

6. (a) Explain classical theory of electronic polarizability of an atom. Discuss the frequency dependence of dielectric constant. (9)
- (b) Assuming that the polarizability of Kr atom is $2.18 \times 10^{-40} \text{ Fm}^2$, calculate its dielectric constant at 0°C and 1 atmosphere. (3)
- (c) Find the total polarizability of CO_2 , if its susceptibility is 0.985×10^{-3} . Density of carbon dioxide is 1.977 kg/m^3 . (3)
7. (a) Prove that for the Kronig-Penny model with $P \ll 1$, (P is Potential Barrier Strength), energy of the lowest energy band at $k = 0$ is (7)

$$E = \frac{h^2 P}{4\pi^2 m a^2}$$

- (b) How does the Kronig – Penny model lead to the formation of energy bands in a linear lattice? What happens to the width of the allowed and forbidden bands with the change in the strength of the periodic potential. (8)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7477

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Unique Paper Code : 42227637_OC

Name of the Paper : Solid State physics

Name of the Course : **B.Sc. Physical Sc. – DSE (Old Course)**

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
 2. Attempt **five** questions in all including Q.No. 1 which is compulsory.
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1. Attempt any **five** of the following : (5×3=15)
 - (a) Distinguish between dia-magnetic and para-magnetic materials.
 - (b) Show that in band theory of solids the effective mass of the electrons is different from its rest mass.

- (c) What are plasmons?
 - (d) Graphically show the variation of total polarizability with frequency.
 - (e) Draw the planes (001), (011), (210) and (122) for a simple cubic lattice.
 - (f) Mention the type of lattice and bases in NaCl structure.
 - (g) Enumerate the properties of type I and type II superconductors.
2. (a) Determine an expression for interplanar spacing between the crystal planes of Miller indices (hkl) of a cubic crystal. (7)
- (b) Define atomic structure factor and Geometrical structure factor. Also explain why (100) plane of bcc is absent in the first order, while the same plane is present in its second order. (8)
3. (a) Define reciprocal lattice? Also write down the condition of Braggs diffraction in reciprocal form. (5)

- (b) Show, that the reciprocal lattice of a bcc lattice is fee lattice. (5)
 - (c) Calculate the glancing angle on the plane (100) of a cube of a rock salt crystal of lattice parameter $2.84 \text{ \AA}$ corresponding to second order diffraction maximum by an X-ray of wavelength $0.710 \text{ \AA}$. (5)
4. What are the assumptions made in Einstein's theory of specific heat? Derive an expression for the specific heat of solids following Einstein model. How does the specific heat depend on temperature and to what extent does this model agree with experimental results. (15)
5. (a) Discuss B-H curve of a ferromagnetic material using the concept of domains. How do you characterize materials as soft and hard from the B-H curve? (10)
- (b) What are the various contributions to the magnetic dipole moment of an atom? Explain with the help of diagram the difference between ferromagnetic and ferrimagnetic materials. (5)