

Total No. of Question : [4]

Registration No. :

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Programme Name : Bachelor of Chemical Engineering
Regular S.Y.B.Tech.Sem.IV ESE May / June 2023
IV SEMESTER (2021 BATCH)
201CHL 214-Heat Transfer Operations

Duration : 2 Hours

Marks : 50

Instructions :

1.Read questions carefully.

(Q1) All Questions are compulsory [20.0]

(1.1) By stating the Fourier's law heat conduction, explain the modes of Heat transfer. [6.0]

CO :- 1

Blooms Taxonomy :- Understand

(1.2) Derive rate of heat flow equation for a cylinder by assuming $T_i > T_o$; with neat diagram and assumptions. [7.0]

CO :- 2

Blooms Taxonomy :- Understand

(1.3) Certain oil is flowing through a 7.5 cm id pipe at 1 m/s having a density 880 kg/m^3 , [7.0]
Viscosity $2.1 \times 10^{-2} \text{ kg/m-sec}$, thermal conductivity $0.135 \text{ W/m } ^\circ\text{C}$ and specific heat is $2.17 \text{ J/kg } ^\circ\text{C}$. It is being heated by passing steam outside the surface of the pipe, the steam side heat transfer coefficient is $11 \text{ KW/m}^2 \text{ } ^\circ\text{C}$, and oil side heat transfer coefficient is $53.00 \text{ W/m}^2 \text{ } ^\circ\text{C}$. Find the overall heat transfer coefficient irrespective of area by neglecting wall resistance.

CO :- 2

Blooms Taxonomy :- Understand

(Q2) All Questions are compulsory [10.0]

(2.1) What is pool boiling of saturated liquid ? Discuss boiling mechanism with boiling curve [5.0]

CO :- 4

Blooms Taxonomy :- Understand

(2.2) Calculate the average heat transfer coefficient for a system where a saturated steam [5.0]
at 80°C condenses on a vertical plate of 100cm high maintained at a temperature of 70°C . The properties are
density= 974.8 kg/m^3 , $k = 0.6715 \text{ W/m } ^\circ\text{C}$, viscosity= $380.5 \times 10^{-6} \text{ kg/m-sec}$ and latent heat= $2300 \text{ KJ/kg } ^\circ\text{C}$

CO :- 4

Blooms Taxonomy :- Understand

OR [2.2 / 2.3]

- (2.3) Distinguish in between Dropwise & Filmwise Condensation in details. [5.0]
(Q3) **All Questions are compulsory** [10.0]
(3.1) Discuss Kettle type reboiler with neat diagram. [5.0]

CO :- 5
Blooms Taxonomy :- Understand

- (3.2) Explain the shell and tube heat exchanger along with appropriate diagram [5.0]

CO :- 5
Blooms Taxonomy :- Understand

OR [3.2 / 3.3]

- (3.3) What is role of baffles in Shell & Tube Heat exchangers? Explain Tube pitch & Clearance in tubes in details. [5.0]
(Q4) **Attempt any two out of three questions** [10.0]
(4.1) What is evaporation? Explain classification of evaporators based on feeding to evaporator. [5.0]

CO :- 6
Blooms Taxonomy :- Understand

- (4.2) A single effect evaporation system is used to concentrate an aqueous solution from 5% to 25% solids by weight , using a saturated steam at 2 bar pressure. If overall heat transfer coefficient is $2000 \text{ W/m}^2 \text{ } ^\circ\text{C}$, calculate capacity , steam consumption and economy by assuming that the feed is 4000 kg/hr at $50 \text{ } ^\circ\text{C}$. Vapor space pressure remains constant at 1.013 bar absolute. Take heat capacity of feed = $4.2 \text{ KJ/kg } ^\circ\text{C}$ [5.0]
 $T_s = 135.55 \text{ } ^\circ\text{C}$ and latent heat of steam = 2163.9 KJ/kg $T_{\text{sat}} = 100 \text{ } ^\circ\text{C}$ and latent heat of vapour = 2256 KJ/kg

CO :- 6
Blooms Taxonomy :- Understand

- (4.3) What is boiling point elevation and state Duhring's rule. [5.0]

CO :- 6
Blooms Taxonomy :- Understand
