Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – SUMMER 2013

Subject Code: 140502 **Date: 12-06-2013**

Subject Name: Chemical Engineering Thermodynamics -I

Time: 10:30am – 01:00pm **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)** State first law of thermodynamics? Derive the expressions for 1st law of thermodynamics for non-flow process. **07**

(b) Discuss the PVT behavior of pure substance. **07**

Q.2 **(a)** Define the following. **07**

i. Standard heat of reaction.
ii. Standard heat of combustion.
iii. Standard heat of formation.

(b) For an ideal gas undergoing adiabatic process, show that **07**

$$(T_2/T_1) = (V_1/V_2)^{\gamma-1}$$

OR

(b) An ideal gas with $C_v = 1.5R$ undergoes the following mechanically reversible changes in a series of non-flow processes as given below: **07**

a) From an initial state of 70°C and 1 bar, it is compressed adiabatically to 150 °C.
b) It is then cooled from 150 °C to 70°C at a constant pressure.
c) Finally the gas is expanded isothermally to its original state.

Calculate Q, W, ΔU and ΔH for each of the three processes and for the cycle.

Q.3 **(a)** Calculate the standard heat of reaction of the methanol synthesis at 800°C. **07**

$$CO_{(g)} + 2H_{2(g)} \text{ - - - - > } CH_3OH_{(g)}$$

The standard heat of reaction at 25°C is -90135 J

component	A	$B*10^3$	$C*10^6$	$D*10^{-5}$
CH_3OH	2.211	12.216	-3.450	0.0000
CO	3.376	0.557	0.0000	-0.031
H_2	3.249	0.422	0.0000	0.083

$Cp/R = A= BT+CT^2 +DT^{-2}$ J and T is in K

(b) State various equations of state for real gas? Describe Virial equation in brief. **07**

OR

Q.3 **(a)** Write in brief on "Heat effects accompanying phase change" **07**

(b) Write a short note on Thermodynamic Diagrams. **07**

Q.4	**(a)**	Distinguish between Heat engine and Heat pump	**07**
	(b)	A steel casting [Cp = 0.5 kJ kg^{-1} K^{-1}] weighing 40 kg and at a temperature of 450°C is quenched in 150 kg of oil [Cp = 2.5 kJ kg^{-1} K^{-1}] at 25°C. If there are no heat losses, what is the change entropy of (i) the casting (ii) the oil and (iii) both considered together?	**07**

OR

Q.4	**(a)**	Explain any method of liquefaction process	**07**
	(b)	Discuss about factors affecting the choice of refrigerant.	**07**
Q.5	**(a)**	What is the criterion of exactness? Using the criterion of exactness derive the Maxwell equation.	**07**
	(b)	Write a brief note on Absorption refrigeration system?	**07**

OR

Q.5	**(a)**	Write a brief note on Vapor compression refrigeration system?	**07**
	(b)	Discuss the necessity of using a multistage compressor with interstage cooling & show that in the multistage compressor, the total work requirement is minimum when the work in all stages is the same provided the gas is cooled to the initial temperature after each stage?	**07**

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