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

Question Paper Code: 95701

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

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 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. Planck's law is applicable to CO1- U

   (a) Radiation from black body (b) Monochromatic radiation

   (c) Radiation of any length (d) All of the above

3. Reynolds number is the ratio of CO1- U

   (a) Energy transferred by convection to that by conduction

   (b) Inertia force to viscous force

   (c) Kinematic viscosity to thermal diffusivity

   (d)None of the above

4. The condition for Laminar Flow for Flow over Flat Plate in Forced Convection, if the Reynolds Number is CO1- U

   (a) < 2300 (b)<5 X 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 CO1- U

   (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 CO1- U

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

7 The correction of LMTD is necessary in case of .... Flow heat exchanger. CO1- U

(a) Cross flow (b) Parallel flow (c) Counter flow (d) All of these

8 Drop wise condensation occurs on a.....surface CO1- U

(a) oily (b) smooth (c) glazed (d) coated

9 Diffusion coefficient unit is CO1- U

(a) m (b) m/s (c) s (d) m^2/s

10 Molecular weight of N_2 is CO1- U

(a) 28 (b) 32 (c) 40 (d) 77

PART – B (5 x 2= 10Marks)

11 Explain the term thermal conductivity CO1- U

12 Describe Newton's law of cooling. CO1- U

13 Differentiate Opaque body & perfectly transparent surface. CO1- U

14 Explain the assumptions made in Nusselt theory of condensation CO1- U

15 Show the anology of Heat transfer. CO1- U

PART – C (5 x 16= 80 Marks)

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 850°C and 65°C respectively. The respective co-efficient of thermal conductivity of the layers are 1.05, 0.15, and 0.85W/mK and the thickness of 250mm, 120 mm and 200 mm. 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 heating unit made in the form of a cylinder is 6mm diameter & 1.2m long. It is provided with 20 longitudinal fins 3mm thick which protrude 50mm from the surface of the cylinder. The temperature at the base of the fin is 800 C. The ambient temperature is 250 C. The film heat transfer co-efficient from the cylinder and fins to the surrounding air is 10 W/m2k. Calculate the rate of heat transfer from the finned wall to the surrounding. Take k= 90W/mk. CO2- App (16)

17 (a) Air at 25°C flows over 1 m x 3 m (3 m long) horizontal plate maintained at 200°C at 10 m/s. Calculate the average heat transfer coefficients for both laminar and turbulent regions. Take Re (critical) = $3.5x10^5$.insulation. CO2- App (16)

Or

(b) A steam pipe 10 cm outside diameter runs horizontally in a room at 23°C. Take the outside surface temperature of pipe as 165°C. Determine the heat loss per unit length of the pipe. CO2- App (16)

18 (a) Calculate the following for an industrial furnace in the form of blackbody and emitting radiation at 2500°C CO2- App (16)

(i) Monochromatic emissive power at 1.2 μm length

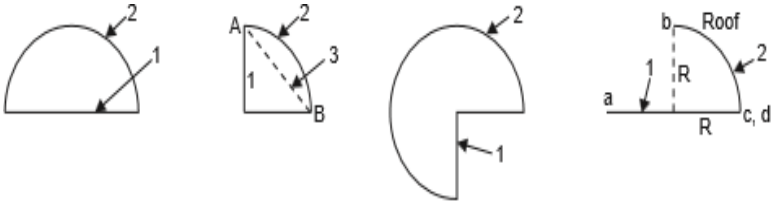
(ii) Wave length at which the emission is maximum

Maximum emissive power Total emissive power, and total emissive power of the furnace if it is assumed as a real surface with emissivity equal to 0.9.

Or

(b) Determine the shape factor F_{1-2} and F_{2-1} for the following cases shown in Fig CO2- App (16)

Also find F_{2-2}.



(a) Hemisphere (b) Long duct (c) Long duct (d) Long roof

19 (a) Water is boiled at atmospheric pressure by horizontal polished copper heating element of diameter D=5mm and emissivity 0.05 immersed in water. If the surface temperature of the heating element is 350°C. Determine the rate of heat transfer from the wire to the water per unit length of the wire CO3- App (16)

Or

(b) Hot oil with a capacity rate of 2500 W/K flows through the 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^2 K. Determine the heat exchanger area required for (1) parallel flow and (2) counter flow. CO3- App (16)

20	(a)	A square plate of side 1 m has one of its sides coated with naphthalene and stands vertically in still air at 53°C. Determine diffusion rate. M = 128, D = 6.11 × 10–6 m2/s, kinematic viscosity = 18.8 × 10–6, Sc = 3.077. The vapor pressure at 53°C is 1.333×10–3bar. Rv=8315/128=64.91 J/kgK, T=53+273 = 326 K.	CO3- App	(16)
		Or		
	(b)	A spherical tank of 0.18 m radius made of fused silica has a wall thickness of 2.5 mm. It is originally filled with helium at 6 bar gauge and 0°C. Determine the rate of pressure drop with time at this condition due to gas diffusion. D = 0.04 × 10–12 m2/s, the density of gas at the solid surface is given by 18 × 10–9 kg/m3 Pa. (also termed solubility).	CO3- App	(16)