Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2140106 **Date: 13/12/2019**

Subject Name: Basic 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 open system, closed system and isolated system with example.	**03**
	(b)	Explain the concept of thermodynamic equilibrium. State zeroth law of thermodynamics and explain how it leads to the concept of temperature?	**04**
	(c)	Explain the followings 1.Microscopic and macroscopic point of view 2.Control volume and control surface 3.Intensive and extensive properties 4.Continum	**07**
Q.2	**(a)**	Define point function and path function with example.	**03**
	(b)	Prove that work is a path function.	**04**
	(c)	Derive any two T-ds relations and explain their importance in thermodynamics.	**07**
		OR	
	(c)	Derive the expression for efficiency and mean effective pressure for dual cycle.	**07**
Q.3	**(a)**	Define available energy and unavailable energy for a nonflow process.	**03**
	(b)	In a gas turbine unit, the gas flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of the gases at inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively and the velocity of gases at inlet and outlet are 50 m/s and 110 m/s respectively. Calculate: the rate at which the heat is rejected from the turbine and the area of inlet pipe given the specific volume of gases at the inlet is 0.45 m^3/kg	**04**
	(c)	In a Carnot cycle, the steam at inlet to the turbine is saturated at pressure of 30 bar and exhaust pressure is 0.04 bar. Determine: 1) the compressor work, 2) the turbine work, 3) Carnot efficiency, 4) the quality of steam at the end of expansion. Use of steam table is permitted.	**07**
		OR	
Q.3	**(a)**	Derive an expression for pdV work for isothermal process.	**03**
	(b)	Define irreversibility and discuss the causes of same.	**04**
	(c)	Compare the Otto, Diesel and Dual cycle for (1) same compression ratio and heat supplied (2) constant maximum pressure and heat supplied	**07**
Q.4	**(a)**	Define Air standard efficiency, thermal efficiency and work ratio.	**03**
	(b)	Discuss air standard Otto cycle.	**04**
	(c)	Derive general energy equation for steady flow process (SFEE) and simplify it when applied for the nozzle and gas turbine.	**07**

OR

Q.4	**(a)**	Derive the expressions for coefficient of volume expansion and coefficient of isothermal compressibility for a perfect gas.	**03**
	(b)	Prove that, C_p-C_v = R	**04**
	(c)	An engine working on an Otto cycle has a volume of 0.45 m^3, pressure 1 bar and temperature 30°C at the beginning of compression stroke. At the end of compression stroke, the pressure is 11 bar. 210 kJ of heat is added at constant volume. Determine pressure, temperature and volume at salient points in the cycle, % clearance, efficiency, net work per cycle and power developed if Revolution speed is 210 RPM.	**07**
Q.5	**(a)**	State and explain the second law of thermodynamics.	**03**
	(b)	Discuss perpetual motion machine of the second kind.	**04**
	(c)	A Carnot engine operates as refrigerator. Define the COP and derive its expression for refrigerator. If the refrigerator has refrigerating capacity of 100 kJ/s while operating between temperature limits of -20°C and 35°C. determine power input and COP.	**07**

OR

Q.5	**(a)**	State and explain Boyle's law and Charles law.	**03**
	(b)	Prove that all reversible engines working between the two constant temperature reservoirs have the same efficiency.	**04**
	(c)	Explain the effect of following variables on the performance of Rankine cycle with help of p-h and T-s diagram. 1.Effect of increase in boiler pressure 2.Effect of decrease in condenser pressure 3.Effect of superheating the steam	**07**

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