Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V (New) EXAMINATION – WINTER 2019

Subject Code: 2153502 **Date: 04/12/2019**

Subject Name: Introduction to 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.**

			MARKS
Q.1	**(a)**	State Fourier's law of heat conduction? Mention the significance of negative sign in heat conduction equation.	**03**
	(b)	Differentiate Critical thickness of Insulation and Optimum thickness of Insulation	**04**
	(c)	Describe the different kind of Boundary conditions used in heat transfer studies	**07**
Q.2	**(a)**	An electrically heated plate dissipates heat by convection at a rate of q = 8000 W/m^2 into ambient air at T_f = 25 °C. If the surface of hot plate is at T_W = 125 °C. Calculate heat transfer coefficient for convection between plate and air.	**03**
	(b)	What is lumped System analysis? Mention the importance of Biot number in lumped system analysis.	**04**
	(c)	Develop expression for one dimensional steady state temperature distribution T(r) in a sphere where inner surface at r = a and outer surface of r = b of hollow sphere are maintained at temperatures of T_1 and T_2 respectively. Consider that thermal conductivity (k) of sphere is constant	**07**
		OR	
	(c)	Atmospheric air at T_∞ = 400 K with a velocity u_∞ = 1.5 m/s flows over a flat plate L = 2 m long maintained at uniform temperature of T_W = 300K. Calculate average value of heat transfer coefficient and average heat transfer rate from airstream to plate over entire length of L = 2m.	**07**
Q.3	**(a)**	Write the significance of following dimensionless numbers used in heat transfer studies (i) Reynolds number (ii) Prandtl number (iii) Nusselt number	**03**
	(b)	Differentiate velocity boundary layer and thermal boundary layer	**04**
	(c)	Estimate the total heat loss by convection and radiation from an unlagged steam pipe, 50 mm o.d. at 415 K to air at 290K (17 °C). Emissivity e = 0.90 Film coefficient for calculation of heat loss by natural convection is given by $h_C = 1.18\ (\Delta T/D_O)^{0.25}\ W/m^2K$	**07**
		OR	
Q.3	**(a)**	Mention the factors governing the rate of heat transfer in forced and natural convection.	**03**
	(b)	Define Absorptivity, Reflectivity and Transmissivity	**04**
	(c)	Calculate heat transfer area of 1 – 2 heat exchanger from the following data. Inlet and outlet temperatures of cold fluid are 303 K and 318 K respectively. Overall heat transfer coefficient = 4100 W/m^2 K. Heat loss = 407 kW. LMTD correction factor = 0.84.	**07**

Q.4	**(a)**	What is drop wise condensation? Explain why heat transfer coefficient is lesser for film wise condensation than drop wise condensation?	**03**
	(b)	With neat diagrams explain classification of heat exchangers according to flow arrangement.	**04**
	(c)	A heat exchanger is required to cool 20 kg/s of water from 360K to 340K by means of 25kg/s of water entering at 300K. If the overall heat transfer coefficient is 2000 W/m^2K. calculate the surface area required in a) A counter current concentric heat exchanger **b)** A co-current flow concentric tube heat exchanger. (Take C_P of water = 4.187 kJ/kg K)	**07**

OR

Q.4	**(a)**	Discuss the phenomena of hysteresis in a boiling curve.	**03**
	(b)	Why saturated steam is used as heating medium in industries?	**04**
	(c)	Describe the significance of ε - NTU method for heat exchange analysis.	**07**
Q.5	**(a)**	What is understood by boiling point elevation in evaporators	**03**
	(b)	What is Vapor recompression? Mention different methods in which vapor recompression can be done.	**04**
	(c)	With help of boiling curve mention different regimes in a pool boiling.	**07**

OR

Q.5	**(a)**	Define the terms of Capacity & Economy in Evaporators	**03**
	(b)	Explain the different methods of feeding of multiple effect evaporators.	**04**
	(c)	An evaporator operating at atmospheric pressure is designed to concentrate 5% solute to 20 % solute by weight at a rate of 5000 kg/h. Dry saturated steam at a pressure corresponding to saturation temperature of 399K is used. The feed is at 298 K and boiling point rise is 5 K. Overall heat transfer coefficient is 2350 W/m^2 K. Calculate economy of evaporator and area of heat transfer to be provided assuming that there is no boiling point elevation for the solvent. Data: Latent heat of Condensation of steam = 2185 kJ/kg Latent heat of vaporization of water at 101.325 kPa and 373 K = 2257 kJ/kg Specific heat of feed = 4.187 kJ/ kg K	**07**

****