

B.Sc. T.Y. (CBCS Pattern) Sem-V
USDSEPHT10 - Physics Paper-II : Solid State Physics

P. Pages : 2

Time : Three Hours



GUG/W/22/13094

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) Draw (110), (011) and (001) planes in simple cubic unit cell. **3**
iii) The spacing between successive planes in NaCl is 2.82Å . X-rays incident on the surface of the crystal is found to give rise to first order Bragg reflection at glancing angle 7.7° . Calculate the wavelength of X-rays'. **2**

OR

- b) a) What are Miller Indices? How are they obtained? **2½**
b) Explain concept of Reciprocal Lattice. **2½**
c) Give the differences between Amorphous and Crystalline material. **2½**
d) Calculate the angle of diffraction for X-rays having wavelength 1.54Å in different orders 1,2,3, if the interplanar distance is 2.67Å . **2½**

Either:

2. a) i) What is diamagnetic substance? Explain the concept of magnetic susceptibility. **3**
ii) Discuss Langevin's theory of diamagnetism and obtain expression for diamagnetic susceptibility. **5**
iii) The maximum value of the permeability of the material is 0.126 N/A^2 . What is the relative permeability and magnetic susceptibility of the medium (Permeability of free space = $4\pi \times 10^{-7} \text{ henry/m}$). **2**

OR

- b) a) Give the Weiss theory of ferromagnetism. **2½**
b) Distinguish between diamagnetic, paramagnetic and ferromagnetic substances on the basis of their behavior in the presence of external magnetic field. **2½**
c) Prove that susceptibility χ_p of paramagnetic substances is inversely proportional to absolute temperature. **2½**
d) A magnetic material has a magnetization of 2300 A/m and produces a flux density of 0.00314 Wb/m^2 . Calculate magnetizing force and relative permeability of the material. **2½**

Either:

3. a) i) Obtain Clausius-Mosotti Equation for dielectrics. **4**
ii) Write a short note on polar and non-polar dielectrics. **3**

- iii) 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.m². If sulphur solid has cubical symmetry, what will be its relative dielectric constant? **3**

OR

- b) a) Derive an expression representing the relation between three electric vectors E, D and P. **2½**
 b) Explain the concept of electric polarizability on the basis of classical theory. **2½**
 c) Derive Langevin – Debye equation. **2½**
 d) Calculate the electronic polarizability of argon atom. **2½**
 [Given $\epsilon_r = 1.0024$ at NTP and $N = 2.7 \times 10^{25} / \text{m}^3$.]

Either:

4. a) i) Explain in detail Kronig – Penny model. **5**
 ii) Explain Meissner effect in superconductor. **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 500 A/m². Find the Hall voltage if the sample is 3mm wide. **2**

OR

- b) a) What is Hall Effect? Explain the term hall coefficient and hall mobility. **2½**
 b) Discuss Conductor, Semiconductors and insulators on the basis of energy band diagram. **2½**
 c) Explain the term superconductivity. What are the Type-I and Type-II superconductor? **2½**
 d) Find the critical field in Pb at T = 4.2K. Here $H_c(0) = 0.0803 \text{Wb} / \text{m}^2$ for Pb. **2½**

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

- a) Give at least two applications of Bragg's Law. **1**
 b) What are Primitive and Non-primitive unit cell? **1**
 c) What is Brillouin Zone? **1**
 d) State Curie law of paramagnetism. **1**
 e) Why B-H curve is important to study magnetism? **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) What is importance of fermi energy? **1**
 k) Give at least 2 applications of Superconductivity. **1**
 l) What is significance of critical temperature Superconductivity? **1**
