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SEAT No._____

[237/A52]

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SARDAR PATEL UNIVERSITY

M.Sc. (Physics)(IIIrd Semester) Examination

Date : 26/10/2018, Day : Friday, Time : 2:00 p.m. to 5:00 p.m.

Subject : Crystallography and Material Science, Paper No. PS03EPHY01

CBCS(choice based credit system)

Important Note : Q.1 : Multiple choice questions (MCQ) carries one mark each.
Q.2 : Short questions carries two marks each (attempt any seven out of nine)
Q.3 to Q.6 : Long questions carries 12 marks .

Total Marks : 70

Q.1 Choose the appropriate options from the following in Q.1 **(8)**

1 What will be the minimum interplanar spacing(d) that can be determined using X-ray of wavelength 1.5 Å?

(a) 1.5 Å (b) 0.75 Å (c) 3.0 Å (d) it cannot be determined.

2 The interplanar spacing for the planes with indices (200) in a cubic crystal with lattice parameter 'a'will be given by

(a) 2a (b) $\sqrt{2}a$ (c) a/2 (d) a/$\sqrt{2}$

3 Atomic scattering factor is also known as a _____

(a)Polarization factor (b)Structure factor (c)Form factor (d)None of above

4 According to Thomson equation , scattered beam intensity of X-ray by a single electron is stronger at _____

(a)$2\theta = 0°$ (b) $2\theta = 90°$ (c)$2\theta = 180°$ (d) $2\theta = 0°$ and 180°

5 From below which term relates to liquid crystals ?

(a)total internal reflection (b) birefringence (c) superconductivity (d)semiconductor

6 Modified LST relation for transverse optical mode in ferroelectricity theory is given by _____

(a) $\omega^2_{(TO)}/\omega^2_{(LO)} = \varepsilon_\infty / \varepsilon_s$ (b) $\omega^2_{(TO)} \alpha\ 1/\varepsilon_s$ (c) $\omega^2_{(TO)} \alpha\ 1/T\text{-}T_c$
(d) $\omega^2_{(TO)}/\omega^2_{(LO)} \alpha\ \varepsilon_\infty$

7 The T_g for composition $Fe_{80}B_{20}$ known as metglas 2605 is ---- ----- as compared with the melting temperature 1538^{0}C of pure iron.

(a) increased (b) lowered (c) constant (d) increases linearly

8 Which of the following is the example of GMR-CMR material ?

(a)$R_{1-x}MnO_3$ (b) GaAs (c) SnO_2 (d) CdZnTe

P.T.O.

Q.2 **Answer any seven questions out of nine in Q.2** **(14)**

1 How one can index electron diffraction pattern obtained from cubic sample ?

2 Explain with diagram how Ewald sphere and reciprocal lattice are related to each other.

3 Define piezoelectricity and ferroelectricity.

4 Discuss how one can do the chemical analysis of a sample by X-ray spectrometer.

5 Define polaritons and polarons.

6 For what purpose Kramers-Kronig relations are used.

7 State the basic principle on which fiber optics works.

8 What are fullerenes ? Why C_{60} is considered to be the most stable form ?

9 Explain switching property of amorphous semiconductors.

Q.3(a) Derive Laue's equation for the X-ray diffraction from crystals. Show that Laue's equations and the Bragg's equation are equivalent. **(6)**

Q.3(b) Describe the geometrical interpretation of Bragg's law. Explain Ewald construction and derive the Bragg's law in vector form in the reciprocal space. **(6)**

OR

Q.3(b) Write the primitive lattice vectors ($\vec{a}$, $\vec{b}$,$\vec{c}$) for a body-centred cubic(BCC) lattice and derive the reciprocal lattice vectors ($\vec{a}^*$, $\vec{b}^*$,$\vec{c}^*$). Prove that these vectors correspond to the primitive lattice vectors for FCC lattice. **(6)**

Q.4(a) Explain the theory of the ferroelectric displasive transitions in terms of polarization catastrophe. **(6)**

Q.4(b) Obtain structure factor equation for a diamond crystal having eight atoms per unit cell at 000 , ½ ½ 0, 0 ½ ½ , ½ 0 ½ , ¼ ¼ ¼ , ¾ ¾ ¼ , ¾ ¼ ¾ , ¼ ¾ ¾ find out which of the following reflections are absent and present : (100),(200),(111),(222) ,(210), (220). **(6)**

OR

Q.4(b) Derive Thomson equation for the scattering of an X-ray beam by a single electron with necessary diagram. Show that the scattering intensity depends on the scattering angle. **(6)**

Q.5(a) What are high temperature superconductors ? Explain them in detail with proper examples. **(6)**

Q.5(b) Explain Hall effect which is observed at very high values of magnetic field and low temperatures. **(6)**

OR

Q.5(b) Discuss how electron-electron interaction takes place. **(6)**

Q.6(a) Classify liquid crystals and explain orientational order observed in liquid crystals. **(6)**

Q.6(b) What are polymers ? Describe the effect of temperature on polymers. **(6)**

OR

Q.6(b) Describe various techniques by which magnetic fluid can be prepared at laboratory scale. **(6)**

—X—

(2)