Q. Code:172076

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

B.E./ B. TECH.DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

CH22401 – HEAT TRANSFER

(Chemical Engineering)

(Regulation 2022)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Impart knowledge on the various modes of heat transfer and apply conduction heat transfer concept	**3**
CO 2	Apply convective heat transfer concept to fluids without phase change	**3**
CO 3	Develop the ability to analyze heat transfer processes with phase change	**4**
CO 4	Apply the concepts of evaporation to estimate steam economy, capacity of single and multiple effect evaporators	**3**
CO 5	Design thermal analysis of heat exchanger using LMTD and NTU method	**4**

PART- A (20x2=40Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Report the importance of heat transfer in Chemical Engineering with respect to all the modes of heat Transfer.	**1**	**2**
2.	Infer the effect of temperature on thermal conductivity.	**1**	**2**
3.	Give any two example of surface where fins are used for heat transfer.	**1**	**2**
4.	Relate the various methods used to measure the physical property thermal conductivity.	**1**	**3**
5.	Convective heat transfer coefficient strongly depends on what factors?	**2**	**2**
6.	Generalize Newton's law of Cooling statement.	**2**	**2**
7.	Restate the reason for adding fouling factor.	**2**	**2**
8.	Order the three resistance in series for overall resistance to heat flow from a hot fluid to cold fluid.	**2**	**3**
9.	Cite the type of boiling in the presence of bulk fluid flow and in the absence of bulk fluid flow.	**3**	**2**
10.	Differentiate saturated and sub cooled boiling under atmospheric pressure.	**3**	**2**
11.	Condensation will occur when the temperature of vapor is reduced below its _____. Resistance to heat transfer will be in _____ Condensation.	**3**	**2**
12.	Compute the factor which is more likely to remove the stagnant non condensable gases from the vicinity of the surface and thus improve the heat transfer.	**3**	**3**
13.	Infer all other four names used to refer the radiation shape factor.	**4**	**2**

14.	Write the equation used to get heat transfer coefficient for radiation.	**4**	**2**
15.	Predict any two advantage of forced circulation evaporators.	**4**	**2**
16.	Collect any two examples of evaporation.	**4**	**3**
17.	Restate any two heat exchange operation carried out in Chemical Process plants .	**5**	**2**
18.	Draw the temperature profile for both co current and counter current flow.	**5**	**2**
19.	Indicate the purpose of having effectiveness- NTU method of heat exchanger analysis.	**5**	**2**
20.	Mention any two type of heat exchanger used in process industries and cite its field application.	**5**	**3**

PART- B (5x 10=50Marks)

		Marks	CO	RBT LEVEL
21. (a)	A composite furnace wall consists of 250 mm of fire brick, 120 mm of insulating brick and 80 mm of building brick. The individual heat transfer coefficient at the inside and outside of the wall are 80 W/m^2C and 7$W/m^{2\circ}C$ respectively. The temperature of gas within the furnace is 1300°C. The ambient air temperature outside the furnace is 50°C. The maximum temperature of insulating brick should not exceed 1025°C k of firebrick = 1.66 W/m°C k of insulating brick = 0.32 W/m°C k building block = 0.69 W/m°C Calculate: i) The rate of heat transfer per unit area. ii) Interface temperature fire brick and insulating brick.	**(10)**	**1**	**3**
	(OR)			
(b)	Derive the heat flow equation used through a hallow cylinder.	**(10)**	**1**	**3**
22. (a)	Derive the equation for forced convection by using dimensional analysis $N_{NU} = f(N_{Re}, N_{Pr})$	**(10)**	**2**	**3**
	(OR)			
(b)	A steam pipe 20 mm diameter and 1.5 m long has been placed horizontally and exposed to still air at 40^0C. If the pipe wall temperature is 180^0C, determine the rate of heat loss.	**(10)**	**2**	**3**
23. (a)	Describe various pool boiling regimes with a neat sketch	**(10)**	**3**	**3**

(OR)

(b)	Draw temperature and velocity profile for film condensation on a vertical plate.	**(10)**	**3**	**3**
24. (a)	Establish the net energy transferred per unit area per unit time between two grey surfaces with suitable sketches.	**(10)**	**4**	**4**

(OR)

(b)	Illustrate pros and cons of Single effect and multiple effect evaporators. Also compare forward and backward methods of feeding multiple effect evaporators.	**(10)**	**4**	**4**
25. (a)	In a processing plant water is to be cooled from 28℃ to 10℃ by using brine solution entering at an inlet temperature of -2℃and leaving at 4℃. Calculate the area required when using a shell and tube heat exchanger with the water making one shell pass and the brine making two passes. Assume an average overall heat transfer coefficient of 750 $W/m^{2\,K}$ and a design heat load of 8000 W. Use Correction factor F as 0.92	**(10)**	**5**	**4**

(OR)

(b)	Water enters a cross flow heat exchanger (Both Fluids are unmixed) at 10 ℃and flows at the rate of 6200 Kg /h to cool 5500 Kg /hof air that is initially at 60℃. Assume the U value to be 220 W/m^2 K. For an exchanger surface area of $30m^2$. Determine the exit temperature of both air and water. Data: Specific heat of water and air are 4180 J/Kg K and 1010 J/ Kg K respectively Heat Exchanger Effectiveness is 0.95	**(10)**	**5**	**4**

PART- C (1x 10=10Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	An rubber insulating board of thermal conductivity 0.85 W/(m.◦C) is to be used to limit the heat losses to 80 W/m^2 for a temperature difference of 160◦C across the board. Predict the thickness of insulating board.	**(10)**	**5**	**5**

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