Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(OLD) • EXAMINATION – WINTER 2016

Subject Code:141903 **Date:19/11/2016**

Subject Name:Engineering Thermodynamics

Time:02:30 PM to 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.**
4. **Use of steam table is permitted**

Q.1	**(a)**	Define control volume. What is the difference between system and control volume?	**04**
	(b)	Explain thermodynamic equilibrium.	**03**
	(c)	Explain first law of thermodynamics for a closed system undergoing a change of state and derive energy equation $Q = W + \Delta U$	**07**
Q.2	**(a)**	Show that all reversible engines operating between the two constant temperature thermal reservoirs have the same efficiency.	**07**
	(b)	A heat pump is used to heat the house in winter. A house requires 50 kJ/s heat for heating in winter which is delivered by heat pump from outside air. Work required to operate the heat pump is 8 kW. Calculate co-efficient of performance of heat pump and heat extracted from the outside.	**07**
		OR	
	(b)	In case of heating the gas at constant volume, show that the change in entropy is given by $s_2 - s_1 = c_v \log_e \left(\frac{T_2}{T_1}\right)$	**07**
Q.3	**(a)**	Explain the concept of decrease in available energy when heat is transferred through a finite temperature difference with the aid of temperature-entropy diagram.	**07**
	(b)	Expansion of gas takes place in a turbine 8 bar, 550°C to 1 bar, 350°C. The 6 kJ of heat per kg is rejected to the surroundings during process. Surrounding temperature and pressure are 20°C and 0.98 bar respectively. Calculate per kg of gas (i) change of availability (ii) maximum work (iii) irreversibility	**07**
		OR	
Q.3	**(a)**	Explain Joule-Thomson coefficient and the temperature of inversion	**07**
	(b)	Using Clausius–Claperyon's equation, estimate the enthalpy of vaporization at 200°C using the following data. $v_g = 0.1274$ m^3/kg, $v_f = 0.001157$ m^3/kg, $\left(\frac{dp}{dT}\right) = 32$ kPa/K	**07**
Q.4	**(a)**	Explain the effect of following on the efficiency of Rankine cycle. (i) superheating of steam (ii) Turbine inlet steam pressure (iii) condenser pressure	**07**
	(b)	A steam is supplied to steam turbine at pressure 20 bar and degree of superheat to be 137.6°C. The exhaust pressure is 0.08 bar and expansion of steam takes place isentropically. Calculate the thermal efficiency of the cycle.	**07**
		OR	

Q.4 **(a)** Show that the air standard efficiency of Brayton cycle is given by **07**

$$\eta = 1 - \frac{1}{\left(r_p\right)^{\frac{\gamma-1}{\gamma}}}$$

r_p is pressure ratio and γ is ratio of specific heats

(b) The air standard efficiency of an Otto cycle is 60% and γ = 1.5. Calculate the compression ratio of the cycle. **07**

Q.5 **(a)** Define the followings **07**

(i) Dalton's law
(ii) Gibbs-Dalton law
(iii) Amagat's law
(iv) Apparent molecular weight
(v) Gas constant
(vi) Adiabatic mixing of gases
(vii) Avogadro's law

(b) A vessel of 6 m^3 capacity contains two gases A and B in proportion of 45% and 55% respectively at 30°C. If the value of R for the gases is 0.288 kJ/kgK and 0.295 kJ/kgK. If the total weight of the mixture is 2 kg, calculate **07**

(i) The partial pressure
(ii) The total pressure
(iii) The mean value of R for the mixture

OR

Q.5 **(a)** Describe the method of determination of heating value of solid fuel using Bomb calorimeter. **07**

(b) A coal sample gave the following analysis by weight, Carbon 85%, Hydrogen 6%, oxygen 6% and remaining incombustible. Determine the minimum weight of air required per kg of coal for chemically correct composition. **07**

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