Reg. No.												

Question Paper Code	12215

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2023

Sixth Semester

Mechanical Engineering

ME8693 - HEAT AND MASS TRANSFER

(Use of Standard HMT data book is permitted)

(Regulations 2017)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	Write down the three dimensional heat conduction equation in Cartesian coordinate system.	*2,K2,CO1*
2.	Define thermal diffusivity.	*2,K1,CO1*
3.	What is meant by convective heat transfer?	*2,K2,CO2*
4.	Write Dittus-Boelter equation.	*2,K2,CO2*
5.	What is burnout point? Why is it called so?	*2,K2,CO3*
6.	Define LMTD of a heat exchanger.	*2,K1,CO4*
7.	State wien's displacement law.	*2,K1,CO5*
8.	Define emissive power.	*2,K1,CO5*
9.	State Fick's law of diffusion and give its expression.	*2,K1,CO6*
10.	What is Sherwood number?	*2,K1,CO6*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	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.	*13,K3,CO1*
		OR	
	b)	Derive general heat conduction equation for a rectangular slab.	*13,K2,CO1*
12.	a)	(i) Define Reynold's, Nusselt and Prandtl numbers.	*6,K2,CO2*
		(ii) Differentiate between Natural & Forced convection.	*7,K2,CO2*

OR

b) Water flows at 50°C through a 50 mm diameter tube, 4 m long at a velocity of 0.8 m/s. The tube wall is maintained at a constant temperature of 90°C. Determine the heat transfer coefficient and the amount of heat transferred if the exit water temperature is 70°C. *13,K3,CO2*

13. a) An aluminium pan 15cm diameter is used to boil water and the water depth at the time of boiling is 2.5cm. The pan is placed on an electric stove and the heating element raises the temperature of the pan to 110°C. Calculate the power input for boiling and the rate of evaporation. Take C_{sf}=0.0132. *13,K2,CO3*

OR

b) Discuss the various regimes of pool boiling heat transfer. *13,K2,CO3*

14. a) Two large parallel plates of 1m x 1m spaced 0.5 m apart in a very large room whose walls are at 27°C. The plates are at 900°C and 400°C with emissivities 0.2 and 0.5 respectively. Estimate the net heat transfer to each plate and to the room. *13,K3,CO5*

OR

b) Define the following *13,K2,CO5*
(i) Black body (ii) Grey body (iii) Opaque body (iv) White body (v) Specular reflection (vi) Diffuse reflection.

15. a) A vessel contains a binary mixture of O_2 and N_2 with partial pressures in the ratio of 0.21and 0.79 at 15°C. The total pressure of the mixture is 1.1 bar. Estimate the following: *13,K2,CO6*
1. Molar concentrations.
2. Mass densities.
3. Mass fractions.
4. Molar fractions of each spice.

OR

b) (i) Explain Fick's law of diffusion. *6,K2,CO6*
(ii) Write a short-notes on evaporation process in the atmosphere. *7,K2,CO6*

PART - C (1 × 15 = 15 Marks)

16. a) Discuss the general arrangement of parallel flow, counter flow and cross flow heat exchanger. *15,K2,CO4*

OR

b) In a double pipe counter flow heat exchanger 10,000 kg/hr of an oil having a specific heat of 2095 J/kg-K is cooled from 80° C to 50° C by 8000 kg/hr of water entering at 25° C. Determine the heat exchanger area for an overall heat transfer co-efficient of 300 W /m^2 K. Take Cp for water as 4180 J/kg.K. *15,K3,CO4*