K. K. Wagh Institute of Engineering Education & Research, Nashik

(An Autonomous Institute From A.Y. 2022-23)

InSem Examination-I Winter2024	
Exam Seat No.:	
Academic Year: 2024-2025	Semester: III
Class: SY	Program: B.Tech
Branch Code: CHE	Pattern: 2023
Name of Course: Heat Transfer Processes	Course Code: 2307206
Max. Marks: 30	Duration: 1.15 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 2 pages.
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.

		Marks	CO
Question No. 1			
1 a)	Explain Fourier's Law of Heat Conduction and Explain what thermal conductivity is and how it affects the rate of heat transfer through materials. Why is it an important property in heat transfer applications?	(7)	CO1
Question No. 2			
2 a)	Derive the equation for steady-state heat conduction through a hollow cylinder with inner radius r_1 and outer radius r_2. What factors influence the heat transfer rate in this geometry?	(8)	CO1
	OR		
2 b)	Explain the concept of critical thickness of insulation? and determine the required thickness of an insulating powder layer to achieve a specific heat loss rate. The insulating powder has a thermal conductivity of 0.03 W/m·K, and the desired heat loss through the insulation is 150 watts. The temperature difference across the insulation is 25°C, and the surface area covered by the insulation is 5 m². Calculate the thickness of the insulating powder layer needed to meet these requirements	(8)	CO1
Question No. 3			
3 a)	What is Convective Heat Transfer? Differentiate between Natural & Forced Convection?	(7)	CO2, CO4
Question No. 4			
4 a)	Water at 80^{o}C is flowing at a velocity of 3 m/s through a tube of 16 mm diameter maintained at constant wall temperature of 297 K. If the exit temperature of water is 309 K, determine the rate of heat transfer per meter length of tube. **Data:** Properties of water at mean bulk temperature, Dynamic viscosity: 485 x 10^{-6} N.s/m^2 Density: 984 kg/m^3	(8)	CO2, CO4

Thermal Conductivity: 0.657 W/m.K

Specific heat: 4187 J/kg.K

OR

4 b)	A horizontal pipe 1ft (0.3048 m) in diameter is maintained at a temperature of 250^{o}C in a room where the ambient air is at 15^{o}C. Calculate the free convection heat loss per meter of length.	(8)	CO2, CO4

Data: Air properties at film temperature 405. 5 K,

k= 0.03406 W/m^{o} C, Prandtl No. = 0.687,

Kinematic viscosity = 26.54 x 10^{-6} m^2/s

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