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

Question Paper Code: U5701

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

2. The Nusselt number is a function of CO1- U

   (a) Prandtl Number (b) Grashoff's Number

   (c) Prandtl Number And Grashoff's Number (d) Mach Number

3. ……. Number can be used for convective heat transfer CO1- U

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

4. Weather is a example of..... CO1- U

   (a) Conduction current (b) Convection current

   (c) Radiation current (d) None of these

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 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. Drop wise condensation occurs on asurface CO1- U

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

8. The multi-pass heat exchangers used for CO1- U

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

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

9. Diffusion coefficient unit is CO1- U

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

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

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

PART – B (5 x 2= 10Marks)

11. Summarize fin efficiency and fin effectiveness CO1- U

12. Discuss heat transfer coefficient for natural convection is much lesser Than that for forced convection? CO1- U

13. List out any two shape factor algebra. CO1- U

14. Show the heat flux curve for various regions of flow boiling. CO1- U

15. Show the anology of Heat transfer. CO1- U

PART – C (5 x 16= 80Marks)

16. (a) A iron plate (k = 60 W/m C, c =0.46 kJ/Kg. K, ρ = 7850 kg/m3 and $\alpha = 1.6 \times 10^{-5} m^2/s$) of 50 mm thickness is initially at 225^0 C. Suddenly, both surfaces are exposed to an ambient temperature of 25^O C with a heat transfer coefficient of 500 W/ m2 K. Calculate (a) the centre temperature at 2 min after the start of cooling (b) the temperature at a depth 1 cm from the surface at 2 min after the start of cooling and (c) the energy removed from the plate per sq.m during this time. 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^O C. The ambient temperature is 250^OC. The film heat transfer co-efficient from the cylinder and fins to the surrounding air is 10 W/m^2k. 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) = 3.5x105.insulation.	CO2- App	(16)
		Or		
	(b)	Examine the heat transfer from a 60 W incandescent bulb at 115°C to ambient air at 25°C. Assume the bulb as a sphere of 50mm diameter. Also find the % of power lost by free convection.	CO2- App	(16)
18.	(a)	A pipe carrying steam having an outside diameter of 20cm runs in a large room, and is exposed to air at a temperature of 30^{o}C. The pipe surface temperature is 200^{o}C. Find the heat loss per meter length of the pipe by convection and radiation taking the emissivity of the pipe surface as 0.8.	CO2 -App	(16)
		Or		
	(b)	Emissivity of two large parallel plates maintained at 800 °C and 300°C are 0.3 and 0.5 respectively. Find net radiation net radiant heat exchange per square meter for these plates. Find the percentage reduction in heat transfer when a polished aluminium radiation shield of emissivity 0.06 is placed between them. Also find temperature of the shield	CO2 -App	(16)
19.	(a)	The outer surface of the vertical tube, which is 1 m long and has an outer diameter of 80 mm, is exposed to saturated steam at atmospheric pressure and is maintained at 50°C by the flow of cool water through the tube. What is the rate of heat transfer to coolant and what is the rate at which the steam is condensed at the surface.	CO3 -App	(16)
		Or		
	(b)	Hot exhaust gases which enter the cross flow heat exchanger at 300°C and leaves at 100°C are used to heat water at a flow rate of 1 kg/s from 35°C to 125°C. The specific heat of the gas is 1000 J/ kg K. And the overall heat transfer coefficient based on the gas side surface is 100 W/m^2K. Find the required gas side surface area using the NTU method and LMTD method	CO3 -App	(16)

20. (a) Air at 1 atm and 25^{o} C containing small quantities of iodine, flows with a velocity of 6.2 m/s inside a 35 mm diameter tube. Calculate the mass transfer coefficient for iodine. The thermo physical properties of air are: V=15.5 x 10-6 m^{2} /s ; D=0.82 x 10-5 m^{2} /s. CO3- App (16)

Or

(b) Air at 20^{0}C(D=4.166*10-5 m^{2}/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 15^{0}C. Calculate the evaporation rate of water. CO3- App (16)