UNIVERSITY OF THE PUNJAB
Fifth Semester – 2019
Examination: B.S. 4 Years Program

Roll No. in Fig. ....

Roll No. in Words. ....

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Signature of Supdt.:

PAPER: Solid State Physics-1
Course Code: PHY-303   Part–I (Compulsory)

MAX. TIME: 15 Min.
MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.
Please encircle the correct option. Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer, cutting and overwriting is not allowed.   (1x10=10)

A) The coordination number of CsCl structure is

　　i) 5　　　　　　ii) 7　　　　　　iii) 8　　　　　　iv) 14

B) Which combination of following crystal structures are closely-packed structures?

　　i) FCC and SC　ii) BCC and SC　iii) BCC and HCP　iv) HCP and FCC

C) The space lattice of cesium chloride (CsCl) structure is:

　　i) Simple cubic ii) Body centered cubic iii) Face-centered cubic iv) None of these

D) Reciprocal of face centered cubic (FCC) lattice is

　　i) FCC lattice　ii) BCC lattice　iii) SC lattice　iv) HCP lattice　v) none of these

E) For p atoms in primitive cell, which of the following combination of acoustical and optical phonon branches in sequence is true?

　　i) $(3p\text{-}3, 3)$　　ii) $(3, 3p\text{-}3)$　　iii) $(3, 3)$　　iv) none of these

F) According to classical model of lattice heat capacity (C_v), C_v for all solids

　　i) depends on temperature ii) does not depend on temperature iii) remains constant at all temperatures　　iv) ii) and iii)　　v) none of these

G) Van der Waals interactions in inert gas crystals are always
　　i) repulsive ii) attractive iii) neither attractive nor repulsive iv) zero v) none of these

H) At low temperatures, phonon heat capacity, C_v (according of Debye model) varies as:
　　i) T^3　　　　ii) $T^{3/2}$　　　iii) T^2　　　iv) T　　　v) None of these

I) In monatomic lattice, the frequency of the wave at long wavelengths varies with k as:
　　i) k　　　　ii) k^2　　　iii) k^3　　　iv) independent of wave-vector k

J) In a cubic crystals, [111] crystallographic direction to (111) crystal plane is always

　　i) Parallel　ii) Perpendicular iii) neither parallel nor perpendicular iv) none of these

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PAPER: Solid State Physics-1
Course Code: PHY-303   Part – II

MAX. TIME: 2 Hrs. 45 Min.
MAX. MARKS: 50

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Q.2 Give to the point answer / short description of each question.   (4 × 5 = 20)

a) Draw (111), (200), (100) and ($\bar{1}$00) crystallographic planes in cubic unit cell.

b) Differentiate between Bravais and non-Bravais lattice with the help of diagrams.

c) Explain primitive and non-primitive unit cell. Differentiate by sketching diagrams.

d) Show that reciprocal of FCC lattice is a BCC lattice.

e) Calculate the packing fraction of face-centered cubic (FCC) lattice.

Q.3

Consider a linear chain of diatomic atoms of masses m_1 and m_2 ($m_1 > m_2$) with repeat distance a and interatomic force constant c.

i) Establish the equations of motion of two atoms and derive the dispersion relation for a diatomic linear lattice by taking into account nearest neighbor interaction only.   (2+5)

ii) Plot the dispersion curve and distinguish optical and acoustical phonon branches in dispersion curve.   (3)

Q.4

What kind of interaction exists between atoms of inert gas crystals? Discuss briefly. Show that the interaction between two identical inert gas atoms at separation R varies as $-CR^{-6}$.

(3+7)

Q.5

Derive an expression for lattice heat capacity of solids on the basis of classical model. Explain graphically the discrepancies of classical model in explaining the experimental observations for low and high temperature limits.   (6+4)