Paper / Subject Code: 50724 / Chemical Engineering Thermodynamics I

1T00533 - S.E.(Chemical Engineering)(SEM-III)(Choice Base Credit Grading System) (R- 19) (C Scheme) / 50724 - Chemical Engineering Thermodynamics I

QP CODE: 10040048 DATE: 30/11/2023

Time: 3 Hours **Total Marks: 80**

N.B.:

(i) Question No.1. is compulsory.

(ii) Attempt any three questions out of remaining five questions.

(iii) Assume suitable data and justify the same.

(iv) Figures to the right indicate full marks

Q 1 Answer any four of the following: **20**

(a) Define adiabatic process with an example.

(b) State Carnot principle.

(c) Methods of determination of fugacity of pure gases.

(d) What is the significance of departure functions?

(e) Explain the construction & working of Mollier diagram.

Q 2 **(a)** Explain the concept of exergy and get the expression to calculate exergy loss when the system changes its state. **12**

(b) Prove that the heat supplied is equal to the change in internal energy for a constant volume process and the change in enthalpy for a constant pressure process. **08**

Q 3 **(a)** A rigid non conducting tank with a volume of 4 m^3 is divided into two equal parts by a membrane. On one side of the membrane, the tank contained gas A at 5 bar and 350 K and on the other side a gas B at 10 bar and 450 K. A and B are ideal gases with C_v values (5/2)R and (7/2)R respectively. The membrane is suddenly ruptured and the gases get mixed. What are the final temperature and pressure? **12**

(b) What are the limiting conditions to be satisfied by an equation of state? **08**

Q4 **(a)** The work required to compress a gas from 100 kPa & 300 K to 300 kPa pressure is 280 KJ/Kg of gas. The compressed gas is admitted to a nozzle in which its velocity is increased to 700 m/s. Find heat removed during compressor with negligible velocity & leaves nozzle at 100 kpa and 300K. **12**

(b) Explain Kelvin and Clausius statement for second law of thermodynamics. **08**

Q5 **(a)** Determine the molar volume of gaseous methane at 300 K & 600 bar by the following methods: i) Using ideal gas equation **10**
ii) Using Vander Waals equation given that, T_c = 191.1 K and P_c = 46.4 bar

(b) A block of copper at a temperature of 825 K and weighing 5 kg is dropped into 50 kg water at 300 K. If there are no heat losses what is the change in entropy of a) copper b) water c) copper and water both considered together? **10**
Cp of copper is 0.4 kJ/kg.K and that of water is 4.2 kJ/kg.K.

Q 6 **(a)** Derive the expression for Joule Thomson coefficient and show that Joule Thomson coefficient is zero for ideal gases. **10**

(b) Calculate the fugacity of methane gas at 322 K and 55 bar, given that the critical constants are 190.7 K and 46.4 bars. **10**

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