Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2018

Subject Code:2140106 **Date:05/12/2018**

Subject Name:Basic 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	**(a)**	Explain quasi-static process.	**03**
	(b)	Define a thermodynamic system. Differentiate between open system, closed system and an isolated system.	**04**
	(c)	Derive general energy equation for steady flow process (SFEE).	**07**
Q.2	**(a)**	Explain briefly zeroth law of thermodynamics.	**03**
	(b)	State the limitations of first law of thermodynamics.	**04**
	(c)	In an air compressor air flows steadily at the rate of 0.5 kg/s through an air compressor. It enters the compressor at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg and leaves at 5 m/s with a pressure of 7 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 60 kJ/s. Calculate : i. The power required to drive the compressor ; ii. The inlet and output pipe cross-sectional areas.	**07**
		OR	
	(c)	A house requires 2×10^5 kJ/h for heating in winter. Heat pump is used to absorb heat from cold air outside in winter and send heat to the house. Work required to operate the heat pump is 3×10^4 kJ/h. Determine : i. Heat abstracted from outside ii. Co-efficient of performance. iii. If the same device is used in summer for cooling of house then what will be the COP of the heat pump?	**07**
Q.3	**(a)**	Explain the concept of available and unavailable energy. When does the system become dead?	**03**
	(b)	Explain perpetual motion machine of the second kind.	**04**
	(c)	What do you mean by ‘Clausius inequality’?	**07**
		OR	
Q.3	**(a)**	Explain briefly third law of thermodynamics.	**03**
	(b)	Prove that entropy is a property of a system.	**04**
	(c)	State Kelvin-Plant statement of second law of thermodynamics. Prove that violation of Kelvin Plank statement leads to violation of Clausius statement.	**07**
Q.4	**(a)**	Prove that $C_P - C_V = R$	**03**
	(b)	Show that law of adiabatic process is $PV^\gamma = C$.	**04**

(c) 1 kg of air at a pressure of 3 bar and a temperature of 100°C undergoes a reversible polytropic process following the law $PV^{1.2} = C$. If the final pressure is 1.8 bar determine : **07**

i. The final specific volume and temperature;
ii. The work done and the heat transfer

Assume R = 0.287 kJ/kg K and γ = 1.4.

OR

Q.4 **(a)** Show that for isothermal process work done is given by **03**

$$W = p_1 V_1 ln \frac{V_2}{V_1}$$

(b) Explain the processes involved in Dual combustion cycle. Also draw Dual combustion cycle on p – V and T – s diagrams. **04**

(c) Derive the expression for Helmholtz & Gib's function. **07**

Q.5 **(a)** Draw the block diagram of Brayton cycle. Also draw Brayton cycle on p – V and T – s diagrams. **03**

(b) Explain the various operation of a Carnot cycle. Also represent it on a T-s and p-V diagrams. **04**

(c) Derive the expression for air standard efficiency of a Diesel cycle. **07**

OR

Q.5 **(a)** Explain the concept of air-standard efficiency. Also explain the assumptions for analysis of all air standard cycle. **03**

(b) State the methods of increasing the thermal efficiency of a Rankine cycle. **04**

(c) In a steam turbine steam at 20 bar, 360°C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes; find per kg of steam the net work and the cycle efficiency. Take following values: **07**

20 bar (360°C) : h_g = 3159.3 kJ/kg, S_g = 6.9917 kJ/kg-K

0.08 bar :T_S = 41.5 °C, h_f = 173.88 kJ/kg, h_{fg} = 2403.1 kJ/kg
S_f = 0.5926 kJ/kg-K, S_{fg} = 7.6361 kJ/kg-K,
V_f = 0.001008 m^3/kg

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