Roll No. | | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 09

B.Tech. (Chemical Engg.) (Sem.–4)

THERMODYNAMICS

Subject Code : BTCH-403B

M.Code : 78133

Date of Examination : 08-07-22

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) Define standard heat of reaction.

b) What is ideal gas pressure?

c) Define chemical potential in terms of internal energy, enthalpy and Gibbs function?

d) Define state and path functions.

e) Define chemical potential?

f) What is the significance of 'Van Laar Equations'?

g) How heat pump is different from heat engine.

h) Define phase rule and degree of freedom.

i) Explain the difference between work function and free energy.

j) Define second law of thermodynamics.

SECTION-B

2. 1 kg of air at 50°C expands reversibly and adiabatically to 5 times its original volume. The initial pressure of the air was 8 atm. Determine the final pressure, temperature and work done when the expansion is adiabatic given the heat capacity ratio γ =1.4.

3. Show that $dS = \frac{C_p}{T} dT - \left(\frac{\partial V}{\partial T}\right)_P dP$

4. Define fugacity both for vapour phase and liquid phase on the basis of concept of ideal solution.

5. What do you mean by chemical potential? Show that the variation of the chemical potential of a component *i* with pressure is given by $d\mu_i = \bar{V}_i \, dP$.

6. A nozzle to which steam at 500 kPa and 623K is entering at the rate of 12kg/s and leaving at 500 kPa and 523 K, is fitted to a long pipe. The amount of heat loss to the surroundings is calculated to be 120kW. If the velocity of the steam at the entrance of the nozzle is assumed to be negligible, then find the velocity at the outlet. We are given that the enthalpy of the steam at 500 kPa and 623K is 3168 kJ/kg and the enthalpy of steam at 50 kPa and 523 k is 2976 kJ/kg.

SECTION-C

7. a) Distinguish between Raoult's law and Henry's law.

   b) Show that fugacity of species '*i*' in an ideal gas mixture is equal to its partial pressure.

8. a) Prove that $COP_{HP} = COP_R + 1$

   b) Explain Carnot Refrigeration cycle with proper diagram.

9. Differentiate between the heat capacity at constant volume and heat capacity at constant pressure. Obtain the expression for First law of thermodynamics from both heat capacities point of view.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.