

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI (NEW) EXAMINATION – SUMMER 2023****Subject Code:3163516****Date:10-07-2023****Subject Name:Introduction to Heat & Mass 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) What is meant by Critical thickness of Insulation?	03
	(b) Mention the different kind of boundary conditions used in heat transfer studies.	04
	(c) Derive an expression for steady state temperature distribution and heat transfer rate in case of a cylinder of inner and outer radius of r_i and r_o .	07
Q.2	(a) Specify the differences between Forced Convection and Natural Convection	03
	(b) Prove that average heat transfer area in the case of hollow sphere of inner and outer radius r_i and r_o is the geometric mean of inner and outer radius	04
	(c) Calculate the inside heat transfer coefficient for a fluid flowing at a rate of $300 \text{ cm}^3/\text{s}$ through a 20 mm inside diameter tube of heat exchanger. $\mu_{\text{fluid}} = 0.8 \text{ Ns/m}^2$, $\rho_{\text{fluid}} = 1.1 \text{ g/cm}^3$, $C_{p,\text{fluid}} = 1.26 \text{ kJ/kg K}$, $k_{\text{fluid}} = 0.384 \text{ W/mK}$, $\mu_{\text{wall}} = 1.0 \text{ Ns/m}^2$, Length of heat Exchanger = 5 m	07
	OR	
	(c) With the help of neat sketches mention the important parts of a 1-2 shell and tube heat exchanger.	07
Q.3	(a) What is Leidenfrost Mechanism?	03
	(b) Discuss in brief about different laws of radiation.	04
	(c) With suitable diagrams explain various regimes in forced convection boiling?	07
	OR	
Q.3	(a) Differentiate dropwise and filmwise condensation	03
	(b) What is meant by boiling point elevation in evaporators?	04
	(c) A solution containing 10% solids is to be concentrated to a level of 50% solids. Steam is available at a pressure of 0.20 MPa [saturation temperature of 393 K (120°C)]. Feed rate to the evaporator is 30000 kg/h . The evaporator is working at reduced pressure such that boiling point is 323 K (50°C). The overall heat transfer coefficient is $2.9 \text{ kW}/(\text{m}^2 \cdot \text{K})$. Estimate the steam economy and heat transfer surface for feed introduced at 293 K . Data: Specific heat of feed = $3.98 \text{ kJ}/(\text{kg} \cdot \text{K})$ Latent heat of condensation of steam at $0.20 \text{ MPa} = 2202 \text{ kJ/kg}$ Latent heat of vaporization of water at 323 K (i.e. at pressure in the vapor space) = 2383 kJ/kg .	07
Q.4	(a) How mass average velocity is different from molar average velocity?	03
	(b) In a binary solution prove that $D_{AB} = D_{BA}$.	04
	(c) Discuss in brief about following terms in a tray tower a) Flooding b) Dumping c) Weeping d) Coning e) Priming f) Entrainment g) Tray spacing	07

OR

- Q.4** (a) Explain in brief Mier's theory of supersaturation. **03**
(b) Show that mass transfer coefficients k_x' , k_x , k_L are related as **04**
 $k_x' = k_x x_{BM} = k_L C x_{BM}$
(c) How the minimum liquid to gas ratio for case of absorption of solute from a gas stream is determined? **07**

- Q.5** (a) List the assumptions used in the estimation of number of trays by McCabe thiele method **03**
(b) With a neat sketch discuss in detail about boiling point diagrams. **04**
(c) A mixture containing 60 mol% A and the rest B is flash vaporized at 101.3 kPa until 40% of original mixture is vaporized. If the relative volatility of mixture is 2.5, determine the composition of products **07**

OR

- Q.5** (a) Enlist the criteria for solvent selection in case of liquid – liquid extraction. **03**
(b) Differentiate Physisorption & Chemisorption. **04**
(c) Derive an equation to estimate the time required for reducing the moisture content of a feed material to a specific extent in falling rate and constant rate period. **07**