

MSc Degree Examination,YEAR
I SEMESTER
Faculty of Sciences
Physics – Material Science
PAPER IV- PH1MC4-CONDENSED MATTER PHYSICS

Time : 3 Hours.

Maximum Weight : 30

Part A (Short answer questions-weight 1 each)

Answer any six questions

1. What are ferroelectric crystals? Name any two components that exhibit ferroelectricity.
2. What are ferroelectric domains?
3. List out any four applications of piezoelectricity.
4. Differentiate between Type1 and Type2 superconductors.
5. State Hund's rule.
6. Differentiate between diamagnetic and paramagnetic materials.
7. What is Hall Effect?
8. Explain the isotope effect in Super Conductivity.
9. Distinguish between acoustic and optical phonons.
10. Derive an expression for the density of available electron states

(6 x 1 =6 wt)

Part B (Short Essay/Problems-Weight 2 each)

Answer any 4 questions

11. (a) For argon gas, $N= 10^{19}\text{cm}^{-3}$, $Z= 18$ and $r= 10^{-8}\text{cm}$. Calculate the electronic polarization for an applied field of 10Kv/cm .
(b) Silicon has the dielectric constant 12, and edge length of the conventional cubic cell of Silicon lattice is 5.43Å . Calculate the electronic polarisability of Silicon atoms.
12. Show that the intermediate state consists of regions of normal and superconducting metal.
13. Show that how the London equations lead to the Meissner effect and the flux penetration through thin films of superconductors.
14. Discuss the normal and umklap process.
15. Explain the inelastic scattering of neutrons by phonons.
16. A two –dimensional hexagonal lattice spacing $a = 3 \text{ Å}$, and one electron per unit cell. If the electrons are considered free within the two – dimensional plane, what is the Fermi energy E_F (Provide a numerical value in eV).

(4 x 2 =8 wt)

Part C (Essay type questions- weight 4 each)

Answer all questions

17. a) Explain displacive and order- disorder transitions .Describe Landau theory of phase transition.

Or

b) What is single particle tunneling. Derive an expression for AC and DC Josephson effects.

18. a) Distinguish between diamagnetism and paramagnetism. Derive Langevin's diamagnetic equation.

Or

b)Describe paramagnetic susceptibility of conduction electrons.

19. a) Discuss Debye model of lattice heat capacity. Derive an expression for it.

Or

b) Obtain the vibrational spectrum of a linear diatomic lattice and show that the spectrum consists of two branches.

20. a)What is Fermi surface? Discuss the construction of Fermi surfaces.

Or

b) Explain the heat capacity of electron gas deriving necessary expressions.

(4 x 4 =16 wt)