Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III • EXAMINATION – WINTER • 2014

Subject Code: 130405 **Date: 18-12-2014**

Subject Name: Thermodynamics

Time: 02.30 pm - 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		Explain PVT behavior of a pure substance with the help of PT and PV diagram in detail.	**14**
Q.2	**(a)**	Derive expressions of constants 'a' and 'b' of Vanderwall's equation of state in terms of critical properties of substances.	**07**
	(b)	Derive mathematical expression of the first law of thermodynamics for steady state flow process.	**07**
		OR	
	(b)	Describe vapor compression cycle or absorption refrigeration cycle with neat diagrams.	**07**
Q.3	**(a)**	With special reference to mathematical statement of the second law, justify that "All isentropic processes are adiabatic, but all adiabatic processes are not isentropic." Also, derive $\Delta S_{Total} \geq 0$ for heat transfer process.	**09**
	(b)	What are the factors (properties) affects the choice of a refrigerant? Explain in detail	**05**
		OR	
Q.3	**(a)**	State and prove Carnot theorem for heat engines. Also, mention corollary to Carnot theorem.	**07**
	(b)	A steel casting [C_p=0.5 kJ kg^{-1} K^{-1}] weighing 40 kg and at a temperature of 450°C is quenched in 150 kg of oil [C_p=2.5 kJ kg^{-1} K^{-1}] at 25°C. If there are no heat losses, what is the change in entropy of (a) the casting (b) the oil, and (c) both considered together?	**07**
Q.4	**(a)**	Explain criteria of chemical reaction equilibria or phase equilibria in detail.	**07**
	(b)	Differentiate between the following: (i) Reversible Vs irreversible process (ii) State function Vs path function	**07**
		OR	
Q.4	**(a)**	Define and explain followings with examples of each: (i) Sensible heat (ii) Latent heat (iii) Standard heats of formation, reaction and combustion.	**07**
	(b)	Derive Maxwell equations using fundamental property relations for a homogeneous fluid of constant composition.	**07**
Q.5	**(a)**	Explain various types of thermodynamic diagrams in detail.	**07**
	(b)	Define: Force, temperature, Pressure, Work, Energy, Heat and Enthalpy	**07**
		OR	
Q.5	**(a)**	How much heat is required when 200 g of $CaCO_3$ is heated at atmospheric pressure from 30°C to 700°C? Data: $Cp/R = 12.572 + 2.637 \times 10^{-3}T - 3.12 \times 10^{5}T^{-2}$, T is in K	**07**

(b) Mention Various statements of Zeroth, first, second, and third law of thermodynamics. Also, explain limitations of each. **07**

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