

**CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR WOMEN,
NUVEM-GOA**

B.Sc. CBCS Semester V (Regular) Examination, January 2022

Subject Code: UPYD 103

Subject Name: Solid State Physics

Total marks: 60

Duration: 120mins.

Total No. of Pages: 03

Instructions:

- 1) *All questions are compulsory, however internal choice is available.*
- 2) *Figures to the right indicate maximum marks to the question.*
- 3) *Symbols have their usual meanings unless otherwise stated.*
- 4) *Draw neat diagram wherever necessary.*
- 5) *Use of non-programmable calculator is permitted.*

Q 1 Answer any Five of the following (2x5=10)

- a) Define Space lattice & Basis and also write the expression for Crystal structure.
- b) State the assumptions made about the metals in case of Drude - Lorentz theory.
- c) State Bloch theorem and write Bloch function.
- d) State few characteristic properties of a Paramagnetic materials.
- e) Which are the two types of Dielectric material? Explain them.
- f) What are Ferroelectric materials? Name the three main groups of ferroelectrics.
- g) State few differences between Ferroelectric & Ferromagnetic Domains.

Q 2 Answer any Five of the following (2x5=10)

- a) Which are two types of unit cells? Define them.
- b) Calculate the lattice spacing between (011) & (112) planes. Let the Lattice constant of a cubic lattice be 'a'.
- c) Define Brillouin Zones. Give the Braggs equation used to describe the zones in three dimensions.
- d) Based on band structure, explain why resistivity decreases with increase in temperature in case of semiconductors.
- e) Define Plasma. How can metals be good example of plasma?
- f) Define ferroelectric Curie temperature.
- g) Define Piezoelectric effect.

Q3 A)

- i) Name different types of Crystal symmetry. Explain any one of them. (2)
- ii) Two dimensional lattice has the basic vectors $\vec{a} = 2\hat{x}$ and $\vec{b} = \hat{x} + 2\hat{y}$. Find the reciprocal lattice vectors. (3)

OR

Q3.A) Define and sketch all the two dimensional lattices. Show all the parameters in a tabulated form. (5)

- B) Calculate the packing fractions of Simple cubic, Body centered Cubic & Face centered cubic. Compare and comment on the relative packing density of all three. (5)

Q4 A)

- i) State the importance of Hall Effect. (2)
- ii) Calculate the Fermi energy in eV for silver at 0 K, given that the density of silver is 10500 kg/m^3 , its atomic weight is 107.9 and it has one conduction electron per atom. (3)

OR

Q4 A) Using the simplified form of equation from Kronig and Penny model, plot the graph of $P \cdot \sin \alpha a / \alpha a + \cos \alpha a$ for $P=3\pi/2$ as a function of αa . Explain and deduce the conclusions from the same plot. (5)

- B) Using the classical free electron model derive the expression for conductivity of metal. (5)

Q 5 A)

- i) State the conclusions of Classical theory of Diamagnetism (Langevin Theory) (2)
- ii) Estimate the paramagnetic susceptibility of a substance which has 5×10^{28} atoms per unit volume placed in the magnetic field of 1T at 300K. (3)

OR

Q 5 A) Explain the concept of Ferromagnetic domains. (5)

B) Derive the expression for paramagnetic susceptibility on the basis of Classical theory of paramagnetism. (5)

Q 6 A) (2)

i) State few applications of Piezoelectric materials.

ii) If the static dielectric constant of NaCl is 5.6 and its optical refractive index is 1.5. Calculate the ratio of its electric polarizability to its total polarizability. (3)

OR

Q 6 A) Plot and Explain the hysteresis loop of a ferroelectric material. (5)

B) Derive the Clausius-Mossotti Relation and relate the macroscopic dielectric constant with microscopic polarizabilities (5)

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