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R – 1244

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

(2013-2017 Admission)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer all questions in one or two sentences. Each carries 1 mark.

1. Sodium (Na) exhibits body centred cubic (BCC) crystal structure with atomic radius 0.186 nm. The lattice parameter of sodium unit cell is _____ nm.
2. The expression for London penetration depth is _____.
3. What is non-Bravais lattice?
4. State Bragg's law for X-ray diffraction.
5. What is Piezoelectricity?
6. What is Photovoltaic effect?
7. What are the properties of material can be determined by Hall effect experiment?

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8. Magnetic susceptibility (χ) of certain material is -1×10^{-5} . The type of the material is _____.
9. The relation connecting permeability (μ) and susceptibility (χ) is _____.
10. Give an example for ferroelectric material.

SECTION - B

(10 × 1 = 10 Marks)

Answer any eight questions, not exceeding a paragraph. Each question carries 2 marks.

11. Why visible light can't be used to study diffraction from a crystal?
12. Differentiate between crystalline and amorphous materials.
13. Distinguish between primitive and non-primitive cell.
14. Briefly explain the variation of electrical resistivity (ρ) of a metal with temperature.
15. Write a short note on heat capacity of conduction electrons.
16. Explain Josephson effect.
17. Write a note on Colour centers.
18. Write down Clausius – Mosotti equation.
19. Explain the phenomenon of Magnetoresistance.
20. How does the band theory of solids leads to the classification of solids into Conductors, Semiconductors and Insulators?
21. What is Antiferromagnetism?
22. Explain Curie Weiss law.

(8 × 2 = 16 Marks)

SECTION - C

Answer any six questions. Each question carries 4 marks.

23. The Bragg angle for reflection from the (110) planes in BCC iron is 22° for an X-ray wavelength of $\lambda = 1.54 \text{ \AA}$. Calculate cube edge for iron. Also calculate what is the Bragg angle for reflection from the (111) plane.
24. The lattice parameter and atomic weight of diamond crystal are $3.57 \text{ \AA}$ and 12 amu respectively. Calculate density of diamond crystal. Given $N_A = 6.023 \times 10^{23} \text{ atoms/mole}$.
25. Obtain the Miller indices of planes having intercepts (a) $2a, 3b, 4c$ (b) $3a, 5b, \infty$.
26. Briefly describe the structure of sodium chloride.
27. The magnetic field intensity in a piece of ferric oxide is 10^6 A/m . If the susceptibility of the material at room temperature is 1.5×10^{-3} , calculate the flux density and magnetization of the material.
28. The atomic radius of sodium is $1.86 \text{ \AA}$. Calculate the Fermi energy of sodium at absolute zero temperature. It is known that sodium has BCC structure.
29. A copper wire of cross sectional area $5 \times 10^{-2} \text{ cm}^2$ carries a steady current of 50 ampere. Assume one electron per atom, calculate the density of free electrons, the average drift velocity.
30. What are the various sources of polarizability? Explain briefly.
31. A metallic surface, when illuminated with light of wavelength $3333 \text{ \AA}$ emits electron with energies up to 0.6 eV and when illuminated with light of wavelength $2400 \text{ \AA}$, it emits electrons with energies up to 2.04 eV . Calculate Planks constant and work function of the metal?

(6 × 4 = 24 Marks)

SECTION – D

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

32. Discuss the Kronig-Penny model for the motion of electrons in a periodic potential. Show from E-k graph that the material can be dissolved into conductors, insulators and semiconductors.
33. Briefly explain potential energy with distance curve representing interaction between two atoms. Explain various types of primary bonding in solids?
34. Discuss the various experimental aspects of X-ray diffraction. Describe them briefly.
35. What is superconductivity? How superconductivity can be destroyed. Explain following : (a) Meissner effect (b) Critical Field (c) Type I and Type II superconductor.

(2 × 15 = 30 Marks)