Reg. No.													

Question Paper Code	11884

14 JUN 2023

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

Sixth Semester

Mechanical Engineering

20MEPC602 – HEAT TRANSFER

(Regulations 2020)

(Use of standard Heat and Mass Transfer 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 the three dimensional heat transfer Poisson's and Laplace equations in Cartesian co-ordinates.	*2,K1,CO1*
2.	What is the purpose of attaching fins to a surface? What are the different types of fin profiles?	*2,K2,CO1*
3.	Give Example where shape factor of a surface with another surface will be (a) 0, (b) 1	*2,K1,CO2*
4.	Determine the maximum value of $E_{b\lambda}$ at a temperature of 1400 K.	*2,K2,CO2*
5.	State the characteristic of a boundary layer.	*2,K2,CO3*
6.	Define Grashof number (Gr).	*2,K1,CO3*
7.	Distinguish between Film wise condensation and drop wise condensation.	*2,K2,CO4*
8.	Define burnout point in boiling heat transfer. Why is it called so?	*2,K2,CO4*
9.	Summarize the limitations of LMTD method.	*2,K1 CO5*
10.	Discuss about the fouling factor in heat exchanger.	*2,K1,CO5*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	A furnace wall is made up of three-layer thickness 25cm, 10cm, and 15cm with thermal conductivities of 1.65W/m-K and 9.2 W/m-K respectively. The inside is exposed to the gasses at 1250°C with is convection coefficient of 25 w/m^2°C and inside surface of 1100°C, the outside surface is exposed to the air at 25°C with convection coefficient of 12 w/m^2 K. Determine	
		(i) the unknown thermal conductivity	*4,K3,CO1*
		(ii) the overall heat transfer coefficient	*4,K3,CO1*
		(iii) all surface temperature.	*5,K3,CO1*

OR

b) A copper plate 2 mm thick is heated up to 400°C and quenched into water at 30°C. Find the time required for the plate to reach the temperature of 50°C. Heat transfer co-efficient is 100 W/m^2 K. Density of copper is 8800 kg/m^3. Specific heat of copper = 0.36 kJ/kgK. Plate dimensions = 30 X 30cm. *13,K3,CO1*

12. a) Two circular discs of diameter 20 cm each are placed 2 m apart. Calculate the radiant heat exchange for these discs if they are maintained at 800°C and 300°C respectively, and the corresponding emissivities are 0.3 and 0.5. *13,K3,CO2*

OR

b) Two parallel plates of size 1 m x 1 m are spaced 0.5 m apart located in a very large room, the walls of which are maintained at a temperature of 27° C. One plate is maintained at 900°C and the other plate is maintained at 400°C. Their emissivities are 0.2 and 0.5 respectively. If the plates exchange heat between themselves and surroundings, find the net heat transfer to each plate and to the room. Consider only the plate surfaces facing each other. *13,K3,CO2*

13. a) Castor oil at 30°C flows over a flat plate at a velocity of 1.5 m/s. The length of the plate is 4 m. The plate is heated uniformly and maintained at 90°C. Calculate the following. Hydrodynamic boundary layer thicknesses, Thermal boundary layer thickness, Total drag force per unit width on one side of the plate, Heat transfer rate. *13,K4,CO3*

OR

b) A horizontal pipe of 6 m length and 8 cm diameter passes through a large room in which the air and walls are at 18°C. The pipe outer surface is at 70°C. Find the rate of heat losses from the pipe by natural convection? *13,K4,CO3*

14. a) An aluminum pan of 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, Critical flux and the rate of evaporation. Take C_{sf} =0.0132. *13,K4,CO4*

OR

b) A steam condenser consisting of a square array of 900 horizontal tubes each 6mm in diameter. The tubes are exposed to saturated steam at a pressure of 0.1bar and the tube surface temperature is maintained at 23 °C. Calculate,
(i) Heat transfer co efficient(h) *06,K4,CO4*
(ii) Steam condensation rate (m′) *07,K4,CO4*

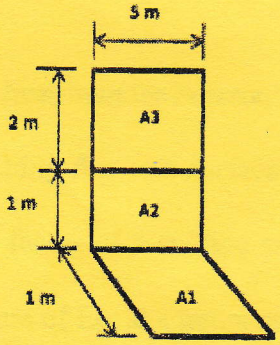
15. a) A coil of single tubing is provided in a reaction vessel whose contents are at a uniform temperature of 85°C. The inlet and outlet temperatures of cooling water flowing through the tube are 5°C and 45°C respectively. If the tube length is increased three times the original, what would be the outlet temperature of the water. Assume the overall heat-transfer coefficient and the water flow rate to remain constant. *13,K3,CO5*

OR

b) Derive an expression for Logarithmic mean temperature difference (LMTD) for Parallel flow heat exchanger. *13,K3,CO5*

PART - C (1 × 15 = 15 Marks)

16. a) Determine the view factor F_{1-2} and F_{2-1} for the below figure. *15,K4,CO6*



OR

b) In an oil cooler for a lubrication system, oil is cooled from 70° C to 40°C by using a cooling water flow at 25 °C. the mass flow rate of oil is 900kg/hr and mass flow rate of water is 700 kg/hr. Comment your selection for a parallel flow or counter flow heat exchanger and justify the reasons. If the overall heat transfer co efficient is 20W/m^2 K, find the area of the heat exchanger. Take specific heat of oil is 2 kJ/kg °C. *15,K4,CO6*