SEAT No._____ No. of printed pages: 03

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SARDAR PATEL UNIVERSITY

M.Sc. Physics I[st] Semester Examination

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

Subject: PHYSICS, Paper: PS01EPHY21

Title: Elements of Solid State Physics and Error Analysis

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 defined 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) If absolute frequency = 10 and total frequency = 200, then relative frequency = _____ .
(a) 0.05 (b) 0.5 (c) 20 (d) 2000

(viii) In a histogram, maximum class interval should be _____ .
(a) 16 (b) 17 (c) 18 (d) 19

(P.T.O.)

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 the BCC structure.
(iii) Differentiate between Miller indices and Miller Bravais indices with proper example.
(iv) Describe the continuum limit of lattice vibration.
(v) Explain in brief thermoelectric effect in semiconductor.
(vi) What is dilation? Prove that dilation $\delta = \in_{xx} + \in_{yy} + \in_{zz}$
(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 the least square method to minimize error in measurements.

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 coordinates 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) (i) A company manufactures 80 resistors and the resistance of these resistors are given below: [3]

Resistance (ohms)	No. of Resistor
93-95	04
96-98	15
99-101	33
102-104	21
105-107	07

Determine: (a) arithmetic mean, (b) The median value and (c) modal value.

(ii) Prove that arithmetic mean is the best estimated true value of the data. [3]

Q.6(b) (i) What is Gaussian distribution? Determine standard deviation from Gaussian distribution. [3]

(ii) In a manufacturing process, 25 components have been selected. 75 minutes is mean time required to complete a electronic components and standard deviation is 10 minutes. [3]

Calculate:

(a) Population of mean,

(b) Standard deviation of the mean and

(c) Size of the sample.

Internal standard error is not to exceed 1 min.

OR

Q.6(b) Explain Chi-square test for goodness of fit and the criteria for goodness of fit. [6]

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