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SARDAR PATEL UNIVERSITY

M.Sc. Physics I[st] Semester Examination

Day: Friday, Date: 28/10/2016, Time: 10.00 a.m. to 01.00 p.m.

Subject: PHYSICS, Paper:PS01EPHY01

Subject: Elements of Solid State Physics

Instructions:

(a) Figure to the right indicate marks.

Total Marks: 70

Q.1	Write answer of all questions by showing your choice against the question number. (i)A plane having intercepts 2,∞, ∞ with a, b, and c axes respectively , the miller indices of the plane are (a) (100) (b) (010) (c) (200) (d) (020) (ii) cubic is highly ---------- and triclinic is highly _____ (a) Non Symmetric and symmetric (b) symmetric and non symmetric (c) symmetric and symmetric (d) (b) Non symmetric and non symmetric (iii) If the lattice parameters are a=b=c and angles are 90, then the system is (a) Cubic (b) monoclinic (c) orthorhombic (d) triclinic (iv) If v_p and v_g are the phase and group velocity of the lattice wave , then in the long wavelength side (a) $v_p > v_g$ (b) $v_p < v_g$ (c) $v_p = v_g$ (d) $v_p = v_g$= (v) If e_{xx}, e_{yy} and e_{zz} are linear strain components, then dilation is given by (a) $e_{xx} + e_{yy} + e_{zz}$ (b) $(e_{xx} + e_{yy} + e_{zz})^2$ (c) $e_{xx} - e_{yy} - e_{zz}$ (d) $(e_{xx} + e_{yy} + e_{zz})^3$ (vi) An isotropic elastic cubic crystal has _____ constants. (a) 2 (b) 3 (c) 6 (d) 9 (vii) The dipole moment per unit volume of a solid is called (a) Polarization of the solid (b) permittivity of the solid (c)electrostatic moment (d) permeability of the solid (viii) Above the Curie temperature, the ferromagnetic material becomes _____ material. (a) Antiferro magnetic (b) ferri-magnetic (c) paramagnetic (d) canted antiferromagnetic	[8]

Q.2	Attempt any Seven of the followings: (i) What do you mean by lattice vibration and phonon ? (ii) Determine number of points per unit cell in primitive and fcc lattice . (iii) Write down the co-ordinates for each atom for base centered cell and b.c.c structures with the help of suitable diagram. . (iv) Convert the following space group into the point group $P2_1/c$, $P2_1nb$, C_c , P2m (v) Distinguish between intrinsic and extrinsic semiconductors with suitable examples. (vi) Explain elastic stiffness constants of a cubic crystal. (vii) What is effective mass? Describe effective masses in semiconductor. (viii) Using necessary diagram, explain direct and indirect band gap in semiconductor. (ix) Show that wave vector of hole (k_h) is opposite sign to that of wave vector of an electron (k_e).	[14]
Q.3(a)	List all the possible screw & glide symmetry. Display 3_2, 4_1 screw and 3 fold and 4 fold rotation axes Prove that 2/m =i giving equivalent points	[6]
Q.3(b)	Differentiate the followings: (i) proper rotation and improper rotation (ii) base centered lattice and body centered lattice (iii) plane of form and plane of zone Do the following planes belong to same Zone axis $(\bar{1}\ 10)$ $(\bar{3}\ 1\ 1)$ $(1\ \bar{3}\ 2)$	[6]
	OR	
Q.3(b)	Determine the transformation Matrix when indices of planes of two different sets are gives as (310) (450) (410) (560) (001) (001)	[6]
Q.4(a)	Obtain the dispersion relation for one dimensional monoatomic lattice and interpret the result.	[6]
Q.4(b)	What do you mean by forbidden bond in lattice vibration - Discuss with respect to lattice vibration in diatomic lattice .	[6]
	OR	
Q.4(b)	Discuss inelastic scattering of photons by phonons. Differentiate between normal process and umklapp process with refer to phonon frequency.	[6]
Q.5(a)	Derive wave equation for elastic waves in a cubic crystal. Solve it for longitudinal and shear waves moving in the [100] direction.	[6]

Q.5(b)	What is Hall effect? Discuss the physical origin of this effect using necessary diagram and obtain the expression to determine Hall coefficient for electron and hole. Also mention uses of Hall effect.	[6]
	OR	
Q.5(b)	Show that the longitudinal and shear waves velocities in [111] direction in cubic crystal are, respectively, given by $V_L = \sqrt{\frac{[C_{11}+2C_{12}+4C_{44}]}{3\rho}}$, $V_S = \sqrt{\frac{[C_{11}-C_{12}+C_{44}]}{3\rho}}$	[6]
Q.6(a)	Derive an expression for the local electric field acting an atom. Explain the terms, depolarization field and Lorentz field.	[6]
Q.6(b)	Define electronic polarizability. Discuss the classical theory of electronic polarizability and obtain the corresponding dispersion relation.	[6]
	OR	
Q.6(b)	What is magnetization? With help of necessary diagram explain cooling by isentropic demagnetization.	[6]

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