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

Question Paper Code: 95701

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

Fifth Semester

Mechanical Engineering

19UME501 – HEAT AND MASS TRANSFER

(Regulation 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The unit for heat transfer is CO2- R

   (a) W/m^2K (b) W (c) W/mK (d) W/m

2. The critical thickness of insulation for a sphere is CO1- R

   (a) k/h (b) 2k/h (c) h/k (d) h/2k

3. Reynolds number is the ratio of CO2- R

   (a) Energy transferred by convection to that by conduction (b)None of the above

   (c) Inertia force to viscous force (d) Kinematic viscosity to thermal diffusivity

4. The condition for Laminar Flow for Flow over Flat Plate in Forced Convection, if the Reynolds Number is CO2- R

   (a) < 2300 (b)$<5 \times 10^5$ (c) >2300 (d) $<10^7$

5. When absorptivity (α) = 1, reflectivity (ρ) = 0 and transmissivity (τ) = 0, then the body is said to be a CO3- R

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

6. The value of the wavelength for maximum emissive power is given by CO3- R

   (a) Wien's law (b) Planck's law (c) Stefan's law (d) Fourier's law

7. The concept of overall coefficient of heat transfer is used in heat transfer problems of CO4- R

(a) Conduction (b) Convection

(c) Radiation (d) Conduction and convection

8. Why are multi-pass heat exchangers used CO4- R

(a) To obtain high heat transfer coefficient (b) to reduce pressure drop

(c) to get a compact unit (d) all of the above

9. _____Number can be used for convective mass transfer CO5- R

(a) Mach (b) Sherwood (c)Nusselt (d) None of the above

10. Universal gas constant value is CO5- R

(a) 8.314 J/kg K (b) 8314 J/kg K (c) 8314 KJ/kg K (d) All of these

PART – B (5 x 2= 10Marks)

11. A hollow cylinder 7cm inner radius and 12cm outer radius has inner surface temperature of 250^0C and outer surface temperature of 110^0C. If the thermal conductivity is 70 W/m K find heat transfer per unit length. CO2- App

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

13. State Planck's distribution law. CO2- R

14. What is meant by Filmwise Condensation? CO5- R

15. Give the examples of mass transfer. CO1- R

PART – C (5 x 16= 80 Marks)

16. (a) A Stainless Steel cylindrical rod fin of 10 mm diameter & 50mm height with thermal conductivity of 30W/mK is exposed to surrounding with a temperature of 65°C. The heat transfer co-efficient is 50W/m^2K and the temperature at the base of the fin is 98°C. Find i) Fin efficiency ii) Temperature at the edge of the rod iii) Heat dissipation iv) Fin effectiveness. CO2-App (16)

Or

(b) A furnace wall made of 3 layer of thickness 250mm,100mm,150mm with thermal conductivity 1.65,k,9.2 w/m^{o}c respectively. The inside is exposed to gases at 1250^{o}c with convection coefficient of 25 w/m^{o}c and inside surface is at 1100^{o}c, the outer surface is exposed to air at 25^{o}c with convection coefficient of 12 w/m^{o}c. determine
1) unknown thermal conductivity.
2) overall heat transfer coeffient.3) all surface temperature. CO2-App (16)

17. (a) Air at 40^{0}C flows over a plate of 0.8m long at a velocity of 50msec. The plate surface is maintained at 300^{0}C. determine heat transfer from the entire plate length to air taking into consideration both laminar and turbulent portion of boundary layer also calculate the percentage error if the boundary layer is assumed to be turbulent nature from the very leading edge of plate. CO2-App (16)

Or

(b) Water at 30^{0}Cflows through a straight tube 20m/s, tube of 60mm diameter. The tube surface is maintained at 70^{0}C and outlet temperature of water is 50^{0}C. find the heat transfer coefficient from tube surface to the water , heat transfer and tube length. CO2-App (16)

18. (a) Two large parallel plates with emissivity 0.5 each are maintained at different temperatures and are exchanging heat only by radiation. Two equally large radiation shields with surface emissivity 0.05 are introduced in parallel to the plates. Find the percentage of reduction in net radiative heat transfer. CO2- App (16)

Or

(b) Two black square plates of size 2 by 2m are placed parallel to each other at a distance of 0.5m. one plate is maintained at a temperature of 1000^{0}C and the other at 500^{0}C.find the heat exchange between plates. CO3- App (16)

19.	(a)	In a counter flow double pipe heat exchanger, water is heated from 25^0C to 65^0C by an oil with a specific heat of 1.45 KJ/Kg and mass flow rate is 0.9 Kg/s. The oil is cooled from 230^0C to 160^0C. If the overall heat transfer coefficient is 420 W/m^{20}C, Calculate the following (i) the rate of heat transfer (ii) the mass flow rate of water (iii) the surface area of the heat exchanger.	CO5- App	(16)
		Or		
	(b)	Water enters a cross flow heat exchanger (both fluid unmixed)at 5°C and flows at the rate of 4600kg/hr to cool 4000kg/hr of air that is initially at 40°C. assume the U value to be 150w/m^2k for an exchanger surface area of 25m^2. Calculate the exit temperature of air and water.	CO5- App	(16)
20.	(a)	Air at 200C(D=4.166*10-5 m2/sec) flows over a tray length =320mm and width =420mm full of water with a velocity of 2.8m/sec. the total pressure of moving air is 1 atm pressure and partial pressure of water present in the air is 0.0068 bar. If the temperature on the water surface is 150C. calculate the evaporation rate of water.	CO2- App	(16)
		Or		
	(b)	Dry air at 27^0C and 1 atm pressure flows over a wet plate of 50cm at 50m/sec. calculate the mass transfer coefficient of water vapour in air at end of plate	CO2- App	(16)