Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2130405 **Date: 31/05/2017**

Subject Name: Thermodynamics

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 Short Questions. 14

1 Define: Refrigeration.

2 Define: COP (Coefficient of performance)

3 State First law of thermodynamics.

4 Define: Sensible heat.

5 Define: Latent heat of sublimation.

6 Define heat capacity.

7 Define: Enthalpy.

8 Write Kelvin planks statement for second law.

9 Define Standard heats of combustion.

10 Define: Heat Pump.

11 What is steady flow process?

12 Write three different units of Temperature.

13 Define: Standard heats of reaction.

14 State Zeroth law of thermodynamics.

Q.2 (a) A man circling the earth in a spaceship weighed 300 N at a location where the local gravitational acceleration was 3.35 m/s^2. Calculate the mass of the man and his weight on the earth, where the gravitational acceleration is 9.81 m/s^2. 03

(b) Define Refrigerator capacity and Coefficient of performance. 04

(c) Derive the following thermodynamic relationships / identities / equations: 07

$$dU = C_V dT + \left[\frac{\beta}{\kappa} T - P \right] dV$$

OR

(c) Explain PVT behavior of pure substances with the help of PT and diagrams. 07

Q.3 (a) The reading on a mercury manometer at 25°C (open to the atmosphere at one end) is 56.38 cm. The local acceleration of gravity is 9.832 m/s^2. Atmospheric pressure is 101.78 kPa. What is the absolute pressure in kPa being measured? The density of mercury at 25°C is 13.534 g/cm^3. 03

(b) Explain the term 'temperature'. Mention different units of temperature and relations among various temperature scales 04

(c) Derive the following thermodynamic relationships / identities / equations: 07

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

OR

Q.3 (a) Prove that C_p-C_v = R 03

(b) Water at 368 K is pumped from a storage tank at the rate of 25 m^3/h. The motor for the pump supplies work at the rate of 2 hp. The water passes through a heat exchanger, where it gives up heat at the rate of 42000 kJ/min and is delivered to a second storage tank at an elevation of 20 m above the first tank. What is the temperature of the water delivered to the second storage tank? Assume that the enthalpy of water is zero at 273 K and the specific heat of water is constant at 4.2 kJ / kg K. 04

(c) Write a short note on thermodynamics diagrams. 07

Q.4 (a) Give limitation of first law of Thermodynamics. 03

(b) An electric current of 0.5 A from a 12 V supply is passed for 5 minutes through a resistance in thermal contact with saturated water at 1 atm. As a result, 0.798 g of water is vaporized. Assuming that the water vapors behaves ideally, calculate the molar internal energy change and enthalpy change during the process. 04

(c) Derive a mathematical expression of the first law of thermodynamic for a Flow process. 07

OR

Q.4 (a) Starting from basic principles, obtain different forms of virial equations. 03

(b) Oil at 500 K is to be cooled at a rate of 5000 Kg/hr in counter-current exchanger using cold water available at 295 K. A temperature approach of 10K is to be maintained at both ends of the exchanger. The specific heat of oil and water are respectively 3.2 and 4.2 KJ/Kg K .Determine total entropy change in the process. 04

(c) What are the factors (properties) affects the choice of a refrigerant? 07

Q.5 (a) Derive the following Maxwell's equation from the first principle 03

$$\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$$

(b) With special reference to mathematical statement of the second law ofthermodynamics, justify that "All isentropic processes are adiabatic, but all adiabatic processes are not isentropic." 04

(c) Handbook values for the latent heat of vaporization in J/g are given in the table for benzene at T_n, the normal boiling point. 07

Component	$\Delta H^{\ell v}$ at 25°C (J/g)	$\Delta H^{\ell v}$ at T_n (J/g)	T_n (K)	P_c (bar)	T_c (K)
Benzene	433.3	393.9	353.2	48.98	562.2

Calculate: i) the value of the latent heat at T_n by Watson method, given the value at 25°C.ii) the value of the latent heat at T_n by Riedel equation

OR

Q.5 (a) Define Hess law and write it applications. 03

(b) A refrigeration process operating at a condenser temperature at 290K needs 1 KW of power per ton of refrigeration. 04
i) What is the coefficient of performance?
ii) How much heat is rejected in the condenser?
iii) What is the lowest temperature the system can possibly maintain?

(c) Derive an equation for the Co-efficient of performance of Carnot refrigeration cycle. 07

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