Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140503 Date:21-11-2024

Subject Name: Heat Transfer

Time:02:30 PM TO 05:00 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)**	Define: Thermal Resistance, Thermal diffusivity, Angle of vision	**03**
	(b)	Give Significance of thermal conductivity and discuss the effect of temperature on thermal conductivity of solid and liquid.	**04**
	(c)	Derive equation for heat transfer through a composite wall made up of three different materials in close thermal contact with each other, with no heat loss to surrounding when temperatures of hot and cold ends are T_h and Tc.	**07**
Q.2	**(a)**	Define : Intensity of Radiation, Monochromatic emissive power, Planck's distribution law	**03**
	(b)	Differentiate Viscous sub layer and Buffer layer.	**04**
	(c)	A pipe carrying steam having an outside diameter of 30 cm runs in a large room and is exposed to air at a temperature of 35°C. The pipe surface temperature is 405°C. Calculate the loss of heat to surrounding per meter length of pipe due to thermal radiation. The emissivity of the pipe surface is 0.8. What would be the loss of heat by thermal radiation if the pipe is enclosed in a 50 cm diameter brick conduit of emissivity 0.91? Value of Stefan Boltzmann constant is 5.67×10^{-8} W/(m^2K^4)	**07**
		OR	
	(c)	Draw the temperature profiles of cold and hot fluids for true co-current and counter current flow in double pipe heat exchanger, Derive expression relating Rate of heat transfer and Log mean temperature difference.	**07**
Q.3	**(a)**	Define Radiation shield. How Radiation from gases differ from solids?	**03**
	(b)	Discuss the effect of non-condensable gases on condensation.	**04**
	(c)	Derive and equation for Critical Thickness of Insulation for Composite cylinder.	**07**
		OR	
Q.3	**(a)**	Write Dittus- Boeltier equation and Sieder-Tate equation explaining each term and highlight the difference.	**03**
	(b)	Prove that the temperature of a body at any time τ during Newtonian heating and cooling is given by the relation $t - t_a / t_i - t_a = \exp[-Bi\,F_o]$	**04**
	(c)	Define fin effectiveness and derive an expression for Temperature profile for Insulated Fin at the tip.	**07**
Q.4	**(a)**	Draw the neat diagram of Box type furnace and mention its working principle.	**03**
	(b)	Explain Natural Convection from vertical tube with empirical equation.	**04**
	(c)	Explain in details with neat sketch: Shell & Tube heat exchanger.	**07**

OR

Q.4	**(a)**	When LMTD correction factor is used in heat exchanger calculation?	**03**
	(b)	What are the advantages of square pitch arrangement over the triangular pitch in case of heat exchanger tubes?	**04**
	(c)	Derive an equation for heat transfer coefficient for condensation on vertical plate.	**07**
Q.5	**(a)**	Hot oil at a rate of 1.3 kg/s having Cp of 2083 J/(kg.K) flows through a double pipe heat exchanger. It enters at 643 K and leaves at 583 K. cold fluid enters at 313 K and leaves at 410 k. If the overall heat transfer co-efficient is 500 W/(m2.K), calculate the heat transfer area for parallel flow.	**03**
	(b)	Explain Boiling Point Elevation (BPE).	**04**
	(c)	An evaporator is operating at atmospheric pressure. It is desired to concentrate a feed from 5% solute to 20% solute by weight at a rate of 5000 kg/hr. Dry saturated steam at a pressure corresponding to the saturation temperature 399 K is used. The feed is at 298 K and the boiling point rise is 5 K. The overall heat transfer coefficient is 2350 w/m^2 K. Calculate the economy of the evaporator and the area of the heat transfer to be provided. Data: Treating solution as a pure water and neglecting the B.P.R, the latent heat of condensation of steam at 399 K is 2185 KJ/kg., Latent heat of vaporization of water at 101.325 KPa and 373 K= 2257 KJ/kg and specific heat of feed is 4.187 KJ/Kg. K	**07**

OR

Q.5	**(a)**	What is the reason for increasing the number of passes in a shell & tube heat exchanger?	**03**
	(b)	Explain Vapor recompression in evaporators.	**04**
	(c)	Discuss various boiling regimes and factors affecting on nucleating boiling.	**07**

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