Course Code: 1960325 Roll No: **MLRS-R19**

MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
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III B.Tech II Sem Supply End Examination, January 2023

Heat Transfer

(Mechanical Engineering)

Time: 3 Hours. **Max. Marks: 70**

Note: 1. Question paper consists: Part-A and Part-B.
2. In Part – A, answer all questions which carries 20 marks.
3. In Part – B, answer any one question from each unit.
Each question carries 10 marks and may have a, b as sub questions.

PART- A

(10*2 Marks = 20 Marks)

1.	a)	Compare steady, unsteady, and periodic heat transfer	2M	CO1	BL2
	b)	What are the modes of heat transfer? Explain mechanism in each briefly.	2M	CO1	BL2
	c)	Define Biot number and write it's the significance.	2M	CO2	BL1
	d)	Define fins (or) Extended surfaces.	2M	CO2	BL1
	e)	What is dimensional analysis?	2M	CO3	BL1
	f)	Define Reynolds number (Re), Prandtl number (Pr), Nusselt number (Nu).	2M	CO3	BL1
	g)	List out the assumptions made during derivation of expression for LMTD.	2M	CO4	BL1
	h)	Define hydrodynamic and thermal Entry Lengths.	2M	CO4	BL1
	i)	What do you mean by radiation shields?	2M	CO5	BL1
	j)	State Wien's displacement law and Planck's distribution law.	2M	CO5	BL1

PART- B

(10*5 Marks = 50 Marks)

2	a)	Derive general heat conduction equation in Cartesian coordinates.	5M	CO1	BL6
	b)	Discuss some applications of heat transfer.	5M	CO1	BL2
		OR			
3	a)	Derive an equation for temperature distribution in a hollow sphere.	5M	CO1	BL6
	b)	Hot gas at a constant temperature of 400°C is contained in a spherical shell (2000 mm 1D, 50mm thick) made of steel. Mineral wool insulation (k=0.06 W/m-K) of thickness 100mm is wrapped all around it. Calculate the steady rate at which heat will flow out if the outside air is at a temperature of 30°C. HTC on the inner surface of the steel shell and on the outer surface of the insulation is 15 W/m²K.	5M	CO1	BL3
4		A tube 2 cm. O.D maintained at uniform temperature of T_i is covered with insulation (k=0.20 W/m K) to reduce heat loss to the ambient air T_α with ha=15W/m²K. Find i) the critical thickness r_c of insulation (ii) the ratio of heat loss from the tube with insulation to that without insulation, if the thickness of insulation is equal to r_c.	10M	CO2	BL3
		OR			

5		A stainless steel fin (k=20W/m K) having a diameter of 20 mm and a length of 0.1 m is attached to a wall at 300°C. The ambient temperature is 50°C and the heat transfer coefficient is 10 W/m K. The fin tip is insulated. Determine (a) the rate of heat dissipation from the fin, (b) the temperature at the fin tip, (c) the rate of heat transfer from the wall area covered by the fin was not used and (d) the heat transfer rate from the same fin geometry if the stainless steel fin is replaced by a fictitious fin with infinite thermal conductivity.	10M	CO2	BL3
6		Air at 27°C and 1 atm flows over a flat plate at a speed of 2 m/s. Calculate the boundary layer thickness at a distance of 20 and 40 cm from the leading edge of the plate. Calculate the mass flow which enters the boundary layer between x= 20 cms and x = 40 cms. The viscosity of the air is at 27°C is 1.85×10^{-5} kg/m s. Assume the unit depth in the z- direction.	10M	CO3	BL3
		OR			
7		Liquid bismuth flows at a rate of 4.5 kg/s through a 5 cm diameter stainless steel tube. The bismuth enters at 4150 C and is heated to 4400C as it passes through the tube. If a constant heat flux is maintained at along the tube and the tune wall is at a temperature 200C higher than bismuth bulb temperature, calculate the length of the tube required to affect the heat transfer.	10M	CO3	BL3
8	a)	Air at 20 °C and 1 atmosphere flows over a flat plate at 35 m/s. The plate is 75 cm long and is maintained at 60°C. Calculate the heat transfer from the plate per unit width of the plate. Also calculate the turbulent boundary layer thickness at the end of the plate assuming it to develop from the leading edge of the plate.	5M	CO4	BL3
	b)	Distinguish between bulk mean temperature and film temperature.	5M	CO4	BL2
		OR			
9	a)	Derive an expression for effectiveness of a parallel flow heat exchanger using NTU method.	5M	CO4	BL6
	b)	A hot gas at the rate of 16.2 Kg/Sec at 648°C (Cp = 3.52 kJ/Kg-K) is used to heat 20.2 kg /sec of the incoming fluid at 100°C (Cp = 4.2 kJ/Kg K) in a heat exchanger. If the overall heat transfer Coefficient is 0.92 kW/m²-K for an effective area of 43.8 m², find the fluid outlet temperatures for counter flow sand parallel flow arrangements.	5M	CO4	BL6
10		(i) Define irradiation and radiosity. (ii) What does radiation shape factor mean?	10M	CO5	BL1
		OR			
11		A Counter flow heat exchanger consisting of two concentric flow passages is used for heating 1200 kg/hr of oil (specific heat=2.1kJ/kgK) from an initial temperature of 27 °C. The oil is flowing through the inner pipe and the convective heat transfer coefficient on the oil side is 750 W/m2K. The inner and outer radii of the inner pipe are 12 mm and 15 mm and the thermal conductivity of the pipe materials is 350 W/mK. The oil is heated by hot water supplied at the rate of 400 kg/hr at the inlet temperature of 92 °C. The water side heat transfer coefficient is 1470 W/m²K. The length of the heat exchanger is 9 m. What are the terminal temperatures of the two fluids?	10M	CO5	BL3

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