

B.Sc.T.Y. Sem-V  
**B.Sc. 3535 - 5S-PHY502 : Physics Paper-II**  
**(X-Rays And Solid State Physics)**

P. Pages : 2

Time : Three Hours



GUG/S/19/1321

Max. Marks : 50

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

**1. Either**

- a) i) Describe the salient feature of the continuous X-ray spectrum. 3
- ii) Show that the intensity of X-ray beam decreases exponentially when it passes through the material of thickness X. 3
- iii) Draw the characteristic of X-ray absorption spectrum, showing  $K_I, L_I, L_{II}$  and  $L_{III}$  absorption edges. 2
- iv) The intensity of X-ray beam falls to 25% of its value after penetrating a target of 1 cm thick. Calculate the absorption coefficient of a target. 2

**OR**

- b) i) Why a crystal diffract X-ray? 1
- ii) Derive Bragg's law and give its significance. 4
- iii) Describe Laue's pattern of diffraction of X-rays. 3
- iv) The distance between crystal planes is  $3A^\circ$ . Find the angle in the first order if wavelength of X-ray used is  $0.7 A^\circ$ . 2

**2. Either**

- a) i) Distinguish between diamagnetic, paramagnetic and ferromagnetic substance on the basis of their behaviour in the presence of an external magnetic field. 3
- ii) Discuss Langevin's theory of diamagnetism and obtain expression for diamagnetic susceptibility. 7

**OR**

- b) i) Discuss Kronig-Penney model. 7
- ii) Explain the formation of energy band on the basis of Kronig-Penney model. 3

**3. Either**

- a) Derive Duane-Hunt Law. 2½
- b) Find the total number of atom per unit cell of BCC and FCC lattice. 2½
- c) What is ionic bond? State the properties of ionic crystal. 2½
- d) State and prove Wiedemann-Franz law. 2½

**OR**

- e) Give the application of X-rays in various field. 2½
- f) Derive the expression for the interplanar spacing between two parallel planes with Miller indices (hkl) and lattice constant. 2½
- g) Explain Lennard-Jones potential. 2½
- h) Derive an expression for thermal conductivity of metal on the basis of free electron theory. 2½

4. Either

- a) State Moseley's law. Give its importance. 2½
- b) Draw the planes (100), (010) and (111) in simple cubic unit cell. 2½
- c) Calculate the diamagnetic susceptibility of Helium gas (z:2), assuming that two electrons are contributing to its diamagnetism. (Given :- mean radius of atom = 0.6Å,  $n = 28 \times 10^{26}$  per  $m^3$ ,  $\mu_0 = 4\pi \times 10^{-7}$  henry/m  $e = 1.6 \times 10^{-19}$  C,  $m = 9.1 \times 10^{-31}$  kg) 2½
- d) Distinction between conductor, semiconductor and insulator on the basis of band theory of solids. 2½

**OR**

- e) Find the maximum frequency of X-ray emitted on X-ray tube operating at 30 kV. 2½  
( $e = 1.6 \times 10^{-19}$  C,  $h = 6.63 \times 10^{-34}$  J-sec)
- f) Define a primitive cell. Difference between primitive and non-primitive cell with the help of neat diagram. 2½
- g) Explain bonding of molecules by Vander Wall's force with suitable example. 2½
- h) Show that density of state is 2½  
$$n(E) = \frac{4\pi}{4^3} (2m)^{3/2} E^{1/2}$$

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

- a) State the properties of X-ray. 1
- b) What is Auger effect? 1
- c) What are soft and hard X-ray? 1
- d) What is unit cell? 1
- e) How a Wigner Sietz unit cell is drawn? 1
- f) Define lattice and basis. 1
- g) Why NaCl structure is more stable than CsCl structure? 1
- h) Define magnetic susceptibility. 1
- i) Define cohesive energy of the molecules. 1
- j) What is Hall effect? 1
- k) State the Bloch theorem. 1
- l) What is Fermi energy? 1

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