Reg. No. | | | | | | | | | | | | |

B. E / B. TECH.DEGREE EXAMINATIONS, MAY 2023

Fourth Semester

CH18402 – HEAT TRANSFER

(Chemical Engineering)

(Regulation 2018A)

(Heat and Mass Transfer Data Book is permitted)

TIME:3 HOURS **MAX. MARKS: 100**

CO1 Impart knowledge on the various modes of heat transfer.
CO2 Apply convective heat transfer concept to fluids without phase change.
CO3 Develop the ability to model and analyze heat transfer processes
CO4 Augment the capability to solve heat transfer problems.
CO5 Design and analyze various types of heat exchangers.

PART- A(10x2=20Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	State Fourier's Law of conduction.	**1**	**2**
2.	Define thermal conductivity and write its unit.	**1**	**2**
3.	Establish relationship between Overall heat transfer coefficient and individual heat transfer coefficient.	**2**	**3**
4.	Differentiate natural convection and forced convection with examples.	**2**	**2**
5.	Compare boiling and evaporation.	**3**	**2**
6.	Explain Burnout Phenomenon.	**3**	**2**
7.	Contrast absorptivity and emissivity of a radiating surface.	**4**	**2**
8.	Compare single and multiple effect evaporator.	**4**	**2**
9.	Mention the significance of Logarithmic Mean Temperature Difference.	**5**	**2**
10.	Sketch the flow pattern of a Plate heat exchanger highlighting its compactness.	**5**	**3**

PART- B (5x 14=70Marks)

			Marks	CO	RBT LEVEL
11. (a)	Derive the equation to find out the rate of heat transfer by conduction in a composite wall made of three layers of different materials with one-side is at higher temperature and the other side is at lower temperature.		**(14)**	**1**	**3**
	(OR)				
(b)	Derive the steady state heat conduction equation for a cylinder and discuss the temperature distribution for a composite cylindrical wall.		**(14)**	**1**	**3**

12. (a)	**(i)**	Using Buckingham π theorem, show that the Nu = f (Re, Pr) for forced convection	**(8)**	**2**	**3**
	(ii)	Explain the dimensionless number used in heat transfer and give its significance	**(6)**	**2**	**3**
		(OR)			
(b)	**(i)**	A vertical pipe of 120 mm outer diameter and length 3.2 m is in a room. Where, air is at 298K (25^0C). Calculate the rate of heat loss by free convection per meter length of the pipe, if the pipe surface temperature is 393K (120^0C).	**(8)**	**2**	**3**
	(ii)	A steam pipe 50mm diameter and 3.5m long has been placed horizontally and exposed to still air at 20^0C. If the pipe wall temperature is 295^0C, determine the rate of heat loss. At the mean temperature of 180^0C.	**(6)**	**2**	**3**
13. (a)	**(i)**	Explain with neat sketches, the various flow boiling regimes.	**(8)**	**3**	**3**
	(ii)	Water is to be boiled at atmospheric pressure in a mechanically polished stainless steel pan placed on top of a heating unit. The inner surface of the bottom of the pan is maintained at 110°C. If the diameter of the bottom of the pan is 40 cm, determine (*a*) the rate of heat transfer to the water and (*b*) the rate of evaporation of water.	**(6)**	**3**	**3**
		(OR)			
(b)	**(i)**	Discuss the film condensation and drop wise condensation phenomena highlighting their major differences.	**(8)**	**3**	**3**
	(ii)	Dry steam at 383 K condenses on the outside surface of a horizontal pipe of 25 mm O.D. The pipe surface is maintained at 352 K by circulating water through it. Determine the mean heat transfer coefficient, heat transfer per unit length of pipe and condensate rate per unit length of pipe. The properties of condensate at the film temperature of 350 K are as follows: $\mu = 306 \times 10^{-6}$ Ns/m^2 , k = 0.668 W/(m K), ρ = 974 kg/m^3 , λ = 2225 kJ/kg	**(6)**	**3**	**3**

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14. (a)	Derive the equation for heat transfer between infinitely long grey bodies placed opposite to each other having temperatures T_1 and T_2, with emissivities e_1 and e_2	**(14)**	**4**	**3**
	(OR)			
(b)	Explain any two types of evaporator with a neat sketch and mention its merits. and demerits.	**(14)**	**4**	**3**
15. (a)	Water at the rate of 5 kg/s is heated from 35^0C to 60^0C in a shell and tube heat exchanger. The water is to flow inside tubes of 2 cm diameter with an average velocity of 40 cm/s. hot water available at 95^0C and at the rate of 2.0 kg/s is used as the heating medium on the shell side. If the length of the tubes must not be more than 2 m calculate the number of tube passes, the number of tubes per pass and the length of the tubes for one pass shell, assuming $U_o = 1500$ W/m^{2}K.	**(14)**	**5**	**3**
	(OR)			
(b)	A refrigerator is designed to cool 260kg/h of hot liquid of specific heat 3350J/kg K at 120^0C using a parallel flow arrangement. 1100kg/h of cooling water is available for cooling purposes at a temperature of 10^0C. If the overall heat transfer coefficient is 1160W/m^{2}K and the surface area of the heat exchanger is 0.25m^2, calculate the outlet temperatures of the cooled liquid and water and also the effectiveness of the heat exchanger.	**(14)**	**5**	**3**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	You are provided with a task of designing a heat transfer equipment for a process application Assess the effect of providing different types of fins and insulation.	**(10)**	**3**	**5**

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