

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2014****Subject code: 1723004****Date: 20-06-2014****Subject Name: Advance Heat Transfer****Time: 02:30 pm - 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 **14**

Overhead vapor flows at the rate of 300 Kmole/hr from a distillation column at 4 atm a. It contains saturated hydrocarbons and has the composition: 40 % n- C₃H₈, 40 % n- C₄H₁₀ and 20% n-C₆H₁₄ (mole basis). It is to be condensed in condenser.

Find

Condensing range?

Divide Condensing range into three equal interval and Compute heat removal for interval 1 of condensing range ?

Data

Ki Values of Hydrocarbon for given pressure of 4 atm a are :

$$K_{\text{propane}} = 0.0638 \cdot (t^{\circ} \text{C}) + 0.4531$$

$$K_{\text{butane}} = 0.0301 \cdot (t^{\circ} \text{C}) - 0.2592$$

$$K_{\text{hexane}} = 0.0062 \cdot (t^{\circ} \text{C}) - 0.1277$$

Specific heat and Latent heat data are as under :

Component	!! _i (KJ/Kg)	C _{mp,i} (KJ/Kmol.K)	C _{L,i} (KJ/Kg.K)
Propane	230.27	84.253	3.12
Butane	301.45	110.08	2.7
Hexane	309.82	163.17	2.43

Q.2 (a) Explain the phenomena of pool boiling with neat figure? **07**(b) Discuss Selection Criteria for Horizontal and vertical condenser? **07****OR**(b) Write a design step for single component shell and tube condenser in brief? **07****Q.3** **14**

1.25 kg/s of a solution is concentrated from 10 to 50 % solids in a backward feed triple-effect evaporator using steam at 393 K, and a vacuum such that the boiling point in the last effect is 325 K. If the feed is initially at 297 K.

Find the steam consumption, Steam economy the temperature distribution in the system the heat transfer area in each effect, if each effect being identical.

The overall heat transfer coefficients may be taken as 2.5, 2.0 and 1.6 kW/m² K in the first, second and third effects, respectively.

Data :

Latent heat of steam varies with temperature as follow :

$$!! = -2.5533 \cdot (T) + 3207.2 \quad (\text{Where } T \text{ is temperature in Kelvin, } !! \text{ in KJ/Kg})$$

$$C_p = 4.18 \text{ kJ/kgK}$$

OR

- Q.3** (a) Write a comparison between power plant and chemical Evaporator. **07**
 (b) Explain about Capacity and economy, boiling Point rise in evaporator. **07**

- Q.4** Oil is used as a heating medium in chemical industry. Its operating range is from **14**
 -1.1°C to 316°C. It is required to cool 9000 kg/hr of oil from 260°C to 200°C by
 using atmospheric air as a cooling medium in air cooler. Air inlet and outlet
 temperatures are 27°C and 75°C respectively. Find outside clean heat transfer
 coefficient for given air cooler assuming 100 % fin efficiency?

Data

Component at mean temp.	Specific heat , Kcal/kg.°C	$\bar{c}_p$	k (W/m.K)	ρ (kg/m ³)
Air	0.25	0.02	0.028	---
Oil	2.59	0.595	0.1159	850

Assume : $F_t = 0.98$, $J_f = 0.085 \cdot Re^{0.7324}$ $h_{do} = 5000 \text{ W/m}^2\text{°C}$.

Cooler data :

Tube OD = 19.05 mm.

Tube length = 910 mm.

Fin is spiral wound transverse mild steel fin.

Fin OD = 38 mm.

Tube pitch = 43 mm.

No. of fins per linear inch = 8.

Fin thickness = 0.889 mm.

OR

- Q.4** (a) Explain Plate heat exchanger with advantage and disadvantage over Shell and **07**
 tube heat exchanger?
 (b) What is extended surface? Why it is used? Explain in brief about various extended **07**
 surface used in industries?

- Q.5** (a) Derive an expression for gas and liquid efficiencies of heat utilization in Mixed **10**
 Flow Gas and Mixed Flow Solid single-stage fluidized bed exchangers
 (b) Define: Stefan Boltzmann law, Planck's Law. **04**

OR

- Q.5** (a) Describe Angle of Vision and View factor with suitable example **07**
 (b) Discuss design step for Kettle type reboiler **07**
