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SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)

M.Tech. I Year II Semester Regular & Supplementary Examinations July-2025

ADVANCED HEAT TRANSFER
(Thermal Engineering)

Time: 3 Hours **Max. Marks: 60**

(Answer all Five Units **5 x 12 = 60** Marks)

UNIT-I

1	a	Explain the different modes of heat transfer with appropriate expressions.	CO1	L2	6M
	b	What are Biot and Fourier numbers? Explain their physical significance.	CO1	L1	6M

OR

2		Two walls, 1m apart are connected by a metal rod of 2.5cm in diameter (k= 25W/m K). The temperature of one wall is 1000°C and that of the other wall is 500°C. A fluid of 300°C is flowing through the space between the walls. The heat transfer coefficient of the fluid is 25 W/m^2 K. Find i) Find the heat transferred from the surface of the rod and ii) The position and value of minimum temperature in the rod	CO1	L1	12M

UNIT-II

3	a	What is convective heat transfer? Distinguish between free and forced convection.	CO2	L6	6M
	b	Derive the expression for Reynolds number and how flows are determined by Reynolds number.	CO2	L6	6M

OR

4		A 350 mm long glass plate is hung vertically in the air at 24°C while its temperature is maintained at 80°C. Calculate the boundary layer thickness at the trailing edge of the plate. If a similar plate is placed in a wind tunnel and air is blown over it at a velocity of 6m/s. Find the boundary layer thickness at its trailing edge, Also determine the average heat transfer coefficient for natural and forced convection for the above mentioned data.	CO2	L1	12M

UNIT-III

5	a	What are the factors affecting Nucleate boiling?	CO3	L1	6M
	b	Water at atmospheric pressure is to be boiled in polished copper pan. The diameter of the pan is 350 mm and is kept at 115°C. Calculate the following i) Power of burner ii) Rate of evaporation in kg/h iii) Critical Heat flux	CO3	L5	6M

OR

6		Derive the Nusselt theory of laminar flow film condensation on a vertical plate.	CO3	L6	12M

UNIT-IV

7	a	What do you mean by fouling in heat exchangers? What are the different types of fouling processes?	CO4	L1	6M
	b	What are the parameters affecting fouling? How to prevent fouling in heat exchangers?	CO4	L1	6M
		OR			
8		16.5 kg/s of the product at 650°C (Cp = 3.55 kJ/kg°C) in a chemical plant are to be used to heat 20.5 kg/s of the incoming fluid from 100°C (Cp = 4.2 kJ/kg°C). If the overall heat transfer coefficient is 0.95 kW/m^2 °C and the installed heat transfer surface is 44m^2, calculate the fluid outlet temperatures for the counter flow and parallel flow arrangements.	CO4	L5	12M

UNIT-V

9		A thin aluminum sheet with an emissivity of 0.1 on both sides is placed between two very large parallel plates that are maintained at uniform temperatures Tl = 800 K and T2 = 500 K and have emissivity 0.2 and 0.7 respectively. Determine the net rate of radiation heat transfer between the two plates per unit surface area of the plates and compare the result to that without shield.	CO5	L5	12M
		OR			
10		Determine the number of shields required to keep the temperature of the outside surface of a hollow brick lining of a furnace at 100°C when the temperature inside surface of the lining is 500°C. Take the emissivity of brick lining as well as for shield as 0.87. Heat transfer to the surroundings from the outer surface takes place by radiation and convection. The heat transfer coefficient for natural convection is given by ha = 1.44(Δt)$^{0.33}$ W/m^2 °C, ta(air temperature) =25° C. Neglect the heat transfer by conduction and convection between the brick lining.	CO5	L5	12M

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