

T.Y.B.SC. SEM – V (CBCS - 2016 Course) : WINTER - 2018

SUBJECT : PHYSICS - SOLID STATE PHYSICS

Day : Monday
Date : 15/10/2018

W-2018-0745

Time : 03.00 P.M. To 06.00 P.M
Max. Marks : 60

N.B.

- 1) All questions are **COMPULSORY**.
- 2) Figures to the **RIGHT** indicate **FULL** marks.
- 3) Draw neat diagrams **WHEREVER** necessary.

Q 1. Attempt any **Two** of the following. (12)

- (a) On the basis of Band theory, distinguish between insulators, semiconductors and metals.
- (b) What is reciprocal lattice? Obtain expression for reciprocal lattice vectors \bar{A} , \bar{B} , and \bar{C} .
- (c) With the help of Ewald's construction, show that the diffraction condition in reciprocal lattice is equivalent to $2d \sin \theta = n\lambda$ in the direct lattice.

Q 2. Attempt any **Two** of the following. (12)

- (a) Explain Einstein Model of specific heat for solid.
- (b) Obtain an expression for interplaner distance. Hence, show that for simple cubic

system,
$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

- (c) Show that effective mass of an electron in a crystal is given by $m^* = \frac{\hbar^2}{\left(\frac{d^2 E}{dk^2}\right)}$

Q 3. Attempt any **Two** of the following. (12)

- (a) Write a short note on nearly free electron model.
- (b) Explain the term packing fraction. Show that packing fraction for simple cubic, BCC and FCC structure are 0.52, 0.68 and 0.74 respectively.
- (c) Show that the volume of unit cell of the reciprocal lattice is inversely proportional to the volume of a unit cell of direct lattice.

Q 4. Attempt any **Three** of the following. (12)

- (a) Derive the Bragg's condition for diffraction.
- (b) The Fermi energy of copper is 7.1 eV. Assuming that it is the maximum kinetic energy of electrons in copper, find the number of atoms per unit volume in copper.
- (c) In case of certain crystal the maxima of reflected X-ray are obtained at glancing angle $5^\circ 12'$, $7^\circ 24'$, $9^\circ 1'$ respectively from three different reflecting planes. Determine the type of cubic crystal.
- (d) Show that reciprocal of the reciprocal lattice is direct lattice.

Q 5. Attempt any **Four** of the following. (12)

- (a) Sketch (101), (110) and (010) planes in simple cubic cell.
- (b) If the velocity of sound in a solid is taken to be 3×10^3 m/s and interatomic distance as 5×10^{-10} m. Calculate the value of cut off frequency, assuming a linear lattice.
- (c) How does Fermi energy change with temperature?
- (d) Explain Powder method for X-ray diffraction.
- (e) State and explain Bloch theorem.
- (f) What are Miller indices of the plane? And how they are determined?