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

Question Paper Code: 94903

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

Fourth Semester

Chemical Engineering

19UCH403 – Heat Transfer

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. Thermal conductivity of solid metals with rise in temperature normally CO1- U

   (a) increases (b) decreases (c) cannot determine (d) None of above

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

   (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- U

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

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

4. The buoyancy forces which give rise to the natural convection are called as CO1- U

   (a) convection forces (b) fluid forces (c) body forces (d) none of the above

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- U

(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- U

(a) superheated or unsaturated boiling (b) sub cooled or saturated boiling

(c) sub cooled to superheated boiling (d) vapour in boiling

10. The thermal resistance for heat transfer is low in CO4- U

(a) drop-wise condensation (b) film condensation

(c) both drop-wise and film condensation (d) unpredictable

PART – B (5x 2= 10 Marks)

11. Define specific Heat capacity. CO1- U

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

13. Define Radiation Shape factor. CO1- U

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

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

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) Derive the expression for overall heat transfer coefficient and explain the relationship between individual and overall heat transfer coefficient CO1 -U (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. CO2 -App (16)

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.

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. CO3 -Ana (16)

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

18. (a) Find the heat transfer rate per unit area due to radiation between two infinitely long parallel planes. The first plane has an emissivity of 0.4 and is maintained at 473K(200˚C). The emissivity of the second plate is 0.2 and is maintained at 300K(30˚C). If a radiation shield having e=0.5 is interposed between the given planes, find the percentage reduction in heat transfer rate and the steady-state temperature attained by the shield. 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) In an oil cooler, 60g/s of hot oil enters a thin metal pipe of diameter 25mm. An equal mass of cooling water flows through annular space between the pipe and the large concentric pipe, the oil and water flows in opposite direction. Oil enters at 420K and cooled to 320K. If water enters at 290K, Find the length of the pipe required. The heat transfer coefficient of 1.6KW/m^2K on the oil side and 3.6KW/m^2K for waterside. Cp of oil=2KJ/Kg K. CO1 -App (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)	Briefly explain in detail about the construction and working principle of forced circulation with horizontal external heating element evaporators with a neat sketch	CO1- U	(16)
		Or		
	(b)	Briefly explain in detail about the construction and working principle of forced circulation evaporators with a neat sketch	CO2- U	(16)