Reg. No.												

Question Paper Code	11841

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023

Sixth Semester

Mechanical Engineering

ME8693 - HEAT AND MASS TRANSFER

(Regulations 2017)

(Use of HMT data book is permitted)

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 equations in Cartesian coordinate system.	2,K1,CO1
2.	Define critical thickness of insulation with its significance.	2,K1,CO1
3.	State Newton's law of cooling.	2,K1,CO2
4.	Define the velocity and thermal boundary layers.	2,K1,CO2
5.	State the difference between filmwise and dropwise condensation.	2,K1,CO3
6.	What is compact heat exchanger?	2,K1,CO4
7.	Define emissivity, absorptivity and reflectivity.	2,K1,CO5
8.	Distinguish between Opaque body and white body.	2,K2,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)	Derive general heat conduction equation for plane wall.	13,K2,CO1
		OR	
	b)	The temperatures on the two surfaces of a 25 mm thick steel plate, (k = 48 W/m°C) having a uniform volumetric heat generation of 30 x 10^6 W/m^3, are 180°C and 120°C. Neglecting the end effects, determine the following: (i) The temperature distribution across the plate, (ii) The value and position of the maximum temperature, and (iii) The flow of heat from each surface of the plate.	13,K3,CO1
12.	a)	(i) Define Reynold's, Nusselt and Prandtl numbers. (ii) Differentiate between Natural & Forced convection.	6,K2,CO2 7,K2,CO2

OR

b) A 10 cm spherical steel ball at 260°C is immersed in air at 90°C. Estimate the rate of convective heat loss. *13,K3,CO2*

13. a) An aluminum 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) Explain the various stages of boiling and describe it with neat sketch. *13,K2,CO3*

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

OR

b) Two large parallel plates of 1.5 m x 1.5 m spaced 0.55 m apart in a very large room whose walls are at 30°C. The plates are at 950°C and 450°C with emissivities 0.25 and 0.45 respectively. Estimate the net heat transfer to each plate and to the room. *13,K3,CO5*

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

OR

b) An open pan 20 cm diameter and 8 cm deep contains water at 25°C and is exposed to dry atmospheric air. Estimate the diffusion coefficient of water in air, if the rate of diffusion of water is 8.54×10^{-4} kg/ hr. *13,K2,CO6*

PART - C (1 × 15 = 15 Marks)

16. a) 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*

OR

b) Derive the LMTD for a counter flow heat exchanger stating the assumptions. *15,K2,CO4*