

Registration No. :

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Total number of printed pages – 3

B. Tech
PCMT 4202

Third Semester (Back/ Special) Examination – 2013
METALLURGICAL THERMODYNAMICS AND KINETICS

BRANCH : MME

QUESTION CODE : D 234

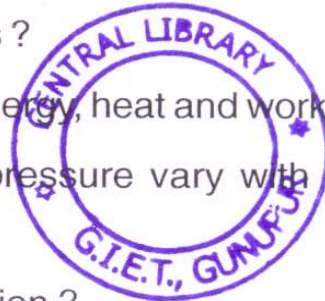
Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10
- (a) What do you mean by state of a system ?
 - (b) What are the parameters required to define a system of known composition ?
 - (c) What do you mean by standard state of a system ?
 - (d) What is Zeroeth law of thermodynamics ?
 - (e) What is the relation between internal energy, heat and work ?
 - (f) Does the heat capacity at constant pressure vary with temperature ?
Explain.
 - (g) What do you mean by degree of reduction ?
 - (h) What is the equilibrium constant for the reaction $\text{PCl}_5 = \text{PCl}_3 + \text{Cl}_{2(g)}$ in terms of activity and partial pressure ?
 - (i) What is Henry's law ?
 - (j) Distinguish between Activation energy and Internal energy.



P.T.O.

(b) Derive the relation $P_1(RT_1/P_1)^{\gamma} = P_2(RT_2/P_2)^{\gamma} = \text{Constant}$. 5

Or

$$C_p - C_v = R$$

3. (a) Derive relation between cell EMF and Free energy of Cell reaction. 5

(b) Calculate the standard emf of a Daniell Cell which is working at 25°C with Standard Free Energy Change of the cell reaction ΔG° is -313.75 kJ/mol at NTP. 5

4. (a) Derive Maxwell's relations. 5

(b) What do you understand by one weight per cent standard state? Derive the relation $(h_B/a_B) = (100M_B/\gamma_B M_A)$ where; A is solvent and B is solute in binary solution. 5

Or

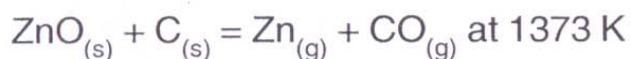
Find the increase in molar entropy of copper when it is heated from 127°C to 927°C. The molar sp. Heat of copper is given by $C_p = 6.2 + 0.0017T$.

5. (a) Derive Gibbs-Helmholtz equation $\left[\frac{\partial(\Delta G/T)}{\partial T} \right]_P = -\Delta H/T^2$. 5

(b) What do you mean by topo-chemical pattern of reaction? Discuss the significance of activation energy in a chemical reaction. 5

Or

Calculate ΔG° for the following reaction at the stated temperature :



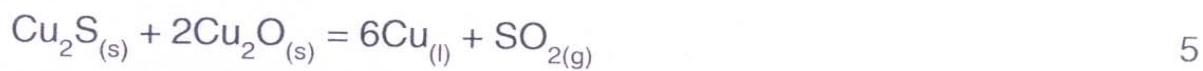
$$\Delta H^\circ_{1373} = 349.9 \text{ kJ/mol and } \Delta S^\circ_{1373} = 285 \text{ J/K mol}$$

6. (a) What do you mean by fugacity? From P-V isotherm how departure from fugacity is explained. 5

(b) What is chemical potential? Derive Gibbs-Duhem relations. 5

7. (a) What is an ideal solution? Explain the important characteristics of an ideal solution in terms of : 5

(b) Calculate the standard enthalpy change for the following reaction at 1250°C



Given the values of standard enthalpy change at 1250°C as follows :

$\Delta H^\circ_{f,1250}$, kJ/mol	$\text{Cu}_2\text{S}_{(s)}$	$\text{Cu}_2\text{O}_{(s)}$	$\text{Cu}_{(l)}$	$\text{SO}_{2(g)}$
	-93.7	-179.6	0	-280.4

8. Write short notes on any **two** of the following : 5×2

- (a) Activity
- (b) Excess function
- (c) Ellingham-Richardson diagram
- (d) Johnson-Mehl equation

