Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019

Subject Code: 2142004 **Date: 14/12/2019**

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.**

			MARKS
Q.1	**(a)**	Define irreversibility. Differentiate between internal and external irreversibility.	**03**
	(b)	What is an air standard cycle?	**04**
	(c)	Write a short note on Vander Waal's equation.	**07**
Q.2	**(a)**	What do you understand by availability of a system?	**03**
	(b)	State the comparisons of Carnot vapour cycle and Rankine cycle.	**04**
	(c)	A Carnot cycle work on steam between the pressure limits of 7 MPa and 7 KPa. Determine the thermal efficiency, turbine work and compression work per kg of steam.	**07**
		OR	
	(c)	Steam enters a nozzle at a pressure of 7 bar and 200^{o} C and leave at a pressure of 2 bar. The initial velocity of steam at the entrance is 50 m/s and exit velocity from nozzle is 750 m/s. The mass flow rate through the nozzle is 1500 kg/h. The heat loss from the nozzle area is the specific volume is 1.25 m^3/kg. Take initial enthalpy 2850 kj/kg. Heat loss from the nozzle is 11705 kj/hr. Determine the final enthalpy and exit area.	**07**
Q.3	**(a)**	Give statement for first law of thermodynamics and also explain its limitation.	**03**
	(b)	Explain any two methods to improve thermal efficiency of Rankine cycle.	**04**
	(c)	A reversible heat engine absorb heat from two thermal reservoirs at constant temperature of 800 K and 550 K, reject heat to a reservoir at 300 K. Calculate the thermal efficiency and heat supplied by each thermal reservoir when the engine produces 80 KW and rejects 55 kj/sec to heat sink.	**07**
		OR	
Q.3	**(a)**	What are the basic components of gas turbine plant?	**03**
	(b)	Enlist the various components used in intercooling and reheating gas cycle based power plant.	**04**
	(c)	A heat engine working on Carnot cycle, absorb q heat from heat source and converts one fourth of heat Q into work. If the temperature of the heat sink is decreased by 100^{o} C, the efficiency becomes doubled. Calculate the temperature of source and sink.	**07**
Q.4	**(a)**	What do you understand by exergy and anergy?	**03**
	(b)	State and prove Carnot's theorem.	**04**
	(c)	In a Rankine cycle, the steam at inlet to the turbine is saturated at a pressure of 34.5 bar and exhaust pressure is 0.25 bar. Determine (1) the turbine work, (2) the pump work, (3) the condenser heat flow, (4) the rankine efficiency, (5) the quality of steam at the end of expansion. Assume flow rate of 9.5 kg/sec.	**07**

OR

Q.4	**(a)**	Explain what is meant by PMM1 and PMM2. Also explain why such devices are impossible to make.	**03**
	(b)	Derive relation for efficiency of Otto cycle as function of compression ratio.	**04**
	(c)	In an engine working on Otto cycle, air has a pressure of 1 bar and temperature 30^{o} C at the entry. Air is compressed with a compression ratio of 6. The heat is added at constant volume until the temperature rise to 1500^{o} C. Determine (1) air standard efficiency (2) pressure and temperature at the end of compression (3) heat supplied (4) mean effective pressure. Take C_v = 0.718 KJ/Kg K. R=0.278 KJ/KgK	**07**
Q.5	**(a)**	State the difference between vapor power cycle and gas power cycle.	**03**
	(b)	State and prove Clausius inequality.	**04**
	(c)	A vessel of volume 0.4 m^3 consist of 0.45 kg of carbon monoxide and 1 kg of air at 15^{o} C. Calculate the partial pressure of each constituents and total pressure in the vessel. The air contains 23.3% oxygen and 76.6% nitrogen by mass. Take the molar mass of carbon monoxide, oxygen and nitrogen as 28, 32 and 28 kg/kg mole, respectively.	**07**

OR

Q.5	**(a)**	State and explain Avogadro's law.	**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)	Derive the two Tds relations starting from the basics. Also explain the utility of the same.	**07**

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