Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3140503 Date:18-07-2024

Subject Name: Heat Transfer

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	List out features of unit operations. Also Define Heat transfer.	**03**
	(b)	A furnace is constructed with 225 mm thick of fire brick,120 mm of insulating brick and 225 mm of building brick. The inside temperature is 1200 K and the outside temperature is 330 K. Find the heat loss per unit area and the temperature at the junction of the fire and insulating brick. **Data**: k for fire brick = 1.4 W/(m.K), k for insulating brick = 0.2 W/(m.K), k for building brick = 0.7 W/(m.K)	**04**
	(c)	Why Insulation is necessary for process equipment. Also Mention characteristics of insulating material & Derive equation for critical radius of insulation.	**07**
Q.2	**(a)**	Discuss the Physical significance of (i) Prandlt Number (ii) Peclet Number (iii) Biot Number.	**03**
	(b)	Explain Velocity boundary layer & Thermal boundary layer. Which dimensionless number is related to it? How?	**04**
	(c)	Determine the heat transfer coefficient for water flowing in a tube of 16 mm diameter at a velocity of 3 m/s. The temperature of the tube is 297 K and the water enters at 353 K and leaves at 309 K. Using Dittus-Boelter equation and Sieder-Tate equation. Data : Properties of water at 331 K at arithmetic mean-bulk temperature are: ϱ = 984.1 kg/m^3, C_p = 4187 J/(kg.K), μ=485*10^{-6} Pa.s, k = 0.657 W/(m.K), Viscosity of water at 297 K, μ_w = 920*10^{-6} Pa.s	**07**
		OR	
	(c)	Derive the equation of overall heat transfer co-efficient(U) from the individual heat transfer co-efficient(h) with neat sketch.	**07**
Q.3	**(a)**	Define: Thermal Conductivity. Enlist the factors on which thermal conductivity of a substance depends?	**03**
	(b)	Describe any two laws of black body radiation.	**04**
	(c)	What is boiling and when does it occurs? Explain Nucleate boiling.	**07**
		OR	

Q.3	**(a)**	Explain basic law for heat conduction.	**03**
	(b)	Explain Kirchhoff's law and Total emissive power for radiation.	**04**
	(c)	Define Condensation. Explain filmwise condensation & Dropwise condensation.	**07**
Q.4	**(a)**	Define: Tube Pitch, Baffle Spacing & Range.	**03**
	(b)	What do you mean by "fouling" in heat exchangers? What is the effect of it on performance of heat exchangers?	**04**
	(c)	Explain design steps for Shell &Tube heat exchanger in detail. Draw neat sketch of 2-4 pass shell & tube heat exchanger.	**07**

OR

Q.4	**(a)**	Define Fin. Enlist different types of it. Differ Transverse fin with longitudinal fin.	**03**
	(b)	What are the advantages of square pitch arrangement over the triangular pitch in case of heat exchanger tubes?	**04**
	(c)	With neat diagram explain construction and working of falling film evaporator.	**07**
Q.5	**(a)**	Explain the significance of LMTD correction factor.	**03**
	(b)	Explain Boiling Point Elevation (BPE).	**04**
	(c)	What is importance of LMTD? Derive the equation for parallel flow arrangement.	**07**

OR

Q.5	**(a)**	Define Capacity and Economy of evaporator.	**03**
	(b)	Calculate rate of heat loss from a thermoflask if the polished silvered surfaces have emissivities of 0.05,the liquid in the flask is at 368 K and the casing is at 293 K. Calculate loss if both surfaces were black. Stefan Boltzmann constant = $5.67*10^{-8}$ $W/(m^2.K^4)$	**04**
	(c)	Write a short note on Multiple Effect Evaporator.	**07**

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