K24P 3146

Reg. No. : .....

Name : .....

III Semester M.Sc. Degree (CBCSS – OBE – Regular)
Examination, October 2024
(2023 Admission)
PHYSICS/PHYSICS WITH COMPUTATIONAL AND NANO SCIENCE SPECIALIZATION
MSPHY03C14/MSPHN03C14 : Condensed Matter Physics – I

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **any 5**, **each one** carries **3** marks.

1. Write a note on phonon momentum.
2. Explain the merits and demerits of Einstein's theory of specific heat of solids.
3. Briefly explain Wiedman Franz law of thermal conductivity.
4. Write a short note on ferromagnetism and Curie Weiss law.
5. What is the isotope effect in a superconductor ?
6. Give a qualitative description of BCS theory. **(5×3=15)**

SECTION – B

Answer **any 3**, **each one** carries **6** marks.

7. From Bragg's law in reciprocal lattice space, we know $2\vec{K}\cdot\vec{G}+\vec{G}^2=0$. Hence obtain $2d\sin\theta = n\lambda$.
8. Show that the effective mass of an electron in an energy band is $m^* = \hbar^2 \Big/ \frac{d^2E}{dk^2}$.

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9. Assume that two semiconductors, A and B, have the same effective density of states at the conduction band edge (N_C) and the valence band edge (N_V). The intrinsic carrier concentrations of A and B at 300 K are respectively 1.5×10^{16} m^{-3} and 3.2×10^{16} m^{-3}. What is the band gap of semiconductor B if semiconductor A has a band gap of 1.12 eV ?

10. Estimate the paramagnetic susceptibility of a substance that has 5×10^{28} atoms/cubic meter and is placed in a magnetic field of 1 Tesla at 300 K.

11. The critical temperature of mercury with isotopic mass 199.5 is 4.185 K. Calculate its critical temperature when its isotopic mass changes to 203.4. **(3×6=18)**

SECTION – C

Answer **any 3**, **each one** carries **9** marks.

12. Derive the dispersion relation in the case of vibration of a diatomic 1 D lattice. Draw the dispersion plot for the first Brillouin zone.

13. Discuss the motion of charge carriers in magnetic and electric fields and hence explain the Hall effect. Derive the relation for the Hall coefficient.

14. Explain the band gap in semiconductors. Obtain the relation for intrinsic carrier concentration in semiconductors.

15. Explain Langevin's theory of diamagnetism and obtain an expression for susceptibility.

16. What is the Meissner effect ? Derive London equations and obtain an expression for penetration depth. **(3×9=27)**

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