Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – SUMMER 2016

Subject Code:140502 Date:03/06/2016

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)**	State and explain various laws of thermodynamics.	**07**
	(b)	Derive the expression for change in entropy when an ideal gas changes its state from (P_1, V_1, T_1) to (P_2, V_2, T_2).	**07**
Q.2	**(a)**	Write the various equations of states along with formula.	**07**
	(b)	Derive a mathematical expression of the first law of thermodynamics for a Steady state flow process between single entrance and exit.	**07**
		OR	
	(b)	One kilo mol CO_2 occupies a volume of 0.381 m^3 at 313 ^{0}K.Compare the pressure given by a). Ideal gas equation b). van der Waals equation. Take the van der Waals constants to be a = 0.365 Nm^4/mol^2 and b = 4.28 x 10^{-5} m^3/mol.	**07**
Q.3	**(a)**	Write short note on: Gibb's Phase rule (ii) Differentiate between State function and Path function	**08**
	(b)	A reversible heat engine A absorbs energy from a reservoir at T_1 and rejects energy at reservoir T_2. A second reversible engine B absorbs the same amount of energy as rejected by engine A from the reservoir at T_2 and rejects the energy to reservoir at T_3. What is the relation between T_1, T_2 and T_3 if: i) the efficiency of engine A and B are same. ii) the work delivered by engines are same.	**06**
		OR	
Q.3	**(a)**	Derive Maxwell's thermodynamics relations.	**07**
	(b)	Derive an equation for the COP (coefficient of performance) of Carnot refrigeration cycle.	**07**
Q.4	**(a)**	Explain the Linde's process for gas – liquefaction.	**07**
	(b)	Explain PVT behavior of pure substances with the help of PT and PV diagrams.	**07**
		OR	
Q.4	**(a)**	Define Mach number. Explain its role in finding the relation between velocity and area of cross-section for flow through nozzles?	**07**
	(b)	A refrigeration machine operating at a condenser temperature of 290 K needs 1 kW of power per ton of refrigeration. Determine: i) the coefficient of performance. ii) the heat rejected to the condenser. iii) the lowest temperature that can be maintained.	**07**
Q.5	**(a)**	Discuss Joule-Thompson expansion of liquefaction process.	**07**
	(b)	Describe in detail vapor compression refrigeration cycle with neat diagrams.	**07**
		OR	
Q.5	**(a)**	Write short note on: (i) Multistage compressors (ii) Jet ejector	**08**

(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 kJ kg^{-1} K^{-1}] at 25°C. If there are no heat losses, what is the change in entropy of (i) the casting (ii) the oil, and (iii) both considered together? **06**

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