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

Question Paper Code: U5701S

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Fifth Semester

Mechanical Engineering

21UME501- HEAT AND MASS TRANSFER

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

1. The rate of heat transfer is said to be constant if temperature CO1-U

   (a) decreases (b) increases (c) become zero (d) none of the above

2. The critical radius (r) of insulation for cylinder is equal to CO1-U
   (Where h = convective heat transfer coefficient and k = thermal conductivity)
   (a) h/k (b) $(k/h)^{1/2}$ (c) 2h/k (d) $(2k/h)^{1/2}$

3. The product of Reynolds number and Prandtl number is known as CO1-U

   (a) Stanton number (b) Biot number

   (c) Peclet number (d) Grashoff number

4. The ratio of kinematic viscosity to thermal diffusivity is known as..... CO1-U

   (a) Nusslet number (b) Prandtlnumber

   (c) Coefficients of heat transfer (d) Poission ratio

5. The radiation emitted by a black body is known as CO1-U

   (a) Black radiation (b) Full radiation

   (c) Total radiation (d) All of these

6. The relation between reflectivity (ρ), absorptivity (α) and transmissivity (τ) is CO1-U

   (a) $\rho - \alpha + \tau = 1$ (b) $\rho + \alpha - \tau = 1$ (c) $\rho + \alpha + \tau = 1$ (d) $\rho - \alpha - \tau = 1$

7. Log mean temperature difference in case of counter flow compared to parallel flow will be CO1-U

(a) Same (b) More

(c) less (d) depends on other factors

8. Hot oil is cooled from 80^0C to 50^0C.in an oil cooler which uses air as the coolant. The air temperature rises from 30^0C. To 400c. The designer uses a LMTD value of 26^0C The type of heat exchanger is CO1-U

(a) Parallel flow (b) Double pipe (c) Counter flow (d) Cross flow

9. ……. Number can be used for convective mass transfer CO1-U

(a) Mach (b) Sherwood

(c) Nusselt (d) None of the above

10. In case of unsaturated air CO1-U

a) Dew point < wet bulb temperature b) Wet bulb temperature < dry bulb temperature

c) Both (a) and (b) d) Neither (a) not (b)

PART – B (5 x 2= 10Marks)

11. What are the modes of heat transfer? CO1-U

12. What is meant by Newtonian and non- Newtonian fluids? CO1-U

13. State wien's displacement law. CO1-U

14. What is meant by LMT? CO4-App

15. Define Schmidt number. CO1-U

PART – C (5 x 16= 80Marks)

16. (a) A surface wall is made up of 3 layers one of fine brick, one of insulating brick and one of red brick. The inner and outer surface temperatures are 900°C and 30°C respectively. The respective co-efficient of thermal conductivity of the layers are 1.2, 0.14, and 0.9W/mK and the thickness of 20cm, 8 cm and 11 cm. Assuming close bonding of the layers at the interfaces. Find the heat loss per square meter and interface temperatures. CO2-App (16)

Or

	(b)	A steel pipe of 120mm ID & 140mm OD with thermal conductivity of 55W/mK. It is covered with two layers insulated each having a thickness of 55 mm. The thermal Conduction of the first insulated material is 0.11 W/mK & That of second is 0.11 W/mK. The temperature of the inside tube surface is 240°C & that of outside surface of the insulation is 60°C. Calculate the loss of heat per Meter length of pipe and the interface temperature between the two layers of Insulation.	CO2-App	(16)
17.	(a)	Air at 20^0 C at atmospheric pressure flows over a flat plate a velocity of 3 m/s.If the plate is 1 m wide and 80^0 C, Calculate the following at x =300mm.Hydrodynamic boundary layer thickness, Thermal boundary layer thickness, Local friction coefficient, Average friction coefficient, Heat transfer	CO2-App	(16)
		Or		
	(b)	In a straight tube of 50 mm diameter, water is flowing at 15 m/s. The tube surface temperature is maintained at 60°C and the flowing water is heated from the inlet temperature 15°C an outlet temperature of 45°C. Calculate the heat transfer coefficient from the tube surface to the water and length of the tube	CO2-App	(16)
18.	(a)	A Black body at 3000 k emits radiation. Calculate the following 1. monochromatic emissive power at 1 μm wave length 2.wave length at which emission is maximum 3.maximum emissive power 4. total emissive power	CO2-App	(16)
		Or		
	(b)	Two large parallel plates with E = 0.5 each, are maintained at different temperature 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)

19. (a) A vertical plate 0.4m height and 0.3 m wide, at 40^{o}C , is exposed to saturated stream at atmospheric pressure. Find the following
    1. film thichness at the bottom of the plate
    2. maximum velocity at the bottom of the plate
    3. total heat flux to the plate

    CO3-App (16)

Or

(b) Water is to be boiled at atmospheric pressure in a polished copper pan by means of an electric heater. The diameter of the pan is 0.38 m and is kept at 115 ^{o}C. calculate the following
    1. Power required to boil the water
    2. Rate of evaporation
    3. Critical heat flux

    CO3-App (16)

20. (a) A mixture of O_2 and N_2 with their partial pressures in the ratio 0.21 to 0.79 is in a container at 25 ^{o}C . Calculate the molar concentration the mass density, and the mass fraction of each species for a total pressure of 1 bar. What would be the average molecular weight of the mixture?

    CO3-App (16)

Or

(b) Air at 1 atm and 25^{o}C containing small quantities of iodine flow with a velocity of 6.2 m/s inside a 35 mm diameter tube. Calculate mass transfer co-efficient for iodine. The thermo physical properties of air are v=15.5 x 10^{-6} m^2/s, d =0.82x$10^{-5}$$m^2$/s

CO3-App (16)