Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – WINTER 2013

Subject Code: 140503 **Date: 26-12-2013**

Subject Name: Process 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.**

Q.1 **(a)** Write the fourier's law of conduction. Explain how thermal conductivity varies with temperature in metals. **07**

(b) Derive the equation of Rate of heat transfer across Cylindrical Surface. **07**

Q.2 **(a)** Show how do the temperature vary with the length of a double pipe heat exchanger with counter current flow. Derive equation for Overall heat transfer coefficient. **07**

(b) A steel pipe for transferring steam with ID and OD of 100 mm and 170mm respectively is covered with two layers of insulation 30 mm and 50 mm thick. Thermal conductivities of the insulating materials are 0.175 W/m ºK and 0.093 W/mºK respectively while that of steel is 50 W/mºK. The inner surface of the pipe has a temperature 300ºC and the outer layer surface is at 50ºC. Determine the heat loss from the pipe and the layer contact temperatures. **07**

OR

(b) Discuss Stefan Boltz man's law of radiation. **07**

Q.3 **(a)** Discuss various regimes of Pool boiling. **07**

(b) Crude oil flows at the rate of 1000 kg/hr through the inside pipe of a double pipe heat exchanger and is heated from 30 ºC to 90ºC. The heat is supplied by Kerosene initially at 200 ºC flowing through the annular space. If the temperature difference (approach) is 10ºC, determine the heat transfer area for co-current flow and the kerosene flow rate. **07**

C_p for Crude oil = 0.5 kcal/kgºC

C_p for Crude Kerosene = 0.6 kcal/kgºC

U_0 = 400 kcal/hrm^{2}ºC

OR

Q.3 **(a)** Compare different methods of feeding the evaporator .Explain with diagram. **07**

(b) It is desired to concentrate 5000 kg/hr of a solution of sodium hydroxide from 10% to 25% solids in a single effect evaporator. Steam is available at 110 ºC and the vapor space is maintained at 410 mm of Hg (mercury). The boiling point of water corresponding to the vapor space pressure is 84 ºC. The solution has a boiling point elevation of 10ºC. The enthalpies of the feed and thick liquor are 90 and 80 kcal/kg. respectively and the enthalpy of the vapor is 650 kcal/kg. The feed enters at its boiling point corresponding to the vapor space pressure. **07**

Λ =525 kcal/kg.

(a) Calculate the stream consumption per hour

(b) If the available heat transfer area is 35 m^2, estimate the heat transfer coefficient.

Q.4	**(a)**	Discuss Evaporator Capacity and Economy. Compare the two for single and multiple effect evaporator system.	**07**
		(b)Discuss construction and working of Plate type Heat Exchanger.	**07**
		OR	
Q.4	**(a)**	Discuss Condensation of vapor on Vertical and horizontal surface.	**07**
	(b)	With neat diagram explain construction and working of 1-2 Shell and Tube Condenser.	**07**
Q.5	**(a)**	With help of Diagram explain different types of Fins.	**07**
	(b)	Discuss Efficiency and effectiveness of Fins.	**07**
		OR	
Q.5	**(a)**	Discuss LMTD Correction factor.	**07**
	(b)	Boiling point elevation and its effect on performance of Evaporator.	**07**

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