(7 pages)

Reg. No. : ....

Code No. : 7397   **Sub. Code : ZPHM 33**

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2023.

Third Semester

Physics — Core

CONDENSED MATTER PHYSICS

(For those who joined in July 2021–2022 onwards)

Time : Three hours   Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The following expression in the condition for diffraction

    (a) $\vec{K} \cdot \vec{G} = G^2$

    (b) $\vec{K} \cdot \vec{G} = 2G^2$

    (c) $2\vec{K} \cdot \vec{G} = G^2$

    (d) $2\vec{K} \cdot \vec{G} + \vec{G} = 0$

2. In case of mono atomic one dimensional lattice, the range of k values for first Brillowin zone is

    (a) $0 \le k \le \dfrac{\pi}{a}$

    (b) $\dfrac{-\pi}{a} \le k \dfrac{\pi}{a}$

    (c) $\dfrac{-\pi}{2a} \le k \le \dfrac{\pi}{2a}$

    (d) $\dfrac{-2\pi}{a} \le k \le \dfrac{2\pi}{a}$

3. From the kinetic theory of gases, the thermal conductivity is

    (a) $k = \dfrac{1}{3} cvl$

    (b) $k = 3\, cvl$

    (c) $k = \dfrac{3c}{vl}$

    (d) $\dfrac{3vl}{c}$

4. Dielectric crystal has thermal conductivity as —————— as metal.

    (a) low

    (b) high

    (c) not mentioned

    (d) cannot compared

5. The density of states is given by

    (a) $D(\Sigma) = \dfrac{3N}{\Sigma}$

    (b) $DC(\Sigma) = \dfrac{3N}{5\Sigma}$

    (c) $D(\Sigma) = \dfrac{3N}{2\Sigma}$

    (d) $D(\Sigma) = \dfrac{3N}{8\Sigma}$

6. The electrical conductivity is ———— proportional to electron density and relaxation time of the electron

   (a) inversely   (b) directly

   (c) equally   (d) reversibly

7. Ferities are ———— material.

   (a) ferro magnetic   (b) non-magnetic

   (c) ferno electric   (d) ferrimagnetic

8. Materials which lack permanent magnetic dipoles are called

   (a) diamagnetic   (b) ferromagnetic

   (c) semi magnetic   (d) none of the above

9. The ratio between permittivity of the medium and the permittivity of free space is known as

   (a) dielectric loss

   (b) electric susceptibility

   (c) dielectric constant

   (d) electric polarization

10. The super conducting state is perfectly ———— in nature

    (a) diamagnetic   (b) para magnetic

    (c) feromagnetic   (d) ferrimagnetic

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Write a note on hydrogen bonding with suitable diagram.

    Or

    (b) Explain the concept of Brillouin zone.

12. (a) Discuss the vibrations of crystals with monoatomic basis and get the plot of 10 versus k.

    Or

    (b) Derive the expression for Debye T^3 law.

13. (a) Describe Detlas –Van Alphan effect. Also describe the special case law temperature and high magnetic field.

    Or

    (b) Using fermi sphere. Find electrical conductivity Ohm's law.

14. (a) Calculate the magnetic moment (μ) using Langevin's diamagnetic equation.

Or

(b) Compare ferrimagnetic order and antiferrimagnetic order.

15. (a) Give an elementary treatment of BCS theory of super conductivity. How does it explain the energy gap at OK?

Or

(b) What is Meissner effect? Explain.

PART C — (5 × 8 = 40 marks)

Answer ALL questions choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Explain diffraction of x-rays by single lattice arrays of atoms and get Bragg's law.

Or

(b) Explain :

(i) ionic crystals

(ii) quasi crystals

17. (a) Derive an expression for density of energy states in metal from fundamentals.

Or

(b) Discuss in detail about "Umklapp processess"

18. (a) Describe Hall effect? Explain its relation to mechanical forces exerted by the magnetic field on the conductor. Show that the Hall coefficient is equal to $\dfrac{1}{ne}$.

Or

(b) Discuss the Kronig-Penny model. How does it lead to the formation of energy bands in solids?

19. (a) Explain about domain theory of ferro magnetism.

Or

(b) Obtain the dispersion relations for ferro magnetic magnons. Hence deduce Bloch's $T^{3/2}$ law.

20. (a) Describe in detail about the determination of dielectric constant of a dielectric material.

Or

(b) Explain about local field in a dielectric and arrive Claussius-Mossoti-relation.

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