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

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

3rd Semester Back Examination 2016-17
METALLURGICAL THERMODYNAMICS AND KINETICS
BRANCH(S):METTA, MME
Time: 3 Hours
Max Marks: 70
Q.CODE:Y500

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 entropy. Is it a path function?
b) What is third law of thermodynamics?
c) Define Internal Energy.
d) Write Gibb's Helmholtz equation & define Gibb's Free energy.
e) Give an example of a closed system &how a closed system differs from open system.
f) Define compressibility factor.
g) Write the expression for first law of thermodynamics.
h) Define specific heat at constant pressure.
i) What is the difference between physical adsorption and chemisorption?
j) Define fugacity.

Q2 Derive the following. **(10)**

a)dH = C_p dT+[V-T($\frac{\partial V}{\partial T}$)$_P$]dP

b) dS= C_p dT/T –($\frac{\partial V}{\partial T}$)$_P$ dP

c) dG= VdP-SdT

Q3 **a)** Derive the relation between the standard Gibb's energy change and equilibrium constant. **(5)**

b) What is the effect of temperature on the equilibrium constant? **(5)**

Q4 **a)** One mole of solid Cr_2O_3 at 2500K is dissolved in a large volume of a liquid Raoultian solution of Al_2O_3 and Cr_2O_3 in which X_{Cr2O3} =0.2 and which is also at 2500K. Calculate the changes in enthalpy and entropy caused by the addition. The normal melting temperature of Cr_2O_3 is 2538 K, and it can be assumed that the $\Delta S_{m,Al2O3} = \Delta S_{m,\ Cr2O3}$. **(5)**

b) Derive the Maxwell relations. **(5)**

Q5 **a)** Consider the second-order reaction **(5)**

A + B $\xrightarrow{k}$ D k= 5.41/ (moles).

The initial concentration of the reactants wasc^0_A= c^0_B= 0.02 moles/lit.

Determine the fraction of A which will be consumed during the first minute.

b) A monoatomic gas (diffusant) is enclosed within a thin metallicspherical shell at constant temperature. During a t_1=100 h period, some of the gas diffuses through the shell such that the pressure inside drops fromp_0=10 atm top_1=9.5 atm. The partial pressure of the diffusant outside the shell isp_{out}=1 atm. Find the time t_2 necessary for the pressure to drop top_2=8 atm. **(5)**

Q6 **a)** Explain the diffusion mechanisms in metals with the help of suitable diagrams. **(5)**

b) Write the differences between thermal and configurational entropy. **(5)**

Q7 Show that: **(10)**

$$C_P = T\left(\partial S / \partial T\right)_P$$

$$C_V = T(\partial S / \partial T)_V$$

$$\left(\partial C_P \big/ \partial P\right)_T = -T\left(\partial^2 V / \partial T^2\right)_P$$

$$\left(\partial C_V / \partial V\right)_T = T\left(\partial^2 P / \partial T^2\right)_V$$

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) Kinetics of homogeneous reactions

b) Clausius-Clapeyron equation

c) Gibbs–Duhem relation

d) Van't Hoff isobar