

Registration No. :

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Total number of printed pages – 2

B. Tech
PCMT 4202

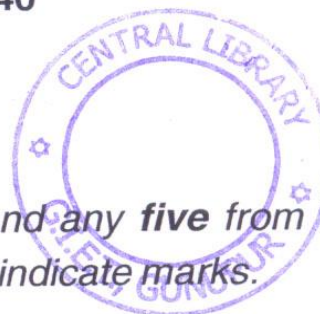
Third Semester Back Examination – 2014
METALLURGICAL THERMODYNAMICS AND KINETICS

BRANCH : MME

QUESTION CODE : L 340

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 thermodynamic state of a system ?
 - (b) What is Zeroeth law of thermodynamics ?
 - (c) Differentiate between reversible and Irreversible process.
 - (d) What is internal energy ?
 - (e) What do you mean by Fugacity ?
 - (f) What is an ideal solution ?
 - (g) What is an isolated system ?
 - (h) What is Heterogeneous and Homogeneous reaction ?
 - (i) Give one example to each of Gas – solid, Liquid – liquid and Liquid – solid reaction.
 - (j) What is Henry's law ?
2. Discuss Topochemical pattern of reaction for iron ore reduction. What are the different kinetic steps involve in this reduction and suggest the rate-controlling step. 10
3. Differentiate between (any **three**) : 10
 - (a) Activation energy and internal energy
 - (b) Equilibrium constant and rate constant

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- (c) Ideal and non-ideal solution
- (d) Reversible and irreversible process
- (e) Adiabatic and closed system.
4. (a) Find the enthalpy change for the reaction $\text{CaO} + (\text{CO}_2) = \text{CaCO}_3$ at 600°C . 6
- The values of ΔH°_f at 298 K for CaO , (CO_2) and CaCO_3 (in kJ/mole) are -634.3, -393.5 and -1206.7 respectively.
- $C_p \text{CaCO}_3 = 104.516 + (21.924 \times 10^{-3} T) - (25.945 \times 10^{-5} T^2) \text{ J/gm.mol.K}$
- $C_p (\text{CO}_2) = 44.141 + (9.037 \times 10^{-3} T) - (8.535 \times 10^{-5} T^2) \text{ J/gm.mol.K}$
- $C_p \text{CaO} = 49.622 + (4.519 \times 10^{-3} T) - (6.945 \times 10^{-5} T^2) \text{ J/gm.mol.K}$
- (b) What is entropy ? Discuss important characteristics of entropy. 4
5. (a) What is Chemical Potential ? Derive Gibbs' Duhem relations. 6
- (b) Calculate the standard heat of reaction at 298 K and 1 atm pressure of
- $$3\text{FeO} + 2\text{Al} = \text{Al}_2\text{O}_3 + 3\text{Fe}$$
- In terms of Al_2O_3 formed and per mole of Fe formed. 4
- Data given : $\Delta H^\circ_{298, \text{FeO}} = -264.85 \text{ kJ/mole}$
- $\Delta H^\circ_{298, \text{Al}_2\text{O}_3} = -1673.6 \text{ kJ/mol}$
6. (a) Derive Maxwell's relations. 6
- (b) Discuss one weight percent standard state. 4
7. (a) Discuss temperature dependence of entropy. 5
- (b) Derive relation $C_p - C_v = R$. 5
8. Write short notes on any **two** : 5×2
- (a) Significance of first law of thermodynamics
- (b) State and Path function
- (c) Partial molal quantities
- (d) Thermo Gravimetric Analysis
- (e) Ellingham Diagram.