USDSEPHT-10 - Physics Paper-II (Solid State Physics)

P. Pages : 3

Time : Three Hours

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GUG/S/23/13094

Max. Marks : 50

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Notes : 1. All questions are compulsory.
2. Draw neat and well labelled diagrams wherever necessary.

Either:

1. a) i) Distinguish between Crystalline solids and Amorphous solids. **3**

ii) Derive Bragg's law of X-ray diffraction in crystal. Give applications of Braggs Law. **4**

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

OR

b) a) What are Miller Indices? Obtain the Miller indices of planes having intercepts (a, 2b, 3c) in cubic structure. **2½**

b) Draw (111), (010) and (001) planes in simple cubic unit cell. **2½**

c) Draw Bravais lattices in two dimensions. **2½**

d) The distance between crystal planes is $3A^0$. Find the angle of diffraction in the first order if the wavelength of X-rays is $0.1A^0$. **2½**

Either:

2. a) i) Discuss Langevin's theory of diamagnetism and obtain expression for diamagnetic susceptibility. **5**

ii) What is paramagnetic substance? Explain the concept of magnetic susceptibility. **3**

iii) A magnetic material has a magnetization of 2300A/m and produces a flux density of $0.00314 \, Wb/m^2$. Calculate magnetizing force and relative permeability of the material. **2**

OR

b) a) Distinguish between diamagnetic, paramagnetic and ferromagnetic substances on the basis of their behavior in the presence of external magnetic field. **2½**

b) Describe the salient features of diamagnetic materials. **2½**

		c)	Prove that susceptibility χ_p of paramagnetic substances is inversely proportional to absolute temperature.	**2½**
		d)	Give the Weiss theory of ferromagnetism.	**2½**

Either:

3. a) i) Drive Clausius-Mosotti Equation for dielectrics. **3**

ii) Explain the phenomena of Normal and Anomalous dispersion. **3**

iii) Explain the concept of electric polarizability on the basis of classical theory. **2**

iv) Calculate the electronic polarizability of argon atom. **2**
[Given $\varepsilon_r = 1.0024$ at NTP and $N = 2.7 \times 10^{25} / m^3$]

OR

b) a) Derive an expression representing the relation between three electric vectors E, D and P. **2½**

b) Write a short note on polar and non-polar dielectrics. **2½**

c) Derive Langevin – Debye equation. **2½**

d) The atomic weight and density of sulphur are 32 and 2.08 gm/cm3 respectively. The electronic polarizability of the atom is 3.28×10^{-40} F.m^2. If sulphur solid has cubical symmetry, what will be its relative dielectric constant? **2½**

Either:

4. a) i) Explain in detail Kroning – Penny model. **5**

ii) What is Hall Effect? Explain the term hall coefficient and hall mobility. **3**

iii) An n-type germanium sample has a donor density of $10^{21} m^3$. It is arranged in a Hall experiment having magnetic field of 0.5T and the current density is $500A / m^3$. Find the hall voltage if the sample is 3mm wide. **2**

OR

b) a) Classify solid as conductor, semiconductors and insulators on the basis of energyband picture. **2½**

b) Explain Meissner effect in superconductor. **2½**

c) Explain the term superconductivity. What are the Type-I and Type-II superconductor? **2½**

d) The critical field for niobium is 1×10^5 A / m at 8K and 2×10^5 A / m at 0K. Calculate the transition temperature of the element. **2½**

5.   Solve **any ten** of the followings.

        a)   Why a crystal diffract X-rays?   **1**

        b)   What is unit cell?   **1**

        c)   Define Reciprocal lattice.   **1**

        d)   State Curie law of paramagnetism.   **1**

        e)   What is B-H curve?   **1**

        f)   What is Hysteresis loss?   **1**

        g)   Define dielectric susceptibility?   **1**

        h)   Give applications of dielectric substances?   **1**

        i)   What do you mean by dielectric loss?   **1**

        j)   Define fermi energy?   **1**

        k)   Give at least 2 applications of Superconductivity.   **1**

        l)   What is significance of critical temperature in Superconductivity?   **1**

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