Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025

Fourth Semester

Chemical Engineering

CH3491 – Heat Transfer

(Approved Heat and Mass Transfer Data Book is Permitted)

Regulations - 2021

Duration : 3 Hrs *Maximum: 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	State the Fourier's law of heat conduction.	L1	1	2
2.	Define fin effectiveness.	L1	1	2
3.	Differentiate between natural and forced convection.	L2	2	2
4.	Recall the term Nusselt number.	L1	2	2
5.	Classify the different types of heat exchangers.	L1	3	2
6.	What do you mean by NTU.	L1	3	2
7.	Compare film wise and drop wise condensation.	L2	4	2
8.	What is meant by nucleate boiling?	L1	4	2
9.	State the Stefan-Boltzman law.	L1	5	2
10.	What do you understand by Intensity of radiation?	L1	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	A steel tube having k =46W/m°C has an inside diameter of 3.0 cm and a tube wall thickness of 2 mm. A fluid flows on the inside of the tube producing a convection coefficient of 1500W/m²°C on the inside surface, while a second fluid flows across the outside of the tube producing a convection coefficient of 197 W/m²°C on the outside tube surface. The inside fluid temperature is 223°C while the outside fluid temperature is 57°C. Find the heat lost by the tube per meter of length.	L3	1	16
		Or			
	b	A circumferential fin of rectangular profile is installed on a 10-cm-diameter tube maintained at 120°C. The fin has a length of 15 cm and thickness of 2 mm. The fin is exposed to a convection environment at 23°C with h = 60 W/m²°C and the fin conductivity is 120 W/m°C. Calculate the heat lost by the fin expressed in watts.	L3	1	16
12.	a	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 distances of 20 cm and 40 cm from the leading edge of the plate. Examine the mass flow that enters the boundary layer between x=20 cm and x=40 cm. The viscosity of air at 27°C is 1.85×10^{-5} kg/ms. Assume unit depth in the z direction.	L3	2	16
		Or			

	b	In a plant location near a furnace, a net radiant energy flux of 800 W/m^2 is incident on a vertical metal surface 3.5 m high and 2 m wide. The metal is insulated on the back side and painted black so that all the incoming radiation is lost by free convection to the surrounding air at 30°C. What average temperature will be attained by the plate?	L3	2	16
13.	a	A counterflow double-pipe heat exchanger is to be used to heat 0.7 kg/s of water from 35°C to 90°C with an oil flow of 0.95 kg/s. The oil has a specific heat of 2.1 kJ/kg°C and enters the heat exchanger at a temperature of 175°C. The overall heat-transfer coefficient is 425 W/m^2°C. Calculate the area of the heat exchanger and the effectiveness.	L3	3	16
		Or			
	b	Hot exhaust gases are used in a finned-tube cross-flow heat exchanger to heat 2.5 kg/s of water from 35 to 85°C. The gases [c_p =1.09 kJ/kg°C] enter at 200°C and leave at 93°C. The overall heat-transfer coefficient is 180W/m^2°C. Calculate the area of the heat exchanger using (a) the LMTD approach and (b) the effectiveness- NTU method.	L3	3	16
14.	a	Water at 5 atm flows inside a tube of 1-in [2.54-cm] diameter under local boiling conditions where the tube wall temperature is 10°C above the saturation temperature. Estimate the heat transfer in a 1 m length of tube.	L3	4	16
		Or			
	b	Copper electric heating rods 2.5 cm in diameter are used to produce steam at 34kPa gauge pressure in a nucleate-pool-boiling arrangement where ΔT_x =4°C. Estimate the length of rod necessary to produce 908 kg/h of saturated vapor steam.	L3	4	16
15.	a	An aluminum cube, 5 cm on a side, is heated to a uniform temperature of 500 K and then suddenly allowed to cool in surrounding air at 1 atm and 300 K. The effective radiation temperature of the surroundings is also 300 K. How long will it take the cube to cool to a temperature of 50°C if the surface is coated with a flat black paint?	L3	5	16
		Or			
	b	Identify the need of multiple effect evaporator and explain its operation with the help of a neat sketch.	L3	5	16