

SEAT No. _____

No. of printed pages: 02

[80]

SARDAR PATEL UNIVERSITY

M.Sc. Physics Ist Semester Examination (Nc)

Day: Thursday, Date: 19/04/2018, Time: 02:00 p.m. to 05:00 p.m.

Subject: PHYSICS, Paper: PS01EPHY01

Title: Elements of Solid State Physics

Instructions:

Figures to the right indicate marks.

Total Marks: 70

Q.1 Write answer of all questions by showing your choice against the question number. [8]

- (i) Crystalline materials differ from amorphous material by _____ .
(a) containing different chemical elements
(b) having periodic spacing of atoms
(c) being natural rather than manmade
(d) all of the above
- (ii) An infinite periodic arrangement of points in a space is known as :
(a) lattice (b) symmetry (c) zone (d) plane
- (iii) The group velocity is define by:
(a) $d\omega/dt$ (b) $dt/d\omega$ (c) $-d\omega/dt$ (d) $-dt/d\omega$
- (iv) The range of the first Brillouin zone of linear lattice K is specified by:
(a) $-2\pi < K \leq 2\pi$ (b) $-3\pi < K \leq 3\pi$ (c) $-\pi/a < K \leq \pi/a$ (d) $-2\pi/a < K \leq 2\pi/a$
- (v) In a solid there are total _____ shear and normal stresses.
(a) 3 (b) 6 (c) 9 (d) 12
- (vi) Under hydrostatic pressure, dilation is _____.
(a) Infinity (b) zero (c) positive (d) negative
- (vii) In a semiconductor, near the top of the band the effective mass is _____.
(a) infinity (b) zero (c) negative (d) positive
- (viii) A Diamagnetic material has _____ susceptibility.
(a) infinity (b) zero (c) positive (d) negative

Q.2 Attempt any Seven of the following: [14]

- (i) Define: Unit cell and Primitive cell
- (ii) What is packing fraction? Calculate the packing fraction for BCC structure.
- (iii) Differentiate between Miller indices and Miller Bravais indices with proper example.

(P.T.O.)

- (iv) Describe the continuum limit of lattice vibration.
- (v) Explain in brief thermoelectric effect in semiconductor.
- (vi) Prove that velocity of holes is same as that of velocity of an electrons in semiconductor.
- (vii) Describe impurity conductivity in semiconductor in brief.
- (viii) Draw the experimental set up used to determine elastic constants of solid and write the equations to determine velocity of shear waves.
- (ix) Explain direct band gap in semiconductor in brief.

Q.3(a) Differentiate the terms crystalline and amorphous solids. Write down seven crystal system with their lattice parameters. [6]

Q.3(b) Draw and describe the crystal structures of the diamond and CsCl giving coordinate of the atoms with proper illustration. [6]

OR

Q.3(b) Explain in detail the conventional unit cell of hexagonal close packed (HCP) structure using necessary diagram. [6]

Q.4(a) Define lattice vibration and obtain the relation to explain the origin of acoustical and optical branch in linear diatomic lattice. [6]

Q.4(b) Obtain the dispersion relation for one dimensional mono-atomic lattice. [6]

OR

Q.4(b) Explain crystal momentum. Find out the equation of energy gain and loss of the scattered neutrons by phonons. [6]

Q.5(a) Obtain an equation for longitudinal wave and the transverse wave propagate along the [100] direction in a crystal. [6]

Q.5(b) What is intrinsic semiconductor? Derive an expression for the carrier concentration in case of intrinsic semiconductor. [6]

OR

Q.5(b) Using necessary diagram, find out the expression for the longitudinal and transverse waves propagate in the cubic crystal in [111] direction. [6]

Q.6(a) What is effective mass? Describe physical interpretation of effective mass and explain effective masses in semiconductors using necessary diagram. [6]

Q.6(b) Define dipole moment and derive an expression for Lorentz field and field of dipoles inside the cavity using suitable diagram. [6]

OR

Q.6(b) What is demagnetization? With the help of necessary diagram describe cooling by isentropic demagnetization in detail. [6]

—————X—————