Registration No. : | | | | | | | | | | |

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 $PCl_5 = PCl_3 + Cl_{2(g)}$ in terms of activity and partial pressure ?

   (i) What is Henry's law ?

   (j) Distinguish between Activation energy and Internal energy.

(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 EMFand Free energy of Cell reaction. 5

(b) Calculate the standard emf of a Denial Cell which is working at 25°C with Standard Free Energy Change of the cell reaction $\Delta G°$ 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 standards 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 $\Delta G°$ for the following reaction at the stated temperature :

$ZnO_{(s)} + C_{(s)} = Zn_{(g)} + CO_{(g)}$ at 1373 K

$\Delta H°_{1373} = 349.9$ kJ/mol and $\Delta S°_{1373} = 285$ 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

$Cu_2S_{(s)} + 2Cu_2O_{(s)} = 6Cu_{(l)} + SO_{2(g)}$ 5

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

$\Delta H^\circ_{f,1523,}$ kJ/mol	$Cu_2S_{(s)}$	$Cu_2O_{(s)}$	$Cu_{(l)}$	$SO_{2(g)}$
	–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.