Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2153502 **Date: 16/11/2018**

Subject Name: Introduction to 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)**	State and define the law governing conduction.	**03**
	(b)	Explain surface properties of radiation.	**04**
	(c)	Explain critical thickness of insulation. Derive the expression for cylinder and sphere.	**07**
Q.2	**(a)**	Define capacity and economy of evaporator.	**03**
	(b)	Differentiate filmwise and dropwise condensation.	**04**
	(c)	Derive the expression for LMTD in parallel flow heat exchanger.	**07**
		OR	
	(c)	Derive the expression for NTU in parallel flow heat exchanger.	**07**
Q.3	**(a)**	Classify the heat exchangers.	**03**
	(b)	Explain the concept of Black body	**04**
	(c)	Derive an expression for Reynold's analogy.	**07**
		OR	
Q.3	**(a)**	Explain natural convection phenomena.	**03**
	(b)	Give the physical significance of (i)Prandtl number (ii)Reynold's number	**04**
	(c)	A steel ball of 50 mm diameter is cooled by exposing it to an air stream at 320 K. Under these conditions the convective heat transfer coefficient 100 W/ m^2 K. Estimate the time needed to cool the steel ball from 1120 to 520 K. Properties of steel: density = 8000 kg/m^3 and heat capacity = 450 J/kg K. Due to the high thermal conductivity of steel there are no temperature gradients within the ball.	**07**
Q.4	**(a)**	Explain mechanism of conduction in detail.	**03**
	(b)	What are the important dimensionless groups in convection heat transfer? Explain any three with their physical significance.	**04**
	(c)	In a double pipe counter-current heat exchanger, the fluids are as follows. (i) Inlet temperature of hot fluid = 100 ^{0}C. (ii) Outlet temperature of hot fluid = 60 ^{0}C. (iii) Inlet temperature of cold fluid = 40 ^{0}C (iv) Cold fluid outlet temperature = 80 ^{0}C. During operation, due to fouling inside the pipe, the heat transfer rate reduced to half of the original value. Assuming the flow rates and the physical properties of the fluid don't change, Calculate LMTD (in ^{0}C) in the new situation.	**07**
		OR	
Q.4	**(a)**	What is the significance of baffles in heat exchangers?	**03**
	(b)	A small blackbody has a total emissive power of 4 kW/m^2 . Determine its surface temperature.	**04**
	(c)	Using Fourier's law derive an expression for heat transfer by conduction through cylindrical surface.	**07**
Q.5	**(a)**	Discuss in brief about Boiling point elevation.	**03**
	(b)	Discuss briefly about multiple effect evaporation.	**04**

	(c)	An evaporator is operating at atmospheric pressure. It is desired to concentrate the feed from 5% solute to 20% solute at a rate of 5000 kg/h. Dry saturated steam at a pressure corresponding to saturation temperature of 399 K is used. The feed is at 298 K and boiling point rise is of 5 K. Overall heat transfer coefficient is 2350 W/m^{2}K. Calculate economy and heat transfer area for evaporator. Latent heat of condensation of steam at 399 K is 2185 kJ/kg Latent heat of evaporation of water at atmospheric pressure and 373 K is 2257 kJ/kg Specific heat of feed = 4.187 kJ/kg K	**07**

OR

Q.5	**(a)**	An evaporator operating at atmospheric pressure is fed at rate of 10000 kg/h of weak liquor containing 4 % caustic soda. The liquor leaving the evaporator contains 25% caustic soda. Find capacity of evaporator.	**03**
	(b)	Derive Kirchhoff's law for radiation.	**04**
	(c)	Discuss regimes of pool boiling in detail.	**07**

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