Question Bank

B.Sc. - PHYSICS

SOLID STATE PHYSICS

PH-10

Very Short Answer Type Questions

Q.1 What are ferroelectric crystals?

Q.2 Differentiate between Type1 and Type2 superconductors.

Q.3 State Hund's rule.

Q.4 Differentiate between diamagnetic and paramagnetic materials.

Q.5 What is Hall Effect?

Q.6 Explain the isotope effect in Superconductivity.

Q.7   Distinguish between acoustic and optical phonons.

Q.8   Derive an expression for the density of available electron states.

Q.9   What is the significance of Fermi function?

Q.10 Show that 1 amu≈931 MeV

Q.11 What is Curie temperature?

Q.12 Calculate the number of atoms per unit cell of a face centered cubic crystal.

Q.13 Draw a (1 1 0) plane in a cubic unit cell.

Q.14 Calculate the energy released in the fission of 1 gm of U^{235}.

Q.15 Out of vibrational and rotational energy levels of a molecule, which are equally spaced?

Q.16 What is heat of dissociation of a molecule?

Q.17 Define Wigner Seitz cell.

Q.18 How does the dielectric constant of a polar dielectric (like water) vary from zero to optical frequencies of an applied electric field?

Q.19 Draw the reciprocal lattice of fcc lattice.

Q.20 Name the crystal system in a 3D lattice.

Q.21 Define Coordination number.

Q.22 What is the number of nearest neighbours for the three types of cubic lattices? What are their nearest neighbour distances?

Q.23 How do entropy and specific heat vary with temperature for a conductor?

Q.24 Discuss the concept of effective mass. How does it vary with wave vectors?

Q.25 Name the seven crystal systems in a 3D lattice. Give the relation between the length and angles of the axes of unit cell in each type.

Q.26 Obtain the Lorentz relation for local field at a point inside a dielectric. How is local field different from Maxwell field?

Q.27 Draw hcp structure.

Q.28 What are covalent crystals? Give an example.

Q.29 What are domains?

Q.30 Why diamagnetic materials have negative susceptibility?

Q.31 State and explain Curie's law.

Short Answer Type Questions

Q.1 Explain the construction of reciprocal lattice.

Q.2 Show the Fermi energy at absolute zero is a function of number of free electrons per unit volume of the metal.

Q.3 Describe the method to determine Miller indices of a plane. Find the Miler indices for a plane having intercepts a,b,-c on the crystallographic axes.

Q.5 Show that for a bcc structure, the cube edge is given by $a = 4r/\sqrt{3}$, where r is the atomic radius.

Q.6 Explain the process of Van der Wal bonding in crystals. What are the factors on which Van der Waal's forces depends?

Q.7 Show that the reciprocal lattice of a bcc lattice is a fcc lattice.

Q.8 What is Meisener effect in Superconductors? Enumerate the properties of type I and type II superconductors.

Q.9 Starting with expressions of electron and holes densities ,show that the Fermi level lies midway between the band gap between the band gap for an intrinsic semiconductor. How does its position change with doping concentration and temperature for an extrinsic semiconductor?

Q.10 What is hysteresis? Discuss its occurrence on the basis of domain concept.

Q.11 Explain the construction of Wigner Seitz cell.

Q.12 Derive Bragg's law of X-ray diffraction in crystal.

Q.13 Calculate the angle of diffraction for X-rays having wavelength 1.54 A^0 in different orders 1, 2, 3, if the interplanar distance is 2.67 A^0.

Q.14 Describe the Langevin's theory of paramagnetism and derive an expression for volume susceptibility.

Q.15 Draw and explain the graphical representation of Bragg's law of X-ray diffraction in terms of reciprocal lattice vector.

Q.16 State the drawbacks of the Drude-Lorentz theory of free electrons in a metal. What were the modification suggested by Sommerfeld?

Q.17 What are Miller indices? Obtain the Miller indices of planes having intercepts (a,b/2,3c) in SC structure.

Q.18 Derive an expressions for thermal conductivity on the basis of free electron theory.

Q.19 Distinguish between Schottkey & Frenkel defects.

Q.20 Discuss 'isotope effect' and critical field in superconductors.

Q.21 Explain how the lattice spacing of a crystal can be determined by using Bragg's spectrometer.

Q.22 X-rays of wavelength 0.71 A^0 are diffracted in second order by the [110] planes of a rock salt cubic crystal of side 2.82 A^0. Calculate the glancing angle of the X rays.

Q.23 Distinguish between diamagnetic, Paramagnetic and ferromagnetic substances on the basis of their behaviour in the presence of an external magnetic field.

Q.24 Discuss Langevin's theory of diamagnetism and obtain an expression for diamagnetic susceptibility.

Q.25 Determine the relation between lattice parameter 'a' and atomic radius 'r' for monatomic bcc structure.

Q.26 Calculate Fermi energy of electron at 0K for a metal with electron density of 10^{28} m^{-3}. Given h=6.63×10^{-34} Js and m =9.11×10^{-31} kg.

Q.27 Discuss the structure of Diamond cubic unit cell.

Q.28 Discuss the failure of classical theory in explaining the observes temperature dependence of specific heat of a solid.

Q.29 Give the qualitative description of the dispersion curves in a 3 D diatomic lattice.

Q.30 Prove that 5 fold rotation axis cannot exist in a crystal lattice.

Long Answer Type Questions

Q.1 State Bloch theorem. Obtain the energy spectrum of an electron in a one dimensional periodic potential. Show that in the limiting case of vanishing potential barrier leads to the results obtained in a free electron model.

Q.2 What is the origin of magnetic properties in a material? Obtain an expression for paramagnetic susceptibility on the basis of Langevin theory. Explain briefly an experimental method used to measure paramagnetic susceptibility.

Q.3 Derive an expression for the electronic polarizability in a varying electric field. What is the implication of Complex dielectric constant?

Q.4 Give the modification incorporated by Debye and derive T^3 law. Calculate the vibrational frequency of carbon whose Debye temperature is 1650 K. Given h=6.6$\times$ 10^{-34} Js, k_B=1.38$\times$ 10^{-23} J/K

Q.5(a) Give Langevin theory of orientational polarization.

(b) What are phonons and write their important properties.

Q.6 (a) Explain GaAs based semi conductor lasers.

(b) Distinguish between Ferro, anti Ferro and ferri magnetic materials.

Q.7 Explain Sommerfield theory of electric conductivity of metal.

Q.8 Discuss in detail the Superconductivity of a material.

Q.9 Derive the dispersion relation for a linear diatomic lattice, stating the assumption involved. Discuss the salient features of various branches in the dispersion curve. Under what condition a diatomic lattice behave as a monatomic lattice?

Q.10 Explain the principle of powder method. How unit cell parameters of a cubic crystal are determined from the powder photograph.

Q.11 Write a short note on

(a) neutron diffraction method.

(b) BCS theory

Q.12 Mention the important characteristics of semi conductors. Explain the type of bonding in semi conductors with the help of band structure. Explain the effect of temperature and impurity on the Fermi level in a semiconductor.