Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – III • EXAMINATION – WINTER 2012

Subject code: 130405 **Date: 03-01-2013**

Subject Name: Thermodynamics

Time: 10.30 am – 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.**
4. **Notations used have their conventional meanings.**

Q.1 **(a)** Explain first law of thermodynamics. Also, Derive mathematical statement of the first law of thermodynamics for steady state flow process. **07**

(b) Derive equations of constants of Vanderwaal's equation of state in terms of critical constants of a substance using condition at critical point in PV diagram. **07**

Q.2 **(a)** Define thermodynamics and its related basic terminologies such as system, surrounding, state, process and also explain scope of thermodynamics. **07**

(b) Explain PVT behavior of a pure substance with the help of PT and PV diagrams. **07**

OR

(b) An instrument to measure the acceleration of gravity on Mars is constructed of a spring from which is suspended a mass of 0.40 kg. At a place on earth where the local acceleration of gravity is 9.81 m/s^2, the spring extends 1.08 cm. When the instrument package is landed on Mars, it radios the information that the spring is extended 0.40 cm. What is the Martian acceleration of gravity? **07**

Q.3 **(a)** Explain sensible heat, latent heat and standard heats of reaction, formation and combustion with examples of each. **07**

(b) Handbook values for the latent heats of vapourization in J/g are given in the table for the pure liquids at T_n, the normal boiling point. **07**

Component	$\Delta H^{\ell v}$ at T_n (J/g)	T_n (K)	P_c (bar)	T_c (K)
Benzene	393.9	353.2	48.98	562.2
Toluene	363.2	383.8	41.06	591.8

For these substances, calculate the value of the latent heat at T_n by Riedel equation and Find out the percentage difference from those listed in the table.

OR

Q.3 **(a)** State and explain various statements of second law of thermodynamics. Also, discuss third law of thermodynamics in brief. **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)** Derive the following equations for homogeneous fluids of constant composition. **07**

$$dH = C_P dT + \left[V - T\left(\frac{\partial V}{\partial T}\right)_P \right] dP$$

$$dS = C_P \frac{dT}{T} - \left(\frac{\partial V}{\partial T}\right)_P dP$$

(b) Write about different types of thermodynamic diagrams used in the study of thermodynamic properties of fluids. **07**

OR

Q.4 **(a)** What are the factors (properties) affecting the choice of a refrigerant? Discuss in detail. **07**

(b) Explain carnot refrigeration cycle and vapor compression refrigeration cycles briefly. **07**

Q.5 **(a)** Explain the reaction coordinate and discuss the criteria of chemical equilibrium in detail. **07**

(b) Derive Carnot equations for a Carnot cycle using an ideal gas. **07**

OR

Q.5 **(a)** Describe the concept of VLE and discuss simple models of VLE. **07**

(b) Explain the concept of entropy in detail with neat diagram. **07**

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