Reg. No. : | | | | | | | | | | |

Question Paper Code: 55091

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Fifth Semester

Chemical Engineering

15UCH501 - CHEMICAL ENGINEERING THERMODYNMICS II

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Fugacity coefficient of a substance is the ratio of its fugacity to

   (a) Mole fraction (b) Activity
   (c) Pressure (d) Activity coefficient

2. For a real gas, the chemical potential is given by

   (a) RTdlnP (b) RTdlnf (c) Rdlnf (d) Rlnf

3. Throttling process is a constant _____ process.

   (a) Enthalpy (b) Entropy (c) Pressure (d) Volume

4. The adiabatic throttling process of a perfect gas is one of the constant enthalpy

   (a) In which there is temperature drop
   (b) ln which it is exemplified by unsteady flow expansion
   (c) Which can be performed in a pipe with a construction
   (d) In which there is an increase in temperature

5. Compute the degree of freedom if the system is made up of liquid water in equilibrium with its vapour.

   (a) 0 (b) 1 (c) 2 (d) 3

6. When a system in equilibrium is subjected to a change in temperature, pressure or concentration, equilibrium is displaced in a direction which tends to undo the effect of the change this is called

(a) Le-chatelier principle (b) Kopp's rule
(c) Law of corresponding state (d) Arrhenius hypothesis

7. The free energy change for a chemical reaction is given by

(a) RTlnk (b) –RTlnk (c) –Rlnk (d) Tlnk

8. In the reaction; $N_2 + O_2 \rightarrow 2NO$ increasing the pressure result in

(a) Shifting the equilibrium towards right
(b) Shifting the equilibrium towards left
(c) No change in equilibrium conditions
(d) Change in equilibrium conditions

9. Fundamental principle of refrigeration is based on law is thermodynamics

(a) Zeroth (b) First (c) Second (d) Third

10. One ton of refrigeration capacity is equivalent to

(a) 50 kcal/hr (b) 3023.94 kcal/hr (c) 4023 kcal/hr (d) 100 kcal/hr

PART - B (5 x 2 = 10 Marks)

11. Is heat transfer to or from the fluid desirable as it flows through a nozzle? How will heat transfer affect the fluid velocity at the nozzle exit?

12. Define: Mach number and explain the different type of flow.

13. How to calculate VLE from 'K' value correlations?

14. Write a short notes on Lewis-Randall rule.

15. Define Refrigeration and list some properties of an ideal refrigerant.

PART - C (5 x 16 = 80 Marks)

16. (a) Prove that multiple phases at the same temperature and pressure are in equilibrium when the chemical potential of each species in the same in all phases. (16)

Or

(b) At 300 K and 1 bar, the volumetric data for a liquid mixture of benzene and cyclohexane are represented by $V=109.4*10^{-6} - 16.8^{-6} x^{-1} - 2.64*10^{-6} x^2$, where "x"

is the mole fraction of benzene and "V" has the units of m3/mol. Find expressions for the partial molar volumes of benzene and cyclohexane. (16)

17. (a) Define azeotrope. Discuss in detail about effect of temperature and pressure on azotropes. (16)

Or

(b) Discuss about phase rule and Duhem's theorem for reacting system. (16)

18. (a) Discuss about the step by step calculation procedure of bubble point and dew point methods. (16)

Or

(b) The system acetone (1) / acetonitrile (2)/ nitro methane (3) at 80^0C and 110 kPa has the overall composition Z_1=0.45, Z_2 =4.5 and Z_3=0.20. Assuming that Raoult's law is appropriate to this system. Determine the quantity of liquid and vapor is moles and its mole fraction (xi and y_i). The vapor pressure of the pure species at 80^0C areP_1^{sat}= 195.75 kPa, P_2^{sat}= 97 .84kPa, and P_3^{sat} =59.32 kPa. (16)

19. (a) Acetic acid is esterified as per the reaction

$$CH_3COOH_{(I)}+C_2H_5OH_{(I)} \rightarrow CH_3COOC_2H_{5(I)}+H_2O_{(I)}$$

Given: ΔH_f^O 298= 13,100 J, ΔG_f^O 298= 9270 J

Assuming ΔH^O is a constant, find equilibrium constant at 100°C. What is composition at 100°C? (16)

Or

(b) Ethanol can be produced according to the reaction

$$C_2H_{4(g)} + H_2O_{(g)} \rightarrow C_2H_5OH_{(g)}$$

If an equimolar mixture of ethylene and water vapor is fed to a reactor which is maintained at 1000K and 1 bar determine the degree of conversion and the composition of the reaction mixture at equilibrium assuming the reaction mixure pressure behaves like an ideal gas K_a = 1.639. (16)

20. (a) Draw the neat sketch and explain about vapor-compression cycle. (16)

Or

(b) Explain air refrigeration cycle and discuss about choice of refrigerant. (16)

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