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

Question Paper Code:55903

B.E./B.Tech. DEGREE EXAMINATION, NOV 2019

Fifth Semester

Chemical Engineering

15UCH503-HEAT TRANSFER

(Use of HMT data book is permitted)

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Thermal conductivity is maximum for which substance ? CO1- R

(a) Silver (b)Ice (c) Aluminum (d) Diamond

2. Heat transfer takes place according to _______ law of thermodynamics CO1- R

(a) First (b) Second (c) Third (d)Zeroth

3. The ratio of energy transferred by convection to that by conduction is called CO2- R

(a) Stanton number (b) Nusselt number (c)Biot number (d) Reynolds number

4. In forced convection, Nusselt number is function of__________ CO2- R

(a) Grashoff number and Peclet number (b) Reynolds number and Prandtl number

(c) Grashoff number and Prandtl number (d) Reynolds number and Grashoff number

5. The body which absorbs all radiations incident upon it is called as _____ CO3- R

(a) Black body (b) White body (c) Opaque body (d) Transparent body

6. The Stefan Boltzman law states that ____________ CO3- R

(a) $E \alpha T$ (b) $E \alpha T^2$ (c) $E \alpha T^3$ (d) $E \alpha T^4$

7. In a shell and tube heat exchanger, baffles are provided on the shell side to CO4- U

(a) Improve heat transfer (b) Provide support for tubes

(c) Prevent stagnation of shell side fluid (d) All of the above

8. The convective coefficients for condensation usually lie in the range of CO4- R

(a) 30-300 W/m2 K (b) 60-3000 W/m2 K (c) 300-10000 W/m2 K (d) 2500-10000 W/m2 K

9. In heat exchangers, the value of logarithmic mean temperature difference should be CO5- R

(a) Maximum possible (b) Minimum possible (c) Zero (d) Constant

10. Heat is transferred from an insulated pipe to the surrounding still air mainly by____ CO5- R

(a) Conduction (b) Free convection (c) Forced convection (d) Radiation

PART – B (5 x 2= 10Marks)

11. Define thermal conductivity. CO1- R

12. State Buckingham's π theorem. CO2- R

13. List the applications of radiation shield. CO3- R

14. Differentiate between film condensation and dropwise condensation. CO4- R

15. Define effectiveness of a heat exchanger. CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) A furnace wall consists of three layers. The inner layer of 10 cm thickness is made of firebrick *(k* =1.04 W/mK). The intermediate layer of 25 cm thickness is made of masonry brick (k = 0.69 W/mK) followed by a 5 cm thick concrete wall (k = 1.37 W/mK). When the furnace is in continuous operation the inner surface of the furnace is at 800°C while the outer concrete surface is at 50°C. Calculate the rate of heat loss per unit area of the wall, the temperature at the interface of the firebrick and masonry brick and the temperature at the interface of the masonry brick and concrete. CO1- App (16)

Or

(b) A steel rod (K = 32 W/mC), 12 mm in diameter and 60 mm long, with an insulated end, is to be used as a spine. It is exposed to surroundings with a temperature of 60˚C and a heat transfer coefficient of 55 $W/m^{2\circ}C$. The temperature at the base of fin is 95˚C. CO1- App (16)

Determine

(a) The fin efficiency

(b) The temperature at the edge of the spine

(c) The heat dissipation.

17. (a) Air at 20^oC and pressure of 1 bar flowing over a flat plate at a velocity of 3 m/s. If the plate 280 mm wide and at 60^oC.Calculate the following quantities at x = 280 mm CO2- App (16)

(i) Boundary layer thickness

(ii) Local friction coefficient

(iii) Average friction coefficient

(iv) Thickness of thermal boundary layer

(v) Local convective heat transfer coefficient

(vi) Average convective heat transfer coefficient

(vii) Rate of heat transfer by convection.

Or

(b) Derive by dimension analysis, Nu=ϕ(Gr,Pr) for free convection. CO2- App (16)

18.	(a)	(i) The sun emits maximum radiation at $\lambda = 0.52\ \mu$. Assuming the sun to be a black body, calculate the surface temperature of the sun. Also calculate the monochromatic emissive power of the sun's surface.	CO3 App	(8)
		(ii) A furnace wall emits radiation at 2000 K. Treating it as black body radiation, calculate (1) Monochromatic radiant flux density at 1 μm wave length. (2) Wave length at which emission is maximum and the corresponding emissive power. (3) Total emissive power.	CO3 App	(8)
		Or		
	(b)	A thin aluminum sheet with an emissivity of 0.1 on both sides is placed between two very large parallel plates that are maintained at uniform temperatures T_1=800 K and T_2=500 K and have emissivities ε_1= 0.2 and ε_2 =0.7 respectively. Determine the net rate of radiation heat transfer between the two plates per unit surface area of the plates and compare the result to without the shield.	CO3- App	(16)
19.	(a)	Classify the types of condensers and explain the working of any two type of condenser.	CO4- U	(16)
		Or		
	(b)	Explain with neat sketch about pool boiling curve for water.	CO4- U	(16)
20.	(a)	Explain the working of Shell and tube heat exchanger with neat diagram.	CO5- U	(16)
		Or		
	(b)	Hot oil with a capacity rate of 2500 W/K flows through a double pipe heat exchanger. It enters at 360 °C and leaves at 300 °C. Cold fluid enters at 30 °C and leaves at 200 °C. If the overall heat transfer coefficient is 800 W/m^2K, determine the heat exchanger area required for (1) Parallel flow (2) Counter flow	CO5- U	(16)