

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-IV (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 140502**Date: 06/06/2017****Subject Name: Chemical Engineering Thermodynamics I****Time: 10:30 AM to 01:00 PM****Total Marks: 70****Instructions:**

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

- Q.1** (a) Discuss the PVT behavior of pure fluids. **07**
 (b) Explain with neat sketch absorption refrigeration cycle. **07**

- Q.2** (a) Differentiate: **07**
 (1) Intensive and extensive properties.
 (2) Reversible and Irreversible process
 (b) Derive the equation for the first law of thermodynamics for flow process. **07**

OR

- (b) An ideal gas is undergoing a series of a three operations. The gas is heated at constant volume from 300 K and 1 bar to a pressure of 2 bar. It is expanded in a reversible adiabatic process to a pressure of 1 bar. It is cooled at constant pressure of 1 bar to 300 K. Determine the heat and work effects for each step. Assume $C_p=29.3$ kJ/kmol K, $C_v=20.985$ kJ/kmol K. **07**
- Q.3** (a) Discuss the important properties to be considered during the choice of refrigerants. **07**
 (b) State various statements of 2nd law of thermodynamics. Explain various steps of Carnot cycle. **07**

OR

- Q.3** (a) Oil at 500 K is to be cooled at a rate of 5000 kg/h in a counter current exchanger using cold water available at 295 K. A temperature approach of 10 K is to be maintained at both ends of the exchanger. The specific heats of oil and water are respectively 3.2 and 4.2 kJ/kg K. Determine the total entropy change in the process. **07**
 (b) For the flow of fluid through nozzles, derive the equation showing relation between cross sectional area A and velocity u. Also explain the significance of Mach number. **07**

- Q.4** (a) Mercury has density of 13690 kg/m³ in the liquid state and 14193 kg/m³ in the solid state, both measured at the melting point of 234.33 K at 1 bar. If the heat of fusion of mercury is 9.7876 kJ/kg, what is the melting point of mercury at 10 bar? **07**
 (b) Define heat of reaction. Derive the equation showing the effect of temperature on heat of reaction. **07**

OR

- Q.4** (a) Derive Maxwell's Equation from basics. **07**
 (b) Write a short note on Thermodynamic diagrams. **07**

- Q.5** (a) Discuss in brief concept of Entropy. **07**
 (b) Derive: $ds = \frac{c_v}{T} dT - \frac{(\partial v / \partial T)_P}{(\partial v / \partial P)_T} dV$ **07**

OR

- Q.5** (a) Derive the van der Waal's constant a and b in terms of critical properties. **07**

- (b) It is required to freeze 1 kg water at 273 K by means of a refrigeration machine which operates in the surrounding at 300 K. the latent heat of fusion of ice at 273 K is 334.11 kJ/kg. Determine (1) the minimum amount of work required (2) the heat given up to the surrounding. **07**
