Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – WINTER 2013

Subject Code: 140502 Date: 23-12-2013

Subject Name: Chemical Engineering Thermodynamics -I

Time: 02:30 pm to 05:00 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)**	Derive equation for first law of thermodynamics for a steady state flow process.	**07**
	(b)	Discuss briefly :1) State and Path functions 2)Closed and Open systems	**07**
Q.2	**(a)**	Discuss PVT behavior of pure substances.	**07**
	(b)	Heat is transferred to10 kg of air which is initially at 100 kpa and 300 K until its temperature reaches 600 K. Determine the change in internal energy and change in enthalpy , amount of heat supplied and the work done for a Constant volume process. Assume air as an ideal gas. Given that : R=8.314 kJ / kmol K, Cp=29.099 kJ / kmol K, Cv =20.785 kJ / kmol K and molecular weight of air =29	**07**
		OR	
	(b)	Nitrogen gas is initially at 10 bar and 280 K is under going a change of state to the final condition of 1 bar and 340 K. Assuming ideal gas condition, calculate change in internal energy and change in enthalpy. Given that: R=8.314 kJ / kmol K, Cp=29.1 kJ / kmol K, Cv =20.8 kJ / kmol K .	**07**
Q.3	**(a)**	Discuss Virial equations and their applications.	**07**
	(b)	Write short note: Ideal gas temperature scale .	**07**
		OR	
Q.3	**(a)**	For an adiabatic process prove that PV^{γ} =constant	**07**
	(b)	Discuss effect of temperature on heat of reaction and derive necessary equation.	**07**
Q.4	**(a)**	State general statements for the second law of thermodynamics.	**07**
	(b)	Explain and prove Carnot's principle with neat sketch.	**07**
		OR	
Q.4	**(a)**	Discuss important properties of a refrigerant.	**07**
Q.4	**(b)**	Write on Multistage compression.	**07**
Q.5	**(a)**	State types of thermodynamic diagrams and discuss any one of them.	**07**
	(b)	Oil at 500 K is to be cooled at a 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 3.2 and 4.2 kJ/kg K. Calculate total entropy change in the process.	**07**
		OR	
Q.5	**(a)**	Prove Maxwell's equations.	**07**
	(b)	A refrigeration machine operating at a condenser temperature at 290 K needs 1kW of power per ton of refrigeration .Determine:1) COP 2) heat rejected to the condenser 3) the lowest temperature that can be maintained. Given that :1 Ton of refrigeration =12660 kJ/h=3516.67 W	**07**

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