Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

Fourth Semester

Chemical Engineering

CH3491 – Heat Transfer

Steam Table, Heat Transfer Data book Can be 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 Fourier's Law of conduction.	RE	1	2
2.	Define the term Heat Flux.	RE	1	2
3.	Distinguish between free and forced convection.	RE	2	2
4.	Define Nusselt number (Nu).	RE	2	2
5.	What is meant by fouling factor?	RE	3	2
6.	Define overall heat transfer co-efficient.	RE	3	2
7.	Give the merits of drop wise condensation?	RE	4	2
8.	What is nucleate boiling and pool boiling?	RE	4	2
9.	What is Stefan - Boltzmann's law of thermal radiation?	RE	5	2
10.	What is Duhring's rule?	RE	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

Q. No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	Derive the expression for heat flux for flow of one-dimensional heat transfer through a composite wall made of three different materials.	AN	1	13
		Or			
	b	Derive the expression for heat transfer and temperature distribution of a long fin.	AN	1	13
12.	a	Discuss the transfer of momentum and heat in the Reynolds's analogy.	AP	2	13
		Or			
	b	Air at 300 K (27°C) and 101.325 kPa flows over a flat plate at a viscosity of 2 m/s. Calculate the boundary layer thickness at a distance of 20 cm and 40 cm from the leading edge of the plate. Also calculate the mass flow of air that enters the boundary layer between x = 20 cm and c = 40 cm.	AP	2	13

13.	a	Write a brief note on classification and design of heat exchangers.	UN	3	13
		Or			
	b	Write a note on (i) LMTD, (ii) Effectiveness, (iii) Heat transfer rate and (iv) Overall heat transfer coefficient.	UN	3	13
14.	a	Compare boiling with nucleate and film boiling.	AN	4	13
		Or			
	b	100 tubes of 12.5 mm outside diameter are arranged horizontally in a square array and are exposed to dry saturated steam at 101.325 kPa (1 atm abs.). Estimate the mass rate of steam condensation per unit length of tubes if the tube wall temperature is 371 K (98°C). The properties of the condensate at the film temperature of 372 K (99°C) are: ρ = 960 kg/m^3, k = 0.68 W/(m K) and μ = 282 x 10^{-6} kg/(m.s), λ = 2256.9 kJ/kg.	AN	4	13
15.	a	An aqueous solution at 15.5◦C, and containing 4% solids, is concentrated to 20% solids. A single effect evaporator with a heat transfer surface area of 37.2 m^2 and an overall heat transfer coefficient of 2000 W m^{-2} K^{-1} is to be used. The calandria contains dry saturated steam at a pressure of 200 kPa and the evaporator operates under a vacuum of 81.3 kPa. If the boiling point rise is 5 K, calculate the evaporator capacity.	AP	5	13
		Or			
	b	Assuming sun to be black body emitting radiation at 6000 K at a mean distance of 12×10^{10} m from the earth. The diameter of the sun is 1.5×10^9 m and that of the earth is 13.2×10^6 m. Calculate the following. i. Total energy emitted by the sun. ii. The emission received per m^2 just outside the earth's atmosphere. iii. The total energy received by the earth if no radiation is blocked by the earth's atmosphere. iv. The energy received by a 2 × 2 m solar collector whose normal is inclined at 45° to the sun. The energy loss through the atmosphere is 50% and the diffuse radiation is 20% of direct radiation.	AP	5	13

*PART – C (Marks 1*15 = 15)*

Q. No		*Questions*	*BLT*	*CO*	*Marks*
16.	a	An exterior wall of a house may be approximated by a 0.1016 m layer of common brick (thermal conductivity = 0.7 W/m.°C) followed by a 0.0381 m layer of gypsum plaster (thermal conductivity = 0.48 W/m.°C). Evaluate the thickness of loosely packed rock-wool insulation (thermal conductivity = 0.065 W/m.°C) should be added to reduce the heat loss (or gain) through the wall by 80 percent?	EV	1	15
		Or			

b	Steam at 0.080 bar is arranged to condense over a 50 cm square vertical plate. The surface temperature is maintained at 20°C. Evaluate the following: i. Film thickness at a distance of 25 cm from the top of the plate. ii. Local heat transfer coefficient at a distance of 25 cm from the top of the plate. iii. Average heat transfer coefficient. iv. Total heat transfer v. Total steam condensation rate. vi. What would be the heat transfer coefficient if the plate is inclined at 30°C with horizontal plane?	EV	3	15