B.TECH SEM - V (2007 COURSE) (CHEMICAL ENGG.) : SUMMER - 2018

SUBJECT : CHEMICAL ENGINERING THERMODYAMICS – II

Day : **Friday** Time : **10.00 AM TO 01.00 PM**

Date : **25/05/2018** **S-2018-2652** Max. Marks : 80

N. B. :

1) **Q.No.1** and **Q.No.5** are **COMPULSORY**. Out of the remaining questions attempt **ANY TWO** questions from each section.
2) Answers to both the sections should be written in **SEPARATE** answer books.
3) Use of non-programmable **CALCULATOR** is allowed.
4) Figures to the right indicate **FULL** marks.
5) Assume suitable data if necessary.

SECTION – I

Q.1 **a)** Derive criteria of phase equilibria. **[05]**

b) Define modified Raoults Law and enumerate its physical significance. **[05]**

c) What is reaction coordinate? Enumerate its physical significance. **[04]**

Q.2 Derive following expressions for solid/liquid equilibrium **[13]**

$$\psi_i = \exp \int_{Tmi}^{T} \frac{H_i^l - H_i^s}{RT^2} dT$$

Where ψ_i is the ratio of fugacities at a given temperature and pressure of system and T_{mi} is the melting temperature of pure species i.

Q.3 What is the effect of pressure and temperature on VLE? Enumerate with neat diagram. **[13]**

Q.4 The following reaction reaches equilibrium at 650^0C and 1 bar **[13]**

$$N_2(g) + C_2H_2(g) \rightarrow 2HCN(g)$$

If the system initially is an equimolar mixture of N_2 and C_2H_2, what is the composition of the system at equilibrium?

Component	$\Delta H_f^0, J$ / mole	$\Delta H_f^0, J$ / mole	C_p / R
N_2	0	0	$3.28 + 0.593 \times 10^{-3}$ T
C_2H_2	227480	209970	$6.132 + 1.952 \times 10^{-3}$ T
HCN	135100	124700	$4.736 + 1.359 \times 10^{-3}$ T

SECTION – II

Q.5 **a)** Define phase rule for reacting system. Enumerate physical significance of degree of freedom. **[05]**

b) How would you apply thermodynamic science to chemical explosions? **[05]**

c) Enumerate any one model to determine excess Gibbs free energy. **[04]**

Q.6 Derive following expression for chemical reaction equilibrium constant **[13]**

$$K = \prod_i (\hat{a}_i)^{v_i} = \exp\left[- \frac{\sum_i v_i G_i^o}{RT} \right]$$

Q.7 What is an electrochemical process? How would you determine activity coefficient of ion in a solution? **[13]**

Q.8 Derive following expression for Gibbs free energy charge and entropy charge on mixing: **[13]**

a) $\Delta G = G^E + RT \sum x_i \ln x_i$ **b)** $\Delta S = S^E - R \sum x_i \ln x_i$

* * * *