B.Sc. (With Credits)-Regular-Semester 2012 Sem. V

# B.Sc. 3535 - Physics : Paper-II (X-Rays and Solid State Physics)

P. Pages : 3 **GUG/W/16/3377**

Time : Three Hours * 4 3 1 6 * Max. Marks : 50

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Notes : 1. All questions are compulsory.
2. Draw neat & well labelled diagram wherever necessary.

**1. Either :**

a) i) Describe the salient features of the continuous x-ray spectrum. **3**

ii) Show that the intensity of x-ray beam decreases exponentially when it passes through a 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 absorption coefficient of a material is $16.2\,m^{-1}$ for $K_\alpha$ radiation of tungsten. Calculate the percentage of intensity of this line that passes through a plate of thickness 0.184 m. **2**

**OR**

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

ii) Differentiate between primitive and non-primitive cell with help of neat diagram. **3**

iii) Show that 5-fold Rotation axis is not allowed. **4**

iv) What is the number of atoms in a primitive cell of diamond? Calculate the length of primitive translation vector if the cube edge $a = 3.56\,A^o$. **2**

**2. Either :**

a) i) Distinguish between diamagnetic, paramagnetic and ferromagnetic substances on the basis of their behaviour in the presence of an external magnetic field. **3**

ii) Discuss Langevin's theory of diamagnetism. **5**

iii) Obtain an expression for diamagnetic susceptibility. **2**

**OR**

b) i) Obtain an expression for electrical conductivity of metal in terms of mean free path of free electron. **4**

ii) Show that the expression for thermal conductivity of a metal on the free electron model is $k = \frac{1}{2} nv\lambda k$ **3**

where n = free electrons
k = Boltzmann's constant.

iii) State and prove Wiedemann – Franz law. **3**

**3. Either :**

a) Identify the impurity in tungsten target which emits strong $K_\alpha$ line of wavelength 0.21 A° and weak $K_\alpha$ line of wavelength 1.537 A°. Assume the screening constant b=1 and for tungsten z=74. **2½**

b) Explain Lane patterns. **2½**

c) Explain Ionic bonding with suitable examples. **2½**

d) Distinguish between metals (conductors), insulators and semiconductors on the basis of band theory of solids. **2½**

**OR**

e) State Moseley's law. Give its importance. **2½**

f) Explain Body – centered cubic structure. **2½**

g) Explain Lennard – Jones Potential. **2½**

h) Explain the formation of energy band on the basis of Kronig – Penney model. **2½**

**4. Either :**

a) Explain Auger effect. **2½**

b) Derive Bragg's Law. **2½**

c) 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 = $4\pi \times 10^{-7}$ henry/m). **2½**

d) Show that good thermal conductor is equally good electrical conductor. **2½**

**OR**

e) Find the maximum frequency of x-rays emitted by an x-ray tube operated at 9 KV. **2½**

f) What are Bravais lattices? Draw the Bravais lattices in two dimensions for SC, BCC and FCC. **2½**

g) Explain the term bonding. What are different kinds of bonding with suitable examples? **2½**

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

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

a) State the properties of x-rays. **1**

b) What is soft x-rays and Hard x-rays? **1**

c) State Duane – Hunt law. **1**

d) How a Wigner Seitz unit cell is drawn? **1**

e) Calculate the number of atoms per unit face centered cubic cell. **1**

f) Give the difference between crystalline and amorphous solids. **1**

g) What is covalent bonding? Give its examples. **1**

h) Why NaCl structure is more stable than CsCl structure? **1**

i) Define atomic magnetic moment. **1**

j) What is Fermi energy? **1**

k) State the Bloch theorem. **1**

l) Define Drift velocity. **1**

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