Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2170102 **Date: 19/11/2018**

Subject Name: Theory of 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.**

			MARKS
Q.1	**(a)**	What is meant by thermal resistance? Explain the electrical analogy for solving heat transfer problems.	**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**
Q.2	**(a)**	Define thermal conductivity. Explain physical significance of thermal conductivity.	**03**
	(b)	Explain the different modes of heat transfer. Describe conduction mode of heat transfer briefly.	**04**
	(c)	A double glazed window is made of 2 glass panes of 6 mm thick each with an air gap of 6 mm between them. Assuming that the air layer is stagnant and only conduction is involved, determine the thermal resistance and overall heat transfer coefficient. The inside is exposed to convection with h = 15 W/m^{2}K and the outside to 9 W/m^{2}K. Compare the values with that of a single glass of 12 mm thickness. The conductivity of the glass = 1.4 W/mK and that for air is 0.025 W/mK.	**07**
		OR	
	(c)	A long rod 12 mm square section made of low carbon steel protrudes into air at 35°C from a furnace wall at 200°C. The convective heat transfer coefficient is estimated at 22 W/m^{2}K. The conductivity of the material is 51.9 W/mK. Determine the location from the wall at which the temperature will be 60°C. Also calculate the temperature at 80 mm from base.	**07**
Q.3	**(a)**	Explain Stefan Boltzmann law.	**03**
	(b)	Explain the criteria of selection of fins.	**04**
	(c)	A thermocouple is formed by soldering end-to-end wires of 0.5 mm dia. The thermal diffusivity of the material is 5.3×10^{-6} m^2/s. The conductivity of the material is 19.1 W/mK. The probe initially at 30°C is placed in a fluid at 600°C to measure the temperature of the fluid. If the convective heat transfer coefficient between the wire and the fluid is 85 W/m^{2}K, determine the time constant for the probe and also the time taken for it to read 598°C.	**07**
		OR	
Q.3	**(a)**	Explain thermal boundary layer.	**03**
	(b)	Some surfaces which do not appear black but have high values of absorptivity – Justify.	**04**
	(c)	Derive an expression for temperature distribution and heat dissipation for in	**07**

a straight fin of rectangular profile for fin insulated at tip.

Q.4 **(a)** Distinguish between mean film and bulk mean temperature. **03**

(b) Enumerate the factors on which the rate of emission of radiation by a body depends. **04**

(c) Derive momentum equation for boundary layer. **07**

OR

Q.4 **(a)** State physical significance of Reynolds Number and Prandtl Number. **03**

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

i. The surface temperature of the sun, and
ii. The heat flux at surface of the sun.

(c) By Buckingham's π theorem method show that for free convection **07**

$$Nu = f\ (Gr, Pr)$$

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**

i. Effectiveness of the heat exchanger
ii. Outlet temperature of water and chemical

OR

Q.5 **(a)** State the limitations of LMTD method in the analysis of heat exchanger. **03**

(b) Write a short note on heat pipe. **04**

(c) Define condensation process. Explain drop wise and film wise condensation **07**

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