Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – IV • EXAMINATION – WINTER 2012

Subject code: 140502 Date: 28/12/2012

Subject Name: Chemical Engineering Thermodynamics - I

Time: 02.30 pm - 05.00 pm Total Marks: 70

Instructions:

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Discuss pdV-work or displacement work with diagram and explain path function and point function with example **07**

(b) Discuss different forms of stored energy and show that the Energy is a property of the system. **07**

Q.2 **(a)** Define enthalpy with its units and discuss specific heat at constant pressure in terms of enthalpy **07**

(b) A stationary mass of gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MPa to a final state of 0.15m^3 and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of 37.6 kj of heat from the gas during the process. How much does the internal energy of the gas change? **07**

OR

(b) Discuss the *P-V-T* behaviour of pure liquids with PT diagram for a pure material. **07**

Q.3 **(a)** Define standard heat of reaction , standard heat of combustion and standard heat of formation with example **07**

(b) A vapour-compression cycle using ammonia as refrigerant is employed in an ice manufacturing plant. Cooling water at 288 K enters the condenser at a rate of 0.25 kg/s and leaves at 300 K. Ammonia at 294 K condenses at a rate of 0.5 kg/minute. Enthalpy of liquid ammonia at 294 K is 281.5 kj/kg. The compressor efficiency is 90%. Saturated ammonia vapour at 258 K and enthalpy of 1426 kj/kg enters the compressor. What is the power requirement of the compressor and refrigeration capacity in tons? **07**

OR

Q.3 **(a)** Explain the principle of corresponding states and discuss the generalized compressibility chart **07**

(b) A vapour compression refrigeration system with ammonia as the working fluid is to operate between 266 K and 300 K. Determine- **07**
(a) COP, given that the enthalpy of saturated vapour at 266 K = 656 kj/kg and enthalpy of superheated vapour leaving the compressor = 724 kj/kg, enthalpy of saturated liquid at 300 K = 144 kj/kg
(b) COP of an ideal Carnot refrigerator

Q.4 **(a)** Discuss the important properties to be considered during the choice of a refrigerant **07**

(b) Discuss the vapour compression cycle with the diagram of components of vapour-compression cycle **07**

OR

Q.4	**(a)**	Define refrigeration, coefficient of performance (COP) and refrigeration capacity. Show schematic representation of refrigeration cycle	**07**
Q.4	**(b)**	Explain the principle of absorption refrigeration with diagram and discuss absorption refrigeration cycle.	**07**
Q.5	**(a)**	State the Joule-Thomson Coefficient and explain the Joule-Thomson inversion curve	**07**
	(b)	The molar volume of an organic liquid at 300 K and 1 bar is 0.1 m^3/Kmol and its coefficient of expansion is 1.25 x 10^{-3} K^{-1}. What would be the change in entropy if the pressure is increased to 20 bar at 300 K? What assumption is involved in the solution?	**07**

OR

Q.5	**(a)**	Derive the steady flow energy equation (S.F.E.E) for a steady flow process	**07**
	(b)	Derive first of the four Maxwell's Equations and state its application in thermodynamics	**07**

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