Seat No.: _____

Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-IV EXAMINATION – WINTER 2015

Subject Code: 140502Date:30/12/2015Subject Name: Chemical EngineeringThermodynamics-ITime: 02:30pm to 05:00pmTotal Marks: 70

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) State First law of Thermodynamics? Derive the expressions for First law of 06 Thermodynamics for non-flow process.
 - (b) Explain PVT behavior of pure substance with the help of PT and PV diagram. 08
- Q.2 (a) Differentiate between i) State function -Vs- Path function

ii) Reversible process -Vs- Irreversible process

(b) Explain sensible heat, latent heat, standard heat of reaction, standard heat of 07 formation and standard heat of combustion with examples of each.

OR

- (b) A particular quantity of an ideal gas $C_v = ((5/2) R$ undergoes the following 07 mechanically reversible steps that together form a cycle. The gas, initially at 1 bar and 300 K, is compressed isothermally to 3 bar. It is then heated at constant P to a temperature of 900 K. finally; it is cooled at constant volume to its initial state with the extraction of 1,300 J as het. Determine Q and W for each step of the cycle and for the complete cycle.
- Q.3 (a) Derive equation of constants of Vander Waal's equation of state in terms of critical 07 constants of a substance using condition at critical point in PV diagram.
 - (b) Explain concept of Entropy in brief.

OR

- Q.3 (a) State and explain various statements of the second law of thermodynamics.
 - (b) Derive following relationships :

i)
$$C_p - C_v = -T \left[\left(\frac{\partial V}{\partial T} \right)_p \right]^2 \left(\frac{\partial P}{\partial V} \right)_p$$

ii) $\left(\frac{\partial T}{\partial P} \right)_S = \left(\frac{\partial V}{\partial S} \right)_p$

- Q.4 (a) Write a short note on residual properties and departure functions. 07
 - (b) For the two phase systems, derive Claucius / Clapeyron equation relating latent heat 07 of vaporization directly to vapor-pressure curve.

OR

- **Q.4** (a) A steel casting $[Cp = 0.5 \text{ kJ kg}^{-1}\text{K}^{-1}]$ weighing 40 kg and at a temperature of 450°C is quenched in 150 kg of oil $[Cp = 2.5 \text{ kJ kg}^{-1}\text{K}^{-1}]$ at 25°C . If there are no heat losses, what is the change entropy of (i) casting (ii) oil and (iii) both considered together?
 - (b) Explain various types of thermodynamics diagrams in brief. 07
- Q.5 (a) Explain any one method of liquefaction processes. 07
 - (b) Write short note on vapor compression refrigeration cycle 07

1

07

07

07

07

- Q.5 (a) Starting from energy balance equation and the continuity equation. Show that 07 maximum velocity attained by a gas in steady state adiabatic flow in a horizontal pipe of constant cross-sectional area is $u_{\text{max}}^2 = -V^2 \left(\frac{\partial P}{\partial V}\right)_s$
 - (b) Discuss thermodynamics fundamentals of compressors and ejectors in brief. 07