

**BACHELOR OF SCIENCE (CBCS-2018 COURSE)**  
**T. Y. B. Sc. Sem-V : WINTER :- 2021**  
**SUBJECT: PHYSICS : SOLID STATE PHYSICS**

Day : Monday  
Date 24-01-2022

W-18408-2021

Time : 02:00 PM-05:00 PM  
Max. Marks: 60

N.B.

- 1) All questions are **COMPULSORY**.
- 2) Figures to the **RIGHT** indicate **FULL** marks.

- Q 1.** Attempt any **Two** of the following. (12)
- (a) Describe any symmetry operations in crystals.
  - (b) Define Fermi energy. Using Fermi distribution, explain how does the Fermi energy change with temperature?
  - (c) Describe powder method for determination of crystal structure.
- Q 2.** Attempt any **Two** of the following. (12)
- (a) Obtain an expression for interplanar distance. Hence, show that for simple cubic system,  $d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}}$
  - (b) Explain how X-rays are used for determination of crystal structure.
  - (c) In a unit cell of simple cubic structure, find the angles between the normal to pair of planes whose Millar indices are, [i] (100) and (010) [ii] (121) and (111)
- Q 3.** Attempt any **Two** of the following. (12)
- (a) With the proper diagram explain body centered cubic, face centered cubic and simple cubic structure in details.
  - (b) Distinguish between metals, semiconductors and insulators on the basis of band theory.
  - (c) Write a short note on classical free electron model.
- Q 4.** Attempt any **Three** of the following. (12)
- (a) What is reciprocal lattice vector? Show that for two dimensional square lattices  $\sigma = \frac{\sqrt{h^2 a^2 + k^2 b^2}}{ab}$
  - (b) Write a short note on Hall effect. Obtain an expression for Hall angle.
  - (c) Calculate the number of atoms per unit cell of metal having a lattice parameter of 2.9 Å and density 7.87 gram/cc. Atomic weight of the metal is 55.85 and Avogadro constant is  $6.023 \times 10^{23}$ .
  - (d) Show that reciprocal of the reciprocal lattice is direct lattice.
- Q 5.** Attempt any **Four** of the following. (12)
- (a) Define Mobility ( $\mu$ ) and show that mobility ( $\mu$ ) =  $\sigma R_H$ , where  $\sigma$  is electrical conductivity of specimen.
  - (b) Write a short note on lattice specific heat capacity.
  - (c) Define the following (a) Basis, (b) Primitive cell, (c) packing fraction
  - (d) Sketch (101), (110) and (010) planes in simple cubic cell.
  - (e) Why ordinary optical grating cannot diffract X-rays? Explain.
  - (f) Obtain number of atoms per unit cell for Body Centered Cubic (BCC) structure.