

**M. Tech. –I (Chemical Engineering) (CBCS – 2015 Course) :**

**WINTER - 2018**

**SUBJECT : THERMODYNAMICS OF PHASE EQUILIBRIA**

Day : Friday  
Date : 07/12/2018

**W-2018-3130**

Time 11.00 AM TO 02.00 PM  
Max. Marks : 60

**N.B.**

- 1) All questions are **COMPULSORY**
- 2) Figures to the right indicate **FULL** marks.
- 3) Answers to both the sections should be written in **SEPARATE** answer book.
- 4) Use of non-programmable calculator is allowed.
- 5) Assume suitable data if necessary.

**SECTION – I**

- Q.1** Derive Gibbs-Duhem equation for binary solutions. (10)  
**OR**
- Q.1** Enumerate the hydrogen bonding interactions among pairs of species and explain the existence of charge transfer complexing equilibrium (10)
- Q.2** Explain UNIQUAC equation and UNIFAC method for the evaluation of activity coefficients. (10)  
**OR**
- Q.2** Elaborate the role of activity coefficient in VLE calculations using suitable model (10)
- Q.3** State and explain Nerst's law in relation with solubility of solid in liquid (10)  
**OR**
- Q.3** Explain the partitioning of solute between two liquid phases. (10)

**SECTION – II**

- Q.4 a)** Explain the chemical equilibrium for simultaneous reactions occurring in single phase (05)  
**b)** Determine the number of degrees of freedom  $F$  for each of following systems; (05)  
i) A system prepared by partially decomposing  $\text{CaCO}_3$  into an evacuated space.  
ii) A system consisting of the gases  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{H}_2$ ,  $\text{H}_2\text{O}$  and  $\text{CH}_4$  in chemical equilibrium.  
**OR**
- Q.4** Derive an expressions which can be used as criteria for combined chemical and phase equilibrium. (10)
- Q.5** Derive Thomson's equation for the effect of particle size on vapor pressure of a spherical droplet. (10)  
**OR**
- Q.5** Elaborate the effect of bubble size on boiling temperature of pure substances. (10)
- Q.6** Derive expressions for ionization of dibasic acid with fractions of: (10)  
i) Un-dissociated  
ii) Slightly ionized  
iii) Completely dissociated  
**OR**
- Q.6** Elaborate the terms: (10)  
i) Exergetic efficiency  
ii) Acidity of solutions

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