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Question Paper Code: 94903

B.E./B.Tech. DEGREE EXAMINATION, MAY 2022

Fourth Semester

Chemical Engineering

19UCH403 – Heat Transfer

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. The amount of heat required to raise the temperature of a substance by 1°C is called as CO1- R

   (a) Work capacity (b) Sensible heat (c) Load capacity (d) Latent heat

2. Metals are good conductors of heat because CO1- R

   (a) their atoms colloid frequently (b) their atoms are relatively far apart

   (c) their atoms does not include frequently (d) None of above

3. Forced convection in liquid bath takes place by CO1- R

   (a) Intense stirring by an external agency (b) Molecular energy interactions

   (c) Intense stirring by an internal agency (d) Molecular energy non interactions

4. Air at 20 degree Celsius flows over a flat surface maintained at 80 degree Celsius. Estimate the value of local heat transfer coefficient if the local heat flow at a point was measured as 1250 W/m^2. Take thermal conductivity of air as 0.028 W/m K CO1- R

   (a) 23.83 $W/m^2 K$ (b) 22.83 $W/m^2 K$ (c) 23.83 $W/m^2 K$ (d) 22.83 $W/m^2 K$

5. Thermal radiation takes place from a body by electromagnetic waves as a result of CO3- U

   (a) the weight of the body (b) the magnetic power of the body

   (c) the temperature of the body (d) none of the above

6. Which one is a perfect black body among the following? CO3- U

   (a) Stars (b) Wood (c) Aluminum (d) A piece of paper

7. The energy transfer between the hot fluid and cold fluids is brought about by their complete physical mixing in CO5- U

(a) Direct contact heat exchanger (b) Regenerators (c) Recuperators (d) Boilers

8. What is the unit of Heat transfer coefficient? CO5- R

(a) $W/(m^2.K)$ (b) W/(m.K) (c) kJ/(kg.K) (d) (m.K)/W

9. In forced convection boiling process, a liquid flows through a tube with CO4- R

(a) superheated or unsaturated boiling (b) subcooled or saturated boiling

(c) subcooled to superheated boiling (d) vapour in boiling

10. Evaporation takes place at CO4- R

(a) freezing point (b) boiling point

(c) in between freezing point and boiling point (d) at all temperatures

PART – B (5x 2= 10 Marks)

11. State Fourier's law of heat conduction. CO1- R

12. State Newton's Law of cooling. CO1- R

13. Define Radiation Shape factor. CO1- R

14. What is the purpose of chiller in heat exchangers? CO1- R

15. Mention the difference between film wise and drop wise condensation. CO1- R

PART C - (5 x 16 = 80 Marks)

16. (a) Derive the equation for heat transfer by conduction through a hollow cylinder and draw the temperature profile CO1 -U (16)

Or

(b) A 50mm diameter pipe of circular cross-section and with walls 3mm thick is covered with two concentric layers of lagging, the inner layer having a thickness of 25mm and thermal conducing of 0.08W/(m. K), and the outer layer having thickness of 40mm and a thermal conductivity of 0.04W/(m. K). Estimate the rate of heat loss per metre length of pipe. If the temperature inside the pipe is 550K (277^0C) and the outside surface temperature is 330K (57^0C) K for pipe is 45 W/ (m. K). CO3 -Ana (16)

17.	(a)	Calculate the heat transfer coefficient for a fluid flowing through a tube having inside diameter 40mm at a rate of 5500kg/h. Assume that the fluid is being heated. Data: Properties of the fluid at the mean bulk temperature are: Viscosity of flowing fluid=0.004(N.s) /m^2 Density of flowing fluid=1.07 g/cm^3 Specific heat of flowing fluid=2.72 kj/ (kg.k) Thermal conductivity of flowing fluid= 0.256 W/ (m.k) Make use of the Dittus-Boelter equation.	CO2 -App	(16)
		Or		
	(b)	Determine the heat transfer coefficient for water flowing in a tube of 16mm diameter at a velocity of 3m/s. The temperature of the tube is 297k (24°c) and water enters at 353k (80°c) and leaves at 309k (36°c). Use 1) the Dittus-Boelter equation and 2) sieder-tata equation. Data: Properties of water at 331k (58°c), i.e., at the arithmetic mean-bulk temperature are: P=984.1 kg/m^3, c_p=4187 J/(kg.K), μ=485*10^-6pa.s, k=0.657 W/(m.K) Viscosity of water at 297K (24˚c), μ_w=920*10^-6 pa.s	CO3 -Ana	(16)
18.	(a)	Calculate the loss of heat by radiation from a steel tube of diameter 70mm and 3m long at a temperature of 500K(227˚C), if the tube is located in a square brick conduit 0.3m side at 300K(27˚C). Assume 'e' for steel as 0.79 and for brick conduit as 0.93.	CO2-App	(16)
		Or		
	(b)	Calculate the net radiant heat exchange per square meter for very large planes at temperature of 703K(430˚C) and 513K(260˚C) respectively. Assume that the emissivity of hot and cold planes are 0.85 and 0.75 respectively.	CO2-App	(16)
19.	(a)	Discuss briefly about shell and tube heat exchangers and its arrangement with a neat sketch.	CO1 -U	(16)
		Or		
	(b)	Hot oil at a rate of 1.2 kg/s (Cp=2083J/kg. K) flows through the double pipe heat exchanger. It enters at 633K and leaves at 573K cold fluid enters at 303K and leaves at 400K. If the overall heat transfer coefficient is 500W/m^2K. Calculate the heat transfer area for i)parallel flow	CO2 -App	(16)

20.	(a)	Discuss briefly about the feed arrangement in multiple effect evaporator with suitable diagram.	CO1- U	(16)
		Or		
	(b)	An evaporator operating at atmospheric pressure is fed at the rate of 10000kg/hr of the weak liquor containing 4% caustic soda. Thick liquor leaving the evaporator contains 25% caustic soda. Find the capacity of evaporator.	CO2- App	(16)