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SARDAR PATEL UNIVERSITY
M.Sc. Physics Ist Semester Examination

Day: Tuesday, Date: 28/04/2015, Time: 10.30 a.m. to 01.30 p.m.

Subject: PHYSICS, Paper: PS01EPHY01

Subject: Elements of Solid State Physics

Instructions:

(a) Figure to the right indicate marks. Total Marks: 70

(b) All questions are compulsory.

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

(i) Unit cell of b.c.c. structure is:

- (a) Primitive (b) non-primitive
(c) may be primitive or non-primitive (d) none of these

(ii) Miller indices (hkl) represents:

- (a) a set of parallel planes (b) a perpendicular plane
(c) a set of perpendicular plane
(d) a set of arbitrarily oriented plane

(iii) In a f.c.c. structure, the number of lattice point per unit cell is:

- (a) 2 (b) 4 (c) 3 (d) 1

(iv) At 0K , semiconductor behaves like :

- (a) Insulator (b) conductor
(c) superconductor (d) none of these

(v) If you have p-type of material, then location of Fermi level is :

- (a) Just above valence band (b) Just below conduction band
(c) Centre of valence band and conduction band
(d) Above conduction band

(vi) $\sqrt{\frac{C_{11} + 2C_{12} + 4C_{44}}{3\rho}}$ equation is used for velocity of

longitudinal wave in direction is:

- (a) [111] (b) [100] (c) [110] (d) [010]

(vii) For a given dielectric, the electronic polarizability (α_e) is :

- (a) increase with temperature (b) decrease with temperature
(c) not affected by temperature change
(d) increase and then decrease with temperature

P.T.O.

- (viii) A substance having positive susceptibility is called:
 (a) paramagnetic (b) diamagnetic
 (c) ferromagnetic (d) ferrimagnetic

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

- (i) Draw the diagram of s.c., f.c.c. and b.c.c.
- (ii) What do you mean by group velocity?
- (iii) Explain first Brillouin zone using necessary diagram in brief.
- (iv) What is hole? Show that effective mass of hole is opposite sign to that of effective mass of an electron at the same point of energy band.
- (v) What is mobility of an electron? Explain intrinsic mobility in semiconductor.
- (vi) What is extrinsic semiconductor? Explain donor and acceptor state in semiconductor using necessary diagram.
- (vii) Define band gap. Explain the direct and indirect band gap in semiconductor using necessary diagram.
- (viii) Explain effective masses in semiconductor in brief.
- (ix) Discuss nuclear demagnetization in brief.

Q.3(a) Differentiate between [6]

- (i) Symmetry element and symmetry operation.
- (ii) Rotoreflection and Rotoinversion.

Display the followings:

$2, \bar{2}, \tilde{2}$

Draw the screw $2_1, 3_2$ and 'a' glide.

Q.3(b)(i) Mention the significance of transformation matrix. Calculate the [6]
 transformation matrix for two set of planes.

(310), (410), (001) and (450), (560), (001).

- (ii) Give the total number of crystal system, Bravais lattice, point group and space group.

OR

Q.3(b)(i) Prove that $2/m = i$ giving proper illustration. [6]

- (ii) Do the following plane belong to same zone $(\bar{1}\bar{1}0)$, (311) and (134).

- (iii) Give the list of total screw and glide.

Q.4(a) What is dispersion relation? Discuss the salient feature of [6]
 dispersion curve for monoatomic lattice giving derivation of it.

Q.4(b) Obtain the necessary equation for dispersion relation for diatomic [6]
 lattice.

OR

- Q.4 (b) What do you mean quantization of lattice vibration? Discuss a method for measurement of phonon dispersion in inelastic neutron scattering. [6]
- Q.5(a) Give detail description of the experimental set up and mention the principle one use for the determination of elastic constants. [6]
- Q.5(b) Deduce the expression for the velocity of the longitudinal and transverse waves in the [100] direction in a cubic crystal. [6]

OR

- Q.5(b) What is Hall effect? Discuss the physical significance of Hall effect. What are the uses of this effect? [6]
- Q.6(a) Differentiate between paramagnetism and diamagnetism? Explain quantum theory of paramagnetism in detail. [6]
- Q.6(b) Define susceptibility. Discuss paramagnetic susceptibility of conduction electron using necessary diagram in detail. [6]

OR

- Q.6(b) What is meant by local field? Obtain Clausius-Mosotti formula relating macroscopic electric field. [6]

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