This question paper contains 2 printed pages

6993 *Your Roll No*

M.Tech. / II Sem.

NANO SCIENCE AND NANO TECHNOLOGY
Paper :NSNT – 203: Solid State Physics/Chemistry

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Time 3 hours Maximum Marks 38

(Write your Roll No on the top immediately on receipt of this question paper)
Attempt all questions

PART A

Note: Answer any three questions. 3x4 =12

1 How will you experimentally determine the diffusion coefficient (D) in the ionic solids?

2. Derive the Born-Lande equation for the lattice energy of an ionic crystal

3. The powder X-ray diffraction pattern of silver with a face centered cubic unit cell has the 111 reflection at $\theta = 19\ 1°$ using Cu-Kα ($\lambda = 1\ 5418$Å) Find the unit cell length '*a*'.

4 Explain the thermodynamic classification of first and second order transitions with examples

PART B

Note: Answer any two questions. 2x4=8

5 (a) Explain the phenomenon of cathodoluminescence in a C-R tube.

(b) Give an example of a molecule with a $\bar{4}$ rotation axis

6(a) For an ohmic metal-semiconductor junction with $\varphi_m < \varphi_s$, give the band diagram and explain it

(b) Give the reason for the absence of 100 reflection in the powder X-ray diffraction pattern of α-Fe, which is body centered cubic.

7(a) What are ferrimagnetic and antiferromagnetic materials? Give two examples of each

(b) What kind of defects would you expect when (i) NaCl is heated in Na vapor and (ii) ZrO_2 is doped with Y_2O_3?

PART C

Note: Answer any <u>three</u> questions. 3x6=18

8(a) Derive the expression for Fermi function for a free electron gas

(b) If ΔH_S for the formation of Schottky defects in MX crystal is 300 KJ/mol, calculate the n_S/N for the temperatures 400, 600 and 800 K

9(a) For a magnet with a pole strength of 'p' near each end with poles separated by a distance 'l' and placed at an angle 'θ' to a uniform field 'H', derive the expression for the potential energy Ep

(b) What is martensitic transformation? Explain it with respect to a non-metallic system

10(a) For paramagnetic materials, using the quantum theory, derive the expression for the maximum value of μ_{II}

(b) Discuss the methods to improve the reactivity of the solids.

11(a) Using a schematic diagram, explain the relationship between the Einstein Coefficients What are the requirements which should be met for stimulated emission?

(b) With an example, show the phase diagram for a simple binary eutectic system with a partial solid solution formation