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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2142004 **Date: 08/06/2017**

Subject Name: Engineering 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.**
4. **Use of steam table is permitted.**

MARKS

Q.1 Short Questions **14**

1 Zeroth law of thermodynamics deals with _____.

(a) Conservation of energy (b) Conservation of mass

(c) Internal energy (d) thermal equilibrium

2 A system is considered to be isolated when there is transfer of _____ across the system boundary.

(a) only mass (b) only heat and work

(c) both mass and energy (d) neither mass nor energy

3 A PMM1 is a device having _____.

(a) maximum efficiency. (b) 100% efficiency.

(c) all reversible processes. (d) capability to destroy energy.

4 Application of second law of thermodynamics to a cyclic process brings out property called _____.

(a) entropy (b) internal energy

(c) heat (d) exergy

5 Throttling of an ideal gas results in _____ remaining constant.

(a) pressure (b) temperature

(c) entropy (d) volume

6 If temperature of sink is decreased, efficiency of Carnot cycle _____.

(a) remains constant. (b) increases.

(c) decreases. (d) increases initially then decreases.

7 Entropy of universe always _____.

(a) increases. (b) decreases.

(c) remains the same. (d) zero.

8 Actual thermal efficiency of Rankine cycle based thermal power plant is in the range of _____.

(a) 62-72% (b) 85-90%

(c) 35-45% (d) 10-15%

9 For a reversible adiabatic process, change in entropy is always _____.

(a) zero (b) positive

(c) negative (d) unity.

10 Difference of maximum reversible work and actual work is called ____.

(a) availability (b) reversibility

(c) irreversibility (d) unavailibility

11 Work ratio of Rankine cycle as compared to Carnot cycle is _____.

(a) lower (b) higher

(c) same (d) same if processes are ideal.

12 Efficiency of Rankine cycle increases with _____.

(a) increase in pressure and temperature (b) decrease in pressure and temperature

(c) increase in pressure but decrease in temperature. (d) decrease in pressure and increase in temperature.

13 Otto cycle is known as _____.

(a) constant volume heat addition cycle. (b) constant pressure heat addition cycle.

(c) constant entropy heat addition cycle. (d) constant temperature heat addition cycle.

14 Entropy change of a system _____.

(a) is always zero (b) is always negative

(c) is always positive (d) can be positive, negative or zero.

Q.2 **(a)** Give statement for first law of thermodynamics and also explain its limitation. **03**

(b) Differentiate between heat and work energy and also explain the sign convection normally adopted related to the same. **04**

(c) Steam enters a converging–diverging nozzle operating at steady state with pressure of 40bar, temperature of 400°C, and velocity of 10 m/s. Steam flows through the nozzle with negligible heat transfer and no significant change in potential energy. At the exit, pressure is 15 bar and the velocity is 665 m/s. The mass flow rate of steam is 2 kg/s. Determine the exit area of the nozzle in m^2. **07**

OR

(c) Derive the steady flow energy equation. Using the same write the equation for: **07**

(i) Work developed by a turbine.

(ii) Exit velocity for an adiabatic nozzle.

Q.3	**(a)**	Write statement of Carnot's theorem and the corollary of Carnot's theorem.	**03**
	(b)	Explain what is meant by PMM1 and PMM2. Also explain why such devices are impossible to make.	**04**
	(c)	Give statements of second law of thermodynamics and also prove their equivalence.	**07**

OR

Q.3	**(a)**	Define a reversible process and enlist the factors that make a process irreversible.	**03**
	(b)	State and prove Clausius inequality.	**04**
	(c)	Steam enters an adiabatic turbine steadily at 3MPa and 400°C and leaves at 50kPa and 100°C. If the power output of the turbine is 2 MW, determine: (i) Isentropic efficiency of the turbine. (ii) Mass flow rate of the steam flowing through the turbine.	**07**
Q.4	**(a)**	Prove that entropy is a point function and hence a property of the system.	**03**
	(b)	Derive relation for efficiency for a Brayton cycle as function of pressure ratio.	**04**
	(c)	One kg of ice at -5°C is exposed to surrounding atmosphere at 20°C, till the ice melts and comes into equilibrium with the atmosphere. Latent heat of fusion for ice is 333.3 kJ/kg. Take specific heat for ice as 2.093 kJ/kg K and that for water as 4.186 kJ/kg K. Determine: (i) Entropy change of the ice mass (ii) Entropy change of the atmosphere. (iii) Entropy change of the universe.	**07**

OR

Q.4	**(a)**	Define available energy and unavailable energy.	**03**
	(b)	Derive the two T- ds equation starting from the basics.	**04**
	(c)	A Carnot heat engine receives heat from a reservoir at 900°C at a rate of 800kJ/min and rejects the waste heat to the ambient air at 27°C. The entire work output of the heat engine is used to drive a refrigerator that removes heat from the refrigerated space at -5°C and transfers it to the same ambient air at 27°C. Determine: (i) Maximum rate of heat removal from the refrigerated space. (ii) The total rate of heat rejection to the ambient air.	**07**
Q.5	**(a)**	Represent Carnot cycle on a T-s and a P-v diagram and derive the expression for thermal efficiency of the same.	**03**
	(b)	Give comparison of Otto cycle and Diesel cycle for: (i) Same compression ratio and heat supplied. (ii) Same maximum pressure and temperature.	**04**
	(c)	Show throttling process on a temperature - pressure chart. Define Joule – Thomson coefficient and show that the value of same is zero for an ideal gas.	**07**

OR

Q.5	**(a)**	State and explain law of corresponding states.	**03**
	(b)	Explain any two methods to improve thermal efficiency of Rankine cycle.	**04**
	(c)	Explain Dalton's law of partial pressure. Also discuss Gibbs Dalton law.	**07**

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