

TE / SEM V / <sup>CHEM</sup> CBSEGS / MAY 2017

25

Q.P. Code : 573900

(3 Hours)

[ Total Marks : 80

- N.B. :** (1) Question no.1 is compulsory.  
 (2) Attempt any **THREE** of the remaining questions.  
 (3) **Figure** to the **right** indicates **full** marks.  
 (4) Assume suitable data wherever necessary.

1. a) What are the desirable properties of the refrigerant? 5  
 b) Discuss chemical potential as criteria of phase equilibria. 5  
 c) Estimate the entropy change of mixing when 2.8 L of oxygen and 19.6 L of hydrogen at 1 atm are mixed to prepare a gas mixture. 5  
 d) Explain in brief boiling point diagram. 5
  
2. a) Discuss in brief phase equilibria in Single component system. 10  
 b) In the synthesis of methanol from CO and H<sub>2</sub> at 500k and 5bar, estimate the degree of conversion of co if the reactor is fed with mixture of CO and H<sub>2</sub> and methanol in the mole ratio of 1 : 2 : 0.02. Given: K = 4.973 x10<sup>-3</sup>. 10
  
3. a) What are the different types of refrigeration? Explain any one in detail. 10  
 b) From VLE measurement for Ethanol Benzene system at 318 K and 40.25 KPa, it is found that vapor is in equilibrium with liquid containing 38.9% benzene. The concentration of benzene in vapor is 56.6%. The system forms an azeotrope at 318 K. At this temperature the vapor pressure of ethanol and benzene are 22.9 KPa and 29.6 KPa respectively. Determine the composition and total pressure of Azeotrope. The system is non ideal. It can be assumed that the activity of the system can be expressed using VAN LAAR Model. 10
  
4. a) List the different techniques for the estimation of critical parameters. Explain any one in detail. 10  
 b) Following simultaneous reaction occur in the reactor, 10  

$$A + B \rightarrow C + D \quad K_a = 0.5$$

$$A + C \rightarrow D + E \quad K_a = 1.5$$

If the equimolar mixture of A and B are fed to the reactor for producing D, Estimate equilibrium conversion at 1 bar. The reaction mixture is assumed to be an ideal gas mixture.
  
5. a) Explain in brief UNIQUAC equation and NRTL equation. 10

[TURN OVER]



- b) Discuss the phase rule for non reacting and reacting systems. Determine the number of degrees of freedom for the system consisting of the gases CO, CO<sub>2</sub>, H<sub>2</sub>, H<sub>2</sub>O, and CH<sub>4</sub> in chemical equilibrium. 10
6. a) Explain heat of reaction in detail. 10
- b) The vapour pressures of acetone (1) and acetonitrile (2) can be evaluated by the Antoine equations :- 10
- $$\ln P_1^s = 14.5463 - 2940.46/(T - 35.93)$$
- $$\ln P_2^s = 14.2724 - 2945.47/(T - 49.15)$$
- where T is in K and P is in kPa. Assuming that the solution formed by these are ideal, calculate :-
- x<sub>1</sub> and y<sub>1</sub> at 327 K and 65 kPa.
  - T and y<sub>1</sub> at 65 kPa and x<sub>1</sub> = 0.4