



Date: 16-11-2024

Dept. No.

Max. : 100 Marks

Time: 01:00 pm-04:00 pm

SECTION A - K1 (CO1)

| Answer ALL the Questions - | | (10 x 1 = 10) |
|-----------------------------------|--|----------------------|
| 1. | Fill in the blanks | |
| a) | The _____ law explains the diffraction of X-rays by crystals. | |
| b) | The 14 distinct types of crystal lattices in three dimensions are known as _____ lattices. | |
| c) | Vibrations of the crystal lattice can be quantized as particles called _____. | |
| d) | The _____ effect in semiconductors helps determine the type and concentration of charge carriers. | |
| e) | The _____ effect in superconductors can occur in both AC and DC circuits, leading to unique quantum phenomena. | |
| 2. | Answer the following | |
| a) | What is a unit cell? | |
| b) | State Curie's law. | |
| c) | What do you mean by hysteresis? | |
| d) | Define Meissner effect. | |
| e) | What are high temperature superconductors? | |

SECTION A - K2 (CO1)

| Answer ALL the Questions | | (10 x 1 = 10) |
|---------------------------------|---|----------------------------------|
| 3. | MCQ | |
| a) | Which of the following is a characteristic of crystalline solids? | |
| a) | Random arrangement of atoms | b) Well-defined geometric shapes |
| c) | No definite melting point | d) Low thermal conductivity |
| b) | Which of the following refers to quantized lattice vibrations? | |
| a) | Electrons | b) Photons |
| c) | Phonons | d) Neutrons |
| c) | In semiconductors, holes are: | |
| a) | Positively charged particles | b) Negatively charged particles |
| c) | Neutrons | d) Photons |
| d) | Which material exhibits strong magnetic properties due to domain alignment? | |
| a) | Diamagnetic | b) Paramagnetic |
| c) | Ferromagnetic | d) Antiferromagnetic |
| e) | Which type of superconductors can exhibit mixed states where magnetic flux penetrates through | |

vortices?

a) Type I b) Type II c) Type III d) High-temperature superconductors

4. True or False

a) All crystalline solids have a random arrangement of atoms.
b) In a diatomic lattice, only acoustical modes of vibrations are present.
c) Diamagnetic materials are strongly attracted to a magnetic field.
d) In Type II superconductors, magnetic flux can penetrate through the material in the form of vortices.
e) The B–H curve shows the relationship between the applied magnetic field (H) and the magnetic flux density (B).

SECTION B - K3 (CO2)

Answer any TWO of the following

(2 x 10 = 20)

5. Derive Bragg's law for X-ray diffraction in crystalline materials.
6. Examine about the Hall Effect in Semiconductors.
7. Elaborate the BCS theory of superconductors.
8. With a neat diagram, describe the working of n-type and p-type semiconductors.

SECTION C – K4 (CO3)

Answer any TWO of the following

(2 x 10 = 20)

9. Discuss the vibrations of a diatomic lattice and describe its optical and acoustical modes.
10. Describe the properties of Dia, Para, Ferro and Ferri magnetic materials in detail.
11. Distinguish between type 1 and type 2 superconductors.
12. Explain the properties of a PN Junction semiconductor.

SECTION D – K5 (CO4)

Answer any ONE of the following

(1 x 20 = 20)

13. Describe the Powder x-ray diffractometer analysis for crystals.
14. Derive an expression for specific heat of a solid at low, medium and high temperatures based on the Debye model.

SECTION E – K6 (CO5)

Answer any ONE of the following

(1 x 20 = 20)

15. Give an account on Einstein's theory of lattice heat capacity. Show that it reduces to Dulong- Petit's law at high temperature.
16. Obtain London equations and discuss its significance. Deduce the expression for penetration depth.

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