Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) EXAMINATION – SUMMER 2016

Subject Code:2140503 **Date:06/06/2016**

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.**

			MARKS
Q.1		**Short Questions**	**14**
	1	Loss of heat from unlagged steam pipe to the ambient air is takes place by which modes of heat transfer	
	2	What is the effect of impurities on thermal conductivity of metal	
	3	What it means 25 percent cut segmental baffles	
	4	In shell and tube heat exchanger tube pitch is defined as	
	5	State which basic law governs radiation mode of heat transfer	
	6	What is physical significance of Reynolds number	
	7	In forced convection, the heat transfer depends on which dimensional numbers	
	8	Nucleate boiling is promoted which surface	
	9	What is the reason behind operating an evaporator in multiple effect	
	10	Which is preferred feeding scheme for evaporation of viscous solution in a multiple effect evaporator	
	11	Why floating tube bundle head arrangement is used in shell and tube heat exchanger	
	12	What is SI unit of fouling factor	
	13	When double pipe heat exchangers are used	
	14	Why baffles are used in heat exchangers	
Q.2	**(a)**	Define thermal conductivity and discuss the effect of temperature on thermal conductivity of gas	**03**
	(b)	Derive equation to calculate the rate of heat flow through cylinder	**04**
	(c)	A furnace wall is made up of 23 cm of fire brick, 7.5 cm of insulating brick and 8.9 cm of red brick. The temperature at the inner surface of wall is 800^0C and that of the outer surface is 60^0C. Average thermal conductivity values of the three types of bricks, i.e. fire brick, insulating brick and red brick are 1.04, 0.104 and 0.744 W/m K respectively. Neglecting resistance of points, calculate the rate of heat flow and temperature at the interfaces between different kinds of bricks.	**07**
		OR	
	(c)	A pipe 6.5 cm outside diameter is lagged with a 5 cm layer of asbestos and 4 cm layer of cork. If the temperature of the outer surface of the pipe is 150 ^{0}C and the temperature of the outer surface of the cork is 35 ^{0}C, thermal conductivity of asbestos is 0.12 W/m^2 k and that of cork is 0.03 W/m^2 k. Calculate the rate of heat loss and temperature at the interface asbestos and cork.	**07**

Q.3	**(a)**	Define heat transfer coefficient and describe its dependence of various parameters	**03**
	(b)	Give the physical significance of (i) Nusselt Number (ii) Prandtl Number	**04**
	(c)	What is importance of LMTD? Derive the equation for parallel flow arrangement	**07**

OR

Q.3	**(a)**	What do you mean by fouling of heat exchangers?	**03**
	(b)	Discuss about concurrent and counter current flow arrangement in heat exchangers	**04**
	(c)	Determine the heat transfer coefficient for water flowing in a tube of 20 mm diameter at a velocity of 2.5 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/m^3, C_p= 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**
Q.4	**(a)**	State and derive Kirchhoff's Law for radiation	**03**
	(b)	A 50 cm I.D iron pipe at 423 K passes through a room in which the surroundings are at temperature of 300 K. If the emissivity of the pipe metal is 0.8, what is the net interchange of radiation energy per meter length of pipe? The outside diameter of the pipe is 60 cm. Take Stefan Boltzman constant =5.67 x 10^{-8} W/m^2.K^4	**04**
	(c)	Explain different regimes of pool boiling of saturated liquid with neat sketch	**07**

OR

Q.4	**(a)**	Define capacity and economy of evaporator	**03**
	(b)	Differential filmwise and dropwise condensation	**04**
	(c)	Define objectives of evaporation and explain construction, working and applications of Calendria type evaporator	**07**
Q.5	**(a)**	Which side of shell and tube heat exchanger will you select to pass corrosive, viscous and high pressure fluid.	**03**
	(b)	Hot oil at a rate of 1.2 kg/s (2083 J/kg.k) flows through a double pipe heat exchanger. It enters at 633 K and leaves at 573 K. Cold fluid enters at 303 K and leaves at 400 K. If the overall heat transfer coefficient is 500 W/m^2 K. Calculate the heat transfer area for (i) parallel flow (ii) counter current flow	**04**
	(c)	Give detailed construction and working of shell and tube heat exchanger with diagram.	**07**

OR

Q.5	**(a)**	Define boiling point rise in the evaporator? How much will be the temperature of solution if the boiling point rise is 5 K and boiling point is 373 K	**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	**07**

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/m^2. 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

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