Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER III (NEW) – EXAMINATION – SUMMER 2017

Subject Code: 2731105 **Date: 02/05/2017**

Subject Name: DESIGN OF HEAT EXCHANGERS

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. **Use of solar energy data book after verification.**

Q.1 **(a)** How do you enhance heat transfer in heat exchanger? Explain briefly about its performance evaluation method. **07**

(b) Explain the method for determining the total pressure drop in double pipe heat exchanger. **07**

Q.2 **(a)** Distilled water with a flow rate of 50 kg/s enters a baffled shell and tube heat exchanger at 32 °C and leaves at 25 °C. Heat will be transferred to 150 kg/s of raw water coming from a supply at 20 °C. You are informed to design the heat exchanger for this purpose. A single shell and tube is preferable. The tube O.D. and I.D. is 19 mm and 16 mm. Tubes are laid out on 2.54 cm square pitch. Maximum length of the heat exchanger is 8 m is required because of space limitations. Assume K_{tube} = 42.3 W/m K and maximum flow velocity through the tube is to be 2 m/s to prevent erosion. Also perform thermal analysis of the heat exchanger using Bell-Delaware method using correction factor of 60%. The following correlations and properties may be used; **07**

	Tube side fluid	Shell side fluid
ρ (kg/m^3)	998.2	995.9
μ (Ns/m^2)	10.02×10^{-4}	8.15×10^{-4}
k (W/m.K)	0.598	0.612
c_p (J/kg.K)	4182	4179
Pr	7.01	5.75

	Tube side fluid	Shell side fluid
Corelations used	$Nu_b = \dfrac{(f/2)\,\mathrm{Re}_b\,\mathrm{Pr}_b}{1.07+12.7(f/2)^{1/2}\left(\mathrm{Pr}_b^{1/2}-1\right)}$ $f = (158\ln \mathrm{Re}_b - 3.28)^{-2}$	$h_{id} = j_i c_p \left(\dfrac{\dot{m}_s}{A_s}\right)\left(\dfrac{k_s}{c_p \mu_s}\right)^{2/3}$ $j_i = 0.185\,\mathrm{Re}_s^{-0.324}$

(b) What is a baffle? Discuss different type and geometry of baffles used in shell and tube heat exchangers. **07**

OR

(b) Draw and explain various shell designs suggested by the "TEMA standard" for the shell and tube heat exchanger? **07**

Q.3 **(a)** Explain double pipe heat exchanger and derive the expression for hydraulic diameter and equivalent diameter for hairpin heat exchanger. **07**

(b) What is fouling? Explain types and mechanisms of fouling. **07**

OR

Q.3 **(a)** Explain the advantages and disadvantages of double pipe heat exchangers. **07**

(b) Explain the strategies for controlling fouling consideration in various type of heat exchanger. **07**

Q.4	**(a)**	Give detailed classification of heat exchanger based on construction and flow arrangement of fluid?	**07**
	(b)	Give detailed classification of heat exchangers used in refrigeration and air conditioning equipments and also explain water cooled condenser.	**07**

OR

Q.4	**(a)**	Compare the LMTD and ε-NTU approach for design and analysis of heat exchangers.	**07**
	(b)	What is chiller? How does it work? Explain the standards for evaporators and condensers.	**07**
Q.5	**(a)**	Compare 'welded plate heat exchanger' and 'plate and frame heat exchanger'.	**07**
	(b)	Answer the following: 1. What is the need for multi-pass heat exchanger? 2. In the heat transfer relation $\dot{Q} = UAF\Delta T_{lm}$ & for a heat exchanger, what is the quantity F called? What does it represent? Can F be greater than one?	**07**

OR

Q.5	**(a)**	Explain passes and flow arrangements in Gasketed plate heat exchangers. State its application also.	**07**
	(b)	Answer the following: 1. Under what conditions can a double pipe heat exchanger replace a shell and tube heat exchanger? 2. Draw the temperature profile along the length of heat exchanger for following cases (1) $C_h \rightarrow \infty$ (2) $C_h = C_c$ and (3) $C_c \rightarrow \infty$	**07**

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