Exam. Code: 5014
Sub. Code: 11866

2046

Bachelor of Science (FYUP)-Fourth Semester

Physics

Paper: Condensed Matter Physics - I

Time allowed: 3 Hours **Max. Marks: 60**

NOTE: ***Attempt five questions in all, including Question No. 7 (Unit-III) which is compulsory and selecting two questions each from Unit I - II. Use of non-programmable calculator is allowed.***

x-x-x

UNIT-I

1. a)What do you mean by lattice ,space lattice and basis? What are Miller indices? Find the miller indices for a plane which intercepts the a , b and c axes at 3a, 2b and 2c. Deduce the expression for the distance between two adjacent planes of a simple cube crystal. [9]

   b) What do you mean by reciprocal lattice? Give its physical significance and show that FCC lattice is the reciprocal of BCC lattice. [3]

2. a) What are the methods for crysatal structure determination for X-rays differaction and why? Derive Laue's equation of diffraction for X-rays and obtain the Bragg's conditions for them. [9]

   b) Explain the crystal structure of diamond. Draw it. Also find the value of its packing fraction. [3]

3. a) Explain Geometrical structure formula and derive the expression for SCC, BCC and FCC lattice. What is the reason for the absence of (100) reflection and presence of (200) reflection? [9]

   b) The Bragg's angle for the order reflection from (111) Plane in a crystal is 60°.Calculate the inter-atomic spacing if X-ray of a wavelength 1.8 $x10^{-10}$ m is used. [3]

UNIT-II

4. a) What are intrinsic and extrinsic semiconductors? Discuss the variation of the Fermi level, carrier concentration and conductivity of extrinsic semiconductors. [9]

   b) Explain the concept of effective mass of electron. What is its significance? [3]

5. a) Describe Kroning-Penney Model and using it show that energy spectrum of electron consists of number of allowed energy bands separated by forbidden region. [9]

   b) Explain the phenomenon of Hall Effect and obtain the expression for Hall-coefficient. [3]

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6 a) Obtain an expression of Fermi Energy, total Energy and density of states for a free electron gas in one- dimension. Show the variation of density of states with energy. [9]

b) Metallic Silver has one free electron per atom. Find Fermi energy if density of Silver is 10.5g cm^{-3} and atomic weight is 1.08 gm atom. [3]

UNIT-III (Compulsory)

7) Attempt any SIX questions in all.

a) Show that Packing fraction of FCC structure is 0.74.
b) Draw and explain the structure of NaCl.
c) What do you mean by atomic Scattering factor?
d) What are direct and indirect band gap Semiconductors?
e) Explain energy band formation of Si lattice as a function of inter-atomic spacing.
f) Show that Five- fold axis symmetry does not exist.
g) Copper has fcc structure and atomic radius is 1.278 A^0. Calculate density. Atomic weight of Cu is 63.54.
h) Draw the plane (111) and (110)

[6*2=12]

x-x-x