USDSEPHT10 - Physics Paper-II (Solid State Physics)

P. Pages : 3

Time : Three Hours

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GUG/W/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) State and Derive Bragg's law of X-ray diffraction in crystal. How Bragg's law helps to determine crystal structure of materials? **5**

ii) Distinguish between Crystalline solids and Amorphous solids. **3**

iii) The spacing between successive planes in NaCl is 2.82A°. X-rays incident on the surface of the crystal is found to give rise to first order Bragg reflection at glancing angle 8.8°. Calculate the wavelength of X-rays. **2**

OR

b) a) Explain concept of Reciprocal Lattice. **2½**

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

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

d) Find the Miller indices of a crystal plane 3a, 2b and 2c on x, y and z axes respectively. **2½**

Either:-

2. a) i) Discuss Langerin's theory of diamagnetism and obtain expression for diamagnetic susceptibility. **7**

ii) The magnetic susceptibility of the medium is 2.3×10^{-5}. Compute its permeability and relative permeability. (Permeability of free space = $4\pi \times 10^{-7}$ hennery/m). **3**

OR

b) a) Give the Weiss theory of ferromagnetism. **2½**

b) Write the properties of diamagnetic materials. **2½**

c) Prove that susceptibility X_p of paramagnetic substances is inversely proportional to absolute temperature. **2½**

d)		The hysteresis loop of transformer has area 2500 erg/cm^3. Calculate the loss of energy per hour at 50 Hz. Frequency. Density of iron is 7.5 gm/cm^3 and weight is 10 kg.	**2½**

Either:-

3.	a)	i)	Obtain Clausius – Mossotti Equation for dielectrics.	**5**
		ii)	Derive an expression representing the relation between three electric vectors, $\overrightarrow{E}, \overrightarrow{D}$ and $\overrightarrow{P}$.	**3**
		iii)	The radius of hydrogen atom is 0.053 nm. Calculate its electronic polarizability. $\left(\text{Given } \varepsilon_0 = 8.85 \times 10^{-12} \text{F/m}\right)$	**2**

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OR

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	b)	a)	Explain the phenomena of Normal and Anomalous dispersion.	**2½**
		b)	Write a short note on polar and non-polar dielectrics.	**2½**
		c)	Derive Langevin – Debye equation.	**2½**
		d)	On the basis of classical theory, explain electric polarizability.	**2½**

Either :-

4.	a)	i)	Discuss Kronig-Penney model.	**7**
		ii)	What is Hall effect?	**1**
		iii)	Assuming that three are 5×10^{28} atoms/m^3 in copper, find the Hall coefficient. Given e $= 1.602 \times 10^{-19}$C.	**2**

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OR

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	b)	a)	Classify solid as conductor, semiconductors and insulators on the basis of energy band picture.	**2½**
		b)	Explain the term superconductivity. What are the Type-I and Type-II superconductor?	**2½**
		c)	Explain Meissner effect in superconductor.	**2½**
		d)	Explain effect of external electric field on superconductors.	**2½**

5.		Solve **any ten** of the following:	
	a)	What is unit cell?	**1**
	b)	Why a crystal diffract X-rays?	**1**

c)	What are Primitive and Non-primitive unit cell?	**1**
d)	Define curie temperature.	**1**
e)	What is Hysteresis loss?	**1**
f)	What is anti ferromagnetic substance?	**1**
g)	What is Electric susceptibility?	**1**
h)	Give applications of dielectric substances?	**1**
i)	What is polarization vector?	**1**
j)	What is fermi energy?	**1**
k)	Give at least two applications of Superconductivity.	**1**
l)	Define critical magnetic field.	**1**

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