Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (New) EXAMINATION – WINTER 2018

Subject Code: 2132502 Date: 05/12/2018

Subject Name: Engineering Thermodynamics & Heat transfer

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*	**(a)**	Differentiate between PMM1 and PMM2.	**03**
	(b)	Differentiate between macroscopic approach and microscopic approach.	**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.2	**(a)**	Explain Zeroth Law of Thermodyanmics.	**03**
	(b)	What are different types of Thermodynamic Systems? Explain any two with suitable example.	**04**
	(c)	In a gas turbine unit, the gases flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate : a. The rate at which heat is rejected to the turbine, and b. The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m^3/kg.	**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 : a. Heat abstracted from outside and b. Co-efficient of performance.	**07**
Q.3	**(a)**	Explain the concept of p-v diagram for a pure substance with neat sketch.	**03**
	(b)	Derive SFEE equation of the nozzle with necessary assumptions.	**04**
	(c)	A system at 500 K receives 7200 kJ/min from a source at 1000 K. The temperature of atmosphere is 300 K. Assuming that the temperatures of system and source remain constant during heat transfer find out : a. The entropy produced during heat transfer ; b. The decrease in available energy after heat transfer.	**07**
		OR	
Q.3	**(a)**	What is meant by thermal resistance? Explain the electrical analogy for solving heat problems.	**03**
	(b)	Explain the concept of available and unavailable energy. When does the system become dead?	**04**

(c) A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245 °C. The mass of the liquid present is 10 kg. Find the following : **07**

a. The pressure,
b. The mass,
c. The specific volume,
d. The specific enthalpy,
e. The specific entropy, and
f. The specific internal energy.

Q.4 **(a)** The inner surface of a plane brick wall is at 60 °C and the outer surface is at 35 °C. Calculate the rate of heat transfer per m^2 of surface area of the wall, which is 220 mm thick. The thermal conductivity of the brick is 0.51 W/m °C. **03**

(b) Derive temperature variation profile $\left(\frac{t-t_1}{t_2-t_1} = \frac{x}{L}\right)$ in a plane wall. **04**

(c) Derive general heat conduction equation in cylindrical coordinates. **07**

OR

Q.4 **(a)** Explain the mechanism of convection heat transfer. Also explain natural and forced convection. **03**

(b) State physical significance of Reynolds Number and Prandtl Number. **04**

(c) By dimensional analysis show that for free convection *Nu = f (Gr, Pr)* **07**

Q.5 **(a)** Enumerate the factors on which the rate of emission of radiation by a body depends. **03**

(b) Assuming the sun to be a black body emitting radiation with maximum intensity at λ = 0.49 μm, calculate the following : **04**

a. The surface temperature of the sun, and
b. The heat flux at surface of the sun.

(c) What is boiling? Explain various regimes of boiling. **07**

OR

Q.5 **(a)** State silent features of shape factor. **03**

(b) Derive the expression for LMTD of counter flow heat exchanger, when $\theta_1 = \theta_2 = \theta$. **04**

(c) A chemical having a specific heat of 3.3 kJ/kg K flowing at the rate 20,000 kg/h enters a parallel flow heat exchanger at 120 °C. The flow rate of cooling water is 50,000 kg/h with an inlet temperature of 20 °C. The heat transfer area is 10 m^2 and overall heat transfer coefficient is 1200 W/m^2 °C. Taking specific heat of water as 4.186 kJ/kg K. Find: **07**

a. Effectiveness of the heat exchanger
b. Outlet temperature of water and chemical

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