GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-IV (New) EXAMINATION – WINTER 2015

Subject Code:2140502Date:30/12/2015Subject Name: CHEMICAL ENGINEERING THERMODYNAMICS-ITime: 2:30pm to 5:00pmTotal Marks: 70

Instructions:

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

Q.1	(a) (b)	Distinguish between steady state and equilibrium state. Explain PVT behavior of pure substances with the help of PT and PV diagrams.	07 07
Q.2	(a)1.	How many degrees of freedom have each of the following system? i)Liquid water in equilibrium with its vapor ii)Liquid water in equilibrium with a mixture of water vapor and nitrogen iii)A liquid solution of alcohol in water in equilibrium with its vapor	03
	2.	Prove that 'A reversible process is never attained in practice. It can only be approached'	04
	(b)	Define heat engine and heat pump. How are the efficiency of a heat engine and the COP of a heat pump defined?	07
	(b)	OR Nitrogen gas is confined in a cylinder and the pressure of the gas is maintained by a weight placed on the piston. The mass of the piston and the weight together is 50 kg. The acceleration due to gravity is 9.81 m/s ² and the atmospheric pressure is 1.01325 bar. Assume frictionless piston. Determine: i) The force exerted by the atmosphere, the piston and the weight on the gas if the piston is 100 mm in diameter. ii) The pressure on the gas. iii) If the gas is allowed to expand pushing up the piston and the weight by 400mm, what is the work done by the gas in kJ?	07
Q.3	(a) (b)	Discuss the theorem of corresponding states and importance of acentric factor. An inventor claims to have devised a cyclic engine which exchanges heat with reservoirs at 27° C and 327° C, and which produces 0.6 kJ of work for each kJ of heat extracted from the hot reservoir. Is the claim believable? If instead he claimed that the delivered work would be 0.25 kJ / kJ of extracted heat, would the engine be feasible?	07 07
Q.3	(a)	An adiabatic process for which there is no heat transfer between system and	07
-		its surrounding. Establish the relation between P, V and T for the same.	07
	(b)	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.	U7
Q.4	(a)	List any two statements of second Law of Thermodynamics and explain the concept of entropy.	07

(b) Discuss about latent heat of pure substance and derive Clapeyron equation 07 of phase transition.

OR

- Q.4 (a) State mathematically the first law of thermodynamics that can be used for 07 solving steady state fluid flow problems.
 - (b) A vapour compression refrigeration system with ammonia as the working fluid is to operate between 266 K and 300 K. Determine following:
 (a) COP, given that the enthalpy of saturated vapour at 266 K = 656 kj/kg and enthalpy of superheated vapour leaving the compressor = 724 kj/kg, enthalpy of saturated liquid at 300 K = 144 kj/kg
 (b) COP of an ideal Carnot refrigerator
- Q.5 (a) Derive first of the four Maxwell's Equations and state its significance in 07 thermodynamics.
 - (b) Show that the maximum fluid velocity attainable for flow through a pipe of 07 uniform cross-section is equal to the sonic velocity.

OR

Q.5	(a)	Explain Carnot refrigerator and derive the COP for the same.	07
	(b)	Explain any method of liquefaction.	07
