnetic field and a critical field of  $0.306\text{Am}^{-1}$  tesla at  $0\text{K}$ . Find the critical field at  $2\text{K}$ .

(6 × 4 = 24 Marks)

### PART – D

Answer **any two** questions; Each question carries **15** marks.

32. Deduce Bragg's law in X-ray diffraction. Describe Bragg's spectrometer and explain how it is used to determine the wavelength of X-rays.
33. Derive expressions for the Fermi energy and density of states for a free electron gas in one, dimension.
34. Obtain Clausius-Mossotti equation and explain how it can be used to determine the dipole moment of a polar molecule from the dielectric constant measurements.
35. Give an account of Weiss theory of ferromagnetism. Explain hysteresis on the basis of this theory.

(2 × 15 = 30 Marks)