

III B.Tech I Semester Supplementary Examinations, November 2005
METALLURGICAL THERMO DYNAMICS
(Metallurgy & Material Technology)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. (a) What is diffusion? State Fick's laws of diffusion. [5]
 (b) Explain the mechanisms of diffusion. [4]
 (c) What do you understand by intrinsic and extrinsic regions of diffusion in a sodium chloride crystal doped with a divalent cation impurity? Explain how the enthalpies of formation and motion of Na^+ ions can be evaluated from the experimental determination of electrical conductivity versus temperature. [7]
2. (a) Explain the use of oxygen nomograms in Ellingham diagrams. [6]
 (b) Draw plot of standard free energy changes of an oxide with temperature. Discuss the properties and useful information that can be obtained from it. [10]
3. (a) Describe lattice thermal conductivity effects and thermo electric effects of solids. [8]
 (b) Define specific heat. Explain the classical, Debye and Einstein's models of lattice specific heat of solids. [8]
4. (a) State Raoult's law and give its derivation from first principles. What are its limitations. [8]
 (b) State and derive Gibbs-Duhem equation. [8]
5. (a) What is allotropic transformation? Give any three examples which show allotropic transformation. [5]
 (b) Explain the method of plotting an equilibrium diagram by the use of cooling curves. [5]
 (c) A gold-Nickel alloy containing 60% nickel is heated to 1200° . Determine the composition and the amount of each phase in the metal when it reaches equilibrium at the temperature. [6]
6. (a) Explain the applications of Gibbs-Helmholtz equation to galvanic cells. [7]
 (b) Suggest methods for the experimental determination of the standard potentials of the electrodes using cells without liquid junctions
 (a) Pb, Pb^{++}
 (b) $Ag, Ag_2O(s)$ [9]

7. (a) Describe various imperfections in crystals and their effects on properties. [10]
(b) Derive an expression relating the equilibrium vacancy concentration with temperature. [6]
8. Write short notes on:
 - (a) Intrinsic diffusivity [6]
 - (b) Anharmonicity [5]
 - (c) Sievert's law [5]

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