AU – 2714

Fifth Semester B. Tech. Che. Tech. (Food, P and P, O and P and Petro.) (CGS) Examination

CHEMICAL ENGINEERING THERMODYNAMICS

Paper – 5 CT 03

(USC – 11027)

P. Pages : 4

Time : Three Hours] [Max. Marks : 80

Note : (1) Separate answer book must be used for each section in the subject Geology, Engineering material of civil branch and Separate answer book must be used for Section A and B in Pharmacy and Cosmetic Tech.
(2) Answer **Three** questions from Section A and **Three** questions from Section B.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Diagrams and Chemical equations should be given wherever necessary.
(6) Use of slide rule, logarithmic tables, Steam tables, Mollier's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
(7) Use pen of Blue/Black ink/refill only for writing the answer book.

SECTION A

1. (a) What do you understand by Thermodynamics equilibrium ? 4

(b) State the Cyclic rule. 3

(c) One mole of gas is allowed to expand isothermally and reversibly from a volume of 1 dm^3 to 50 dm^3 at 273 K. Calculate W, ΔE assuming ideal gas behaviour and non–ideal behaviour.

[a = 6.5 atm. dm^6/mol^2 , b = 0.056 dm^3/mol R = 0.082 dm^3/kmol] 6

OR

2. (a) $dz = y\,dx - x\,dy$

(i) Prove dz = non state function

(ii) Find two integrating factor 7

(b) State Van der Waal equation and derive the expression for work done. 6

3. (a) State Heat Capacity at constant volume and pressure. Also derive the relation between C_p and C_v. 9

(b) Define :

(i) Coefficient of thermal expansion.

(ii) Coefficient of compressibility. 4

OR

4. Derive the following relation :

(i) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$

(ii) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(iii) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(iv) $\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$ 13

5. (a) Show that Relative lowering of vapour pressure is equal to mole fraction of solute. 7

(b) Define partial molar quantity. Explain the methods for the evaluation of a partial molar quantity. 7

OR

6. (a) 100 gm of each ethanol and methanol are mixed at 20°C to prepare an ideal mixture. The vapour pressure of methanol is 88.7 mm Hg and ethenol is 44.5 mm Hg at 20 °C.

Calculate :

(1) V.P. of solution.

(2) V. P of ethanol.

(3) V. P. of methanol. 6

(b) Prove that $\Delta Tb = \frac{R\ Tb^2}{\Delta H\ vap}\ x_2$ 6

(c) State Henry's law. 2

SECTION B

7. (a) Explain phase diagram of :

Water $\rightleftharpoons$ Ice $\rightleftharpoons$ vapour 7

(b) What is phase rule ? Explain the meaning of each component involve in phase rule. 6

OR

8. (a) Calculate f for :

aq. NaCl – KCl – NaBr – kBr system. 4

(b) Show graphically, tertiory system of water – phenol – Aniline. 5

(c) State and explain three component system. 4

9. (a) Derive Boltzman–Distribution Law. 9

(b) What is the relation between energy and partition function ? 4

OR

10. (a) 10 molecules of a gas are present in a container maintained at 298 K. What is the probability that all ten molecules will be found simultaneously in one half of the container ? 5

(b) Prove that Entropy and Thermodynamics property are interrelated. 8

11. (a) Write a condition for feasebility and graphical representation between free energy and affinity. 8

(b) Derive equilibrium constant with respect to different form of chemical equation. 6

OR

12. (a) Prove that $\frac{d\ln kp}{dT} = \frac{\Delta H^0}{RT^2}$ 8

(b) For the reaction $N_2O_4(g) \longrightarrow 2NO_2(g)$ at 300 k and 1 atm kp = 0.157. Calculate k_c and k_x for this reaction under the given condition. 6