# GUJARAT TECHNOLOGICAL UNIVERSITY

## B.E. Sem-III  Remedial Examination March 2010

**Subject code: 132102**          **Subject Name: Metallurgical Thermodynamics**

**Date:  11 /03 /2010**                          **Time: 11.00 am – 01.30pm**

**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)** How the Standard Free Energy of formation of metal oxides varies as a function of temperature?   **03**

**(b)** Draw such a diagram for few of the common metal oxides. What is the diagram known as? Discuss its silent features in brief?   **07**
State the procedure for getting the points 'O', 'H' and 'C' on the above

**(c)** diagram. What are their significances?   **04**

**Q.2** **(a)** Explain in brief the concept of   **07**
1. Entropy
2. Thermodynamic Equilibrium
3. Free Energy
4. Significance of $1^{st}$ law of thermodynamics

**(b)** Using combine statements of $1^{st}$ & $2^{nd}$ law of thermodynamics, derive all Maxwell's relation and hence prove that,   **07**
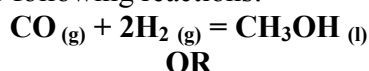$$(\partial T/\partial P)_s = T/C_p \, (\partial V/\partial T)_p$$
**OR**

**(b)** Derive Gibbs' Duhem equation in terms of partial molar quantities   **07**

**Q.3** **(a)** Explain Roult's & Henery's law.   **07**

**(b)** Standard Enthalpy change of combustion of 298º K for $H_{2\,(g)}$, $CO_{(g)}$ and $CH_3OH_{(l)}$ are -286, -283, -714 KJ/mol respectively. Calculate the value of change of enthalpy for following reactions:   **07**
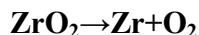$$CO_{(g)} + 2H_{2\,(g)} = CH_3OH_{(l)}$$
**OR**

**Q.3** **Write short notes. (any two)**   **14**
**(1)** Chemical potential & its significance.
**(2)** $3^{rd}$ law of thermodynamics and its verification.
**(3)** Clausius-Clapeyron equation.
**(4)** Ideal & non-ideal solutions.

**Q.4** **(a)** Write a note on Nerrnest Heat theorem.   **07**

**(b)** Calculate Equilibrium constant and equilibrium partial pressure of oxygen at $1727^oC$ for the reaction,   **07**
$$ZrO_2 \rightarrow Zr + O_2$$
$\Delta G = 1087589 + 18.12T \log T -247.36T$ J/mole.
**OR**

**Q.4** **(a)** What is phase diagram?Explain co-relation of free-energy composition **07**
and temperature composition diagram for binary alloy system.
**(b)** Explain 1 wt% standard state in detail. **07**

**Q.5** **(a)** Explain the concept of basicity index for slag. **07**
**(b)** Discuss Equations for Entropy change with change of state. **07**

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**OR**

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**Q.5** **(a)** Describe Extensive & intensive properties. **07**
**(b)** Calculate the standard heat of formation of $WO_{3(s)}$ from $W_{(s)}$ **07**
And $O_{2(g)}$ at $25^o$C and 1 atm pressure from the following data:
$W_{(s)} + O_{2\,(g)} = WO_{2(s)}$ $\Delta H^o_{298}$= -560.66 KJ/mole
$3WO_{2\,(s)} + O_{2\,(g)} = W_3O_{8\,(s)}$ $\Delta H^o_{298}$= - 550.2 KJ/mole
$W_3O_{8\,(s)} + 1/2\ O_{2\,(g)} = 3WO_{3\,(s)}$ $\Delta H^o_{298}$= - 278.25 KJ/mole

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