BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - III CHEMICAL : : SUMMER - 2022
SUBJECT : CHEMICAL ENGINEERING THERMODYNAMICS-I

Day : Monday
Date : 30-05-2022

S-24432-2022

Time : 02:30 PM-05:30 PM
Max. Marks : 60

N. B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Use non programmable **CALCULATOR** is allowed.
4) Assume suitable data if necessary.
5) Use of steam and Psychrometric chart is allowed.

Q.1 Elaborate the following terms: **(10)**

i) Thermodynamic system
ii) Thermodynamic process
iii) Thermodynamic equilibrium
iv) Thermodynamic property

OR

A mass of gas is compressed in a mechanically reversible process from 80 kPa, 0.1 m^3 to 0.4 MPa, 0.03 m^3. Assuming that the pressure and volume are related by PV^n = constant, find the work done by the gas system. **(10)**

Q.2 Derive following expression with usual notations for steady state flow process. **(10)**

$$\Delta H + \frac{\Delta u^2}{2} + g\Delta z = Q + W_s$$

OR

1.5 kg of liquid having a constant specific heat of 2.5 kJ/kg K is stirred in a well-insulated chamber causing the temperature to rise by 15° C. Find ΔE and W for the process. **(10)**

The same liquid as above is stirred in a conducting chamber. During the process 1.7 kJ of heat is transferred from the liquid to the surroundings, while the temperature of the liquid is rising to 15° C. Find ΔE and W for the process.

Q.3 State Carnot's principle about the heat engine and derive Carnot's equations. **(10)**

OR

Two kg of water 80° C are mixed adiabatically with 3 kg of water at 30° C in a constant pressure process of 1 atmosphere. Find the increase in the entropy of the total mass of water due to the mixing process (Cp of water = 4.187 kJ/kg K) **(10)**

P.T.O.

Q.4 One kg of air in a closed system, initially at 5° C and occupying 0.3 m^3 volume, undergoes a constant pressure heating process to 100° C. There is no work other than Pdv work. Find i) the work done during the process, ii) the heat transferred, and iii) the entropy change of the gas. **(10)**

OR

a) What do you mean by equation of state? Give the equations of state for real gases. **(05)**

b) Define compressibility factor and give its significance. **(05)**

Q.5 Derive the four Maxwell relationships for homogeneous phase from first law of thermodynamics. **(10)**

OR

Define fugacity and fugacity coefficient. Elaborate methods to determine fugacity of pure species. **(10)**

Q.6 Describe vapour compression cycle for refrigeration and show it on a T.S. diagram. **(10)**

OR

Enumerate Rankine cycle for power generation with T-S diagram and neat sketch. **(10)**

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