Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – WINTER 2015

Subject Code: 141903 **Date:22/12/2015**

Subject Name: Engineering Thermodynamics

Time: 02:30pm to 05:00pm **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)** Explain briefly the following terms **08**
(1) Thermodynamic system (2) Surroundings (3) Boundary (4) Universe
(5) Process (6) State (7) Cycle (8)Control Volume

(b) Distinguish Between **06**
(1) Intensive and Extensive properties
(2) Homogeneous system and Heterogeneous system
(3)System and Control volume

Q.2 **(a)** Derive the general energy equation for steady flow process and show how this equation can be applied to Boiler. **07**

(b) A well insulated tank containing 2 kg liquid which having a constant specific heat of 2.5 kJ/kgK. The liquid in tank is stirred by paddle wheel. The temperature of liquid rise by 12°C. Calculate the change in internal energy and work done for the process. **07**

OR

(b) What is unsteady state flow process? Explain bottle filling process. **07**

Q.3 **(a)** Prove that all reversible engines working between two constant temperature reservoirs have the same efficiency. **07**

(b) A domestic refrigerator maintains a temperature of -10°C. The ambient temperature 27°C. The heat leaks in to the refrigerator at the continuous rate of 90 kJ/min. Calculate the least power required to pump this heat out continuously. **07**

OR

Q.3 **(a)** With usual notations prove that **07**

$$\oint \frac{\delta Q}{T} \leq 0$$

(b) 5 kg of water at 0°C is exposed to reservoir at 98°C. Calculate the change of entropy of water, reservoir and universe. Assume the specific heat of water is 4.187 kJ/kgK. **07**

Q.4 **(a)** Define available and unavailable energy. With usual notations, show that the availability of a closed system is given by **07**

$$\phi_1 - \phi_0 = (u_1 + p_0 v_1 - T_0 s_1) - (u_0 + p_0 v_0 - T_0 s_0)$$

(b) A lump of 800 kg of steel at 1250 K is to be cooled to 500 K. If it is desired to use the steel lump as source of energy, calculate the available energy and unavailable energy. **07**

OR

Q.4 **(a)** With usual notations, prove the following relation for the gas mixture, **07**

$$C_p - C_v = \sum \frac{m_i}{m} R_i$$

(b) A cylinder of 50 liter capacity contains CO_2 at 100 bar pressure and 20°Ctemperature. Calculate (i) mass of the gas (ii) molecular volume of the gas. Take R_u = 8313.3 J/kg mol K and molecular mass of CO_2 = 44 kg/kg mol. **07**

Q.5 **(a)** Sketch the Rankine cycle on p-V, T-s and h-s diagram and derive the expression for its thermal efficiency with and without pump work. **07**

(b) An engine operating on diesel cycle has maximum pressure and temperature of 45 bar and 1500°C. Pressure and temperature at the beginning of compression are 1 bar and 27°C. Determine air standard efficiency of the cycle. Take $\gamma = 1.4$ for air. **07**

OR

Q.5 **(a)** With neat sketch, explain the working of Junker's gas calorimeter. **07**

(b) Calculate the amount of theoretical air required for the combustion of 1 kg of acetylene (C_2H_2) to CO_2 and H_2O. **07**

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