**Registration no:** | | | | | | | | | | |

**Total Number of Pages: 02** **B.TECH**
**PCMT4202**

# 3rd Semester Regular / Back Examination 2015-16
# METALLURGICAL THERMODYNAMICS AND KINETICS
## BRANCH(S): MM,MME
## Time: 3 Hours
## Max Marks: 70
## Q.CODE: T692

**Answer Question No.1 which is compulsory and any five from the rest.**
**The figures in the right hand margin indicate marks.**

**Q1** **Answer the following questions:** **(2 x 10)**

**a)** Define the terms thermodynamic System and Surrounding
**b)** Differentiate between homogeneous and hetero generous system
**c)** What is a reversible process?
**d)** Define term activity.
**e)** State mathematical formulation of 1st law of thermodynamics.
**f)** What is the value of Gibbs free energy of nucleation at equilibrium temperature?
**g)** What is the basic principle of DAT?
**h)** What is a metallo-thermic reduction?
**i)** How thermodynamics does differ from kinetics?
**j)** Define term regular solution.

**Q2** **Derive following thermodynamic relations(any two):** **(5x2)**

i). $dG=VdP-SdT$

ii) $\left[\frac{\partial(\Delta G/T)}{\partial T}\right]_P = -\Delta H/T^2$

iii) Cp-Cv = R

iv) $S = C_p \ln V + C_v \ln P + \text{Constant}$

**Q3** **a)** Derive partial molar enthalpy of mixing **(5)**

**b)** With the help of an Ellingham diagram, comment on the metallothermic reduction of metal oxide. **(5)**

**Q4** In the iron ore (Hematite ore) reduction by carbon-monoxide discuss different kinetic steps involved. Suggest rate controlling step. Comment on the importance of activation energy in the Chemical reaction. **(10)**

**Q5** **a)** Enthalpy of an ideal gas is independent of pressure in an isothermal process justify from Maxell's relation, i.e $(\delta H/\delta P)_T = 0$ **(5)**

**b)** Determine the temperature above and below which the aluminothermic reduction of MgO become thermodynamic feasible at 1 atm pressure. **(5)**
Data given:

$2\{Al\} + 3/2\ (O_2) = <Al_2O_3>$ ; $\Delta G^o = (-1{,}679{,}876 + 321.79\ T)\ J$
$(Mg) + 1/2\ (O_2) = <MgO>$ ; $\Delta G^o = (-731{,}154 + 205.39\ T)\ J$

**Q6** **a)** What is fugacity? From P-V isotherm derive quantitative expression of fugacity **(2+4)**

$$f = P.e^{-\frac{A}{RT}}$$

**b)** The specific heat($C_p$) of pure iron expressed in J/(mol.K) as a function of temperature T(in K) is given as $C_p=17.49 +24.77x10^{-3}T$ **(4)**
What is the change in enthalpy of pure iron(in J/mol) when it is heated from $25^oC$ to $700^oC$?

**Q7** Discuss temperature dependence of entropy **(10)**

**Q8** **Write Short Notes (Any Two)** **(5 x 2)**

**a)** Gibbs-Duhem equation
**b)** Interfacial reaction kinetics
**c)** Excess function
**d)** Solid electrolyte
**e)** Activity Coefficient