Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-III Examination May 2012

Subject code: 132102

Subject Name: Metallurgical Thermodynamics

Date: 10/05/2012 **Time: 02.30 pm – 05.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** i) What is Gibb's phase rule? Explain the importance of phase rule. Derive Gibb's phase rule. **04**

ii) Explain the differences between a liquidus line and solidus line. **03**

(b) i) Explain Phase, component & Degrees of Freedom? **03**

ii) Explain how the liquidus line is obtained for any isomerphous system. **04**

Q.2 **(a)** State & explain Ellingham diagram for various metal oxides? **07**

(b) i) Explain C- CO & C-CO_2 line in the Ellingham diagram? **04**

ii) Explain the advantages and limitations of Ellingham diagram. **03**

OR

(b) i) State & Define 2nd law of Thermodynamics & its Significance. **04**

ii) Explain Quasi- static process. **03**

Q.3 **(a)** Define and explain the terms specific heat at constant pressure (Cp) and specific heat at constant volume (Cv) and derive the thermodynamics relationship between them. **07**

(b) What is the importance of equilibrium constant (K) & how this can be calculated from standard free energy changes? **07**

OR

Q.3 **(a)** i) Prove that when HENRY'S law is obeyed by the solute, solvent obeys Raoult's law. **07**

(b) i) Distinguish between ideal solutions and regular solutions. **02**

ii) Derive Gibb's- Duhem equations. **05**

Q.4 **(a)** Zinc melts at 420 ^{O}C and its standard entropy at 25 ^{O}C is 9.95 cal/deg/ mole. Calculate the standard entropy of Zinc at 750 ^{0}C. Heat of fusion of Zn at the melting point is H_f = 1.74 KCal/m. **07**

Given Data

ΔS^{0}_{298} = 9.95 Cal/ d/m.

Cp < Zn> = 5.35+ 2.40* 10^{-3}T Cal /d / m.

Cp{Zn} = 7.50 Cal / d/ m

(b) i) Explain Von- Hoff equation. **04**

ii) State & Derive Enthalpy of a system. **03**

OR

Q.4 **(a)** i) The enthalpy changes for the following reactions are as follows **04**

$2B + 3H_2 + 3O_2 = 2H_3BO_3$. $\Delta H^0_{298} = -512.8$ Kcal.

$B_2O_3 + 3H_2O$ (l) $= 2H_3BO_3$. $\Delta H^0_{298} = -4.12$ Kcal.

$H_2 + ½\ O_2 = H_2O$ (l). $\Delta H^0_{298} = -68.73$ Kcal. Calculate the standard heat of formation of B_2O_3 in terms of per mole o B_2O_3 & per gm of B_2O_3. Atomic wt of B & O are 10.82 & 16.

ii)Calculate the work done in Reversible Adiabatic expansion. **03**

(b) State & Derive Maxwell's equation from combined statement of 1st & 2nd law. **07**

Q.5 **(a)** i) Calculate the equilibrium constant for the reaction. **07**

$<NiO> + (H_2) = <Ni> + (H_2O)$ at 1023 K

$<Ni> + ½\ (O_2) = <NiO>\ \Delta G^0_{298} = -58{,}450 + 23.55T$ cal.

$(H2) + ½\ (O_2) = (H_2O)\ \ \Delta G^0_{298} = -58{,}900 + 13.1T$ cal.

Could pure Ni sheet be annealed at 1023 K in an atmosphere of 95% H_2O & 5%H_2 by volume with oxidation?

(b) i) The equation of the state of a gas is given by the expression $(P + a/V^2)$. **04**
$(V-b) = RT$

Prove that : $(\delta P / \delta V)_T * (\delta V / \delta P)_T = 1$

ii) Explain Homogenous & Heterogeneous system. **03**

OR

Q.5

(a) What is blast f/c slag & its composition, Explain briefly the use of b/f Slag. **07**

(b) Explain the following:

(i) Slag basicity **04**

(ii) Hess's Law **03**

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