Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2140503 **Date: 14/12/2019**

Subject Name: Process 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.**

Q.1	**(a)**	Explain how does thermal conductivity of gases, liquid and solids depend upon temperature?	**03**
	(b)	Derive equation to calculate the rate of heat flow through cylinder.	**04**
	(c)	Derive equation for heat transfer through a composite wall made up of three different materials in close thermal contact with each other, with no heat loss to surrounding when temperatures of hot and cold ends are T_h and T_c.	**07**
Q.2	**(a)**	Define: i) emissivity, ii) black body, iii) grey body.	**03**
	(b)	Discuss the Fourier's law of conduction.	**04**
	(c)	Draw the temperature profiles of cold and hot fluids for true co-current and counter current flow in double pipe heat exchanger, Derive expression relating Rate of heat transfer and Log mean temperature difference.	**07**
		OR	
	(c)	Write a short note on significance of various dimensionless numbers in heat transfer.	**07**
Q.3	**(a)**	Write short note on Natural Convection.	**03**
	(b)	Describe Regimes of Pool Boiling.	**04**
	(c)	Determine the heat transfer coefficient for water flowing in a tube of 16 mm diameter at a velocity of 3 m/s. The temperature of the tube is 297 K and water enters at 353 K and leaves at 309 K. Use (i) Dittus-Boelter equation and (ii) Sieder- Tate equation Properties of water at 331 K, i.e. at the arithmetic mean bulk temperature are ρ= 984.1 kg/m3, Cp= 4187 J/(kg K) , μ = 485 x 10-6 Pa.s, k = 0.657 W/(m K), Viscosity of water at 297 K, μ_w = 920 x 10-6 Pa.s	**07**
		OR	
Q.3	**(a)**	Explain the significance of LMTD correction factor.	**03**
	(b)	Distinguish between filmwise and dropwise condensation.	**04**
	(c)	Derive an equation for Overall heat transfer coefficient in double pipe heat exchanger.	**07**
Q.4	**(a)**	Describe different analogy between heat and mass transfer.	**03**
	(b)	Explain the terms absorptivity, emissivity, transmissivity and reflectivity for heat transfer by radiation.	**04**
	(c)	Write short notes on Vapor recompression in evaporator.	**07**

OR

Q.4	**(a)**	What are the advantages of square pitch arrangement over the triangular pitch in case of heat exchanger tubes?	**03**
	(b)	Define heat transfer coefficient and describe its dependence of various parameters.	**04**
	(c)	With a neat sketch explain the construction and working of a fin tube heat exchangers and its application.	**07**
Q.5	**(a)**	What is the reason for increasing the number of passes in a shell & tube heat exchanger?	**03**
	(b)	Write Dittus-Boeltier equation and Sieder-Tate equation explaining each term and highlight the difference.	**04**
	(c)	Give detailed construction and working of shell and tube heat exchanger with diagram.	**07**

OR

Q.5	**(a)**	Discuss Capacity and Economy of evaporators.	**03**
	(b)	Discuss about feed forward and feed backward arrangement is multiple effect evaporator.	**04**
	(c)	An evaporator is operating at atmospheric pressure. It is desired to concentrate a feed from 5% solute to 20% solute by weight at a rate of 5000 kg/hr. Dry saturated steam at a pressure corresponding to the saturation temperature 399 K is used. The feed is at 298 K and the boiling point rise is 5 K. The overall heat transfer coefficient is 2350 w/m2. K. Calculate the economy of the evaporator and the area of the heat transfer to be provided. Data: Treating solution as a pure water and neglecting the B.P.R, the latent heat of condensation of steam at 399 K is 2185 KJ/kg., Latent heat of vaporization of water at 101.325 KPa and 373 K= 2257 KJ/kg and specific heat of feed is 4.187 KJ/kg. K	**07**

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