B.Sc. Third Year (CBCS Pattern) Sem-V
USDSEPHT10 - Physics Paper-II - Solid State Physics

P. Pages : 3   **GUG/W/23/13094 (S)**

Time : Three Hours

Max. Marks : 50

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Notes : 1. All questions are compulsory and carry equal marks.
2. Draw neat and labelled diagrams wherever necessary.
3. Use of log table/calculator is allowed.

Either :

1. A) i) Why does crystal diffract X-rays? **1**

ii) State and prove Bragg's law of x-ray diffraction, also give its physical significance. **4**

iii) Describe the construction and working of Bragg's spectrometer. **3**

iv) An X-ray tube produces on 0.1A° x-ray. Find the accelerating voltage. **2**

OR

B) a) Give the differences between crystalline and amorphous solids. **2½**

b) Draw Bravasis lattices in two dimensions. **2½**

c) What are Miller Indices? **2½**
Find the miller indices of a crystal plane a, 2b and ∞ on x, y and z axes respectively.

d) Draw (001), (010) and (100) planes in simple cubic unit cell. **2½**

Either :

2. A) i) What is meant by diamagnetic substance? **1**

ii) Explain magnetic susceptibility. **2**

iii) Discuss Langevin's theory of diamagnetism. Derive the expression for diamagnetic susceptibility. **7**

OR

B) a) What are ferrimagnetic materials? How it differ from ferromagnetic substances? **2½**

b) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. **2½**

c) Prove that susceptibility χ_p of paramagnetic substances in Inversely proportional to absolute temperature. **2½**

d) The susceptibility of a paramagnetic substance $FeCl_3$ is 3.7×10^{-3} at 27°C. What will be the value of its susceptibility and permeability at 400 °K and 500 °K? **2½**

Either :

3. **A)**

i) Explain the three electric vectors $\vec{E}$, $\vec{D}$ and $\vec{P}$. **3**

ii) Prove that the relation $\vec{D} = \varepsilon_o \vec{E} + \vec{P}$. **3**

iii) Derive an expression for local electric field at an atom inside the dielectric. **4**

OR

B) a) Derive Langevin – Debye equation. **2½**

b) Explain normal and anomalous dispersion. **2½**

c) Explain classical theory of electric polarizability. **2½**

d) The radius of hydrogen atom is 0.053nm. Calculate its electronic polarizability. (Given $\varepsilon_o = 8.85 \times 10^{-12} C^2 / Nm^2$) **2½**

Either :

4. **A)** i) Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids. **3**

ii) Discuss Kronig – Penny model. **7**

OR

B) a) State and explain Meissner effect. **2½**

b) What is hall effect? Explain the term hall coefficient and hall mobility. **2½**

c) What is superconductor? What are the Type I and Type II superconductor? **2½**

d) Assuming that there are $5 \times 10^{28} atoms / m^3$ in copper. Find the hall coefficient. (Given $e = 1.6 \times 10^{-19} C$) **2½**

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

a) What is unit cell?

b) State the relation between crystal structure, lattice and basis.

c) What is packing fraction?

d) What is B-H curve?

e) What is hysteresis losses?

f) What is Curie temperature?

g) What is mean by complex dielectric substance?

h) What is a electric susceptibility?

i) Write Cauchy and Sellmeir's equation.

j) Define critical magnetic field?

k) What is fermi energy?

l) What is the effect of external electric field on super conductors?

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