Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2142004 **Date:23/11/2016**

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.**

MARKS

Q.1 **Choose the best possible option for the following.** **14**

1 Zeroth law of thermodynamics forms the basis for measurement of the following:

(A) Pressure (B) Temperature

(C) Work (D)Heat

2 Which of the following is not a property of the system?

(A) Temperature (B) Pressure

(C) Entropy (D) Heat

3 For a perfect gas, according to Boyle's law (where p = Absolute pressure, v = Volume, and T = Absolute temperature)

(A) p v = constant, if T is kept constant (B) v/T = constant, if p is kept constant

(C) p/T = constant, if v is kept constant (D) T/p = constant, if v is kept constant

4 Heat and work energy

(A) are energy in transit (B) are inexact differential

(C) are boundary phenomena (D) all of the above

5 Work done during a constant volume process is

(A)Maximum (B) zero

(C) positive (D) none of the above

6 During throttling of an ideal gas

(A) temperature is constant (B) volume does not change

(C) pressure does not change (D) entropy does not change

7 Reversible adiabatic process is also known as

(A) polyrtopic process (B) isochoric process

(C) isentropic process (D) adiabatic process

8 Flow work is encountered in

(A) an open system (B) an open system under steady state only

(C)a closed system (D) none of the above

9 Area under a curve on a temperature entropy curve gives

(A)Work (B) Power

(C) Internal energy (D) Heat

10 Workdone in a free expansion process is
(A) minimum (B) positive
(C) maximum (D) zero

11 Entropy of a system can
(A) never decrease (B) either decrease or increase
(C) always remains constant (D) always increase

12 Work ratio of Rankine cycle as compared to Carnot cycle is
(A) less (B) more
(C) equal (D) cannot be predicted

13 For the same compression ratio
(A)Diesel cycle is less efficient compared to Otto cycle (B) Diesel cycle is more efficient compare to Otto cycle
(C) both, Diesel and Otto cycle are equally efficient (D)None of the above

14 State of steam leaving the condenser in an ideal Rankine cycle is always
(A) saturated liquid (B) sub cooled liquid
(C) wet, having x=0.88 (D) superheated

Q.2 **(a)** Explain what is meant by PMM1. Why is such a device not possible? **03**

(b) Give statement for first law of thermodynamics. Also express the same in mathematical form for a closed system undergoing a: **04**
(i) Process (ii) Cyclic process

(c) The mass rate of flow into a steam turbine is 1.5 kg/s, and the heat transfer from the turbine is 8.5 kW. The following data are known for the steam entering and leaving the turbine. **07**

	Inlet condition	Exit condition
Pressure	2.5MPa	0.1MPa
Temperature	350ºC	
Quality		100%
Velocity	50 m/s	100 m/s
Elevation (z)	6m	3m

Determine the power output of the turbine.

OR

(c) Write general form of first law of thermodynamics applied to system under steady state. Using the same derive specific equation for: **07**
(i) Compressor work (ii) Exit velocity in a nozzle.

Q.3 **(a)** Discuss limitations of first law of thermodynamics. **03**

(b) State and prove Carnot's theorem. **04**

(c) A refrigerator freezes 0.8 kg of liquid water at 0ºC. Power input is 400W and heat is rejected at 24ºC. If the refrigerator has COP that is 30% of the maximum possible, determine the time required to freeze the water. Take enthalpy of freezing for water as 335kJ/kg. **07**

OR

Q.3	**(a)**	Give statements for second law of thermodynamics.	**03**
	(b)	State Clausius inequality. Also explain utility of the same.	**04**
	(c)	Two reversible heat engines A and B are arranged in series. Heat engine A rejects heat which is input to heat engine B. The heat engine A receives 200kJ of heat at 421 ºC from source and heat engine B rejects heat to sink at 4.4 ºC. If work output of engine A is twice that of engine B, find: (i) Intermediate temperature between engine A and B (ii) Efficiency of each heat engine (iii)Heat reject into the sink.	**07**
Q.4	**(a)**	Define heat engine. Also explain the need for a sink in a heat engine.	**03**
	(b)	Derive relation for efficiency of Otto cycle as function of compression ratio.	**04**
	(c)	A 10kg metal piece with constant specific heat of 1.0 kJ/kgK at 200ºC is dropped into an insulated tank containing 100kg water at 20ºC. Determine the final equilibrium temperature and the total entropy change for the process.	**07**

OR

Q.4	**(a)**	Define irreversibility. Differentiate between internal and external irreversibilities**.**	**03**
	(b)	Derive Maxwell's equation starting from the basics.	**04**
	(c)	At the beginning of the compression process of an air-standard Diesel cycle operating with a compression ratio of 18, the temperature is 300 K and the pressure is 0.1 MPa. The cut-off ratio for the cycle is 2. Determine: (i) Temperature and pressure at the end of each process of the cycle. (ii) Thermal efficiency	**07**
Q.5	**(a)**	Draw line diagram for a Rankine cycle. Also represent the same on a T-s and h-s chart.	**03**
	(b)	Derive Vander Waal's equation in reduced form of properties.	**04**
	(c)	Enlist measures to increase efficiency of a Rankine cycle and explain any two of them.	**07**

OR

Q.5	**(a)**	Derive relation for available energy from a finite energy source at temperature T when atmosphere is at temperature T_0.	**03**
	(b)	State and explain Dalton's law of partial pressure and also the Gibb's Dalton law.	**04**
	(c)	Derive the two Tds relations starting from the basics. Also explain the utility of the same.	**07**

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