Registration No. ☐☐☐☐☐☐☐☐☐☐

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B.Tech.

PCCH4303

5th Semester Back Examination 2017-18
Process Equipment Design
BRANCH : CHEM
Time : 3 Hours
Max Marks : 70
Question Code : B214
Answer Question No. 1 which is compulsory and any FIVE from the rest.
The figures in the right-hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.
Answer all parts of a question at a place.

1.	**Answer the following questions :**	**(2x10)**
(a)	State Raoult's Law.	
(b)	State Henry's Law.	
(c)	Define relative volatility.	
(d)	Write the characteristics of solvent used in absorption.	
(e)	What is LMTD?	
(f)	What is fouling factor?	
(g)	Define boiling point elevation.	
(h)	Define steam economy.	
(i)	Define pass and partitions in STHE.	
(j)	State different types of pitch used for tube arrangement.	

2. A packed tower is used to separate ammonia from gas mixture by employing pure solvent. Inlet gas mixture contains 15% preferable component flows at a rate of 354 kmol/hr. Outlet gas mixture and solvent contain 4% and 12% of preferable gas component after recovery (all are mole %). Mass transfer coefficient (K_{ya}) is 90 kmol/hr.m^2.(Δy). Equilibrium relation is y=2x, where x and y are mole fractions of ammonia in liquid and gas phase respectively. Calculate the packing height required and diameter of the tower which is operating at gas velocity of 1.5 m/sec and 1 atm pressure. **(10)**

3. A methanol (CH$_3$OH)-water(H$_2$O) solution containing 45mole% methanol at 27^{0}C is to be continuously rectified at 1 std. atm. Pressure at a rate of 5000 kg/hr to provide a distillate containing 97mole%methanol and a residue containing 2.0mole% methanol. The feed is to be preheated by heat exchanger with residue to its boiling point. The distillate is to be totally condensed to a liquid and the reflux returned at the bubble point. A reflux ratio of 3.5 will be used. Relative volatility of 2.9 can be taken for the system. Calculate the height and diameter of the tray type distillation column. Tray spacing of 60cm and vapour velocity of 1.5 m/sec are to be assumed for this operation. **(10)**

4. An evaporator is to be fed with 5000kg/hr solution containing 10% solute by wt. the feed at 40^{0}C is to be concentrated to a solution of 40% solute by wt. Steam is available at an absolute pressure of 2atm. Overall heat transfer coefficient U is 1500 kcal/hr.m^2^{0}C. Evaporator is operated at a pressure of 260mmHg vacuum. BPR of 10^{0}C can be neglected. Tubes of 50mm OD (45mm ID) and length of 120cm are **(10)**

arranged in 75mm triangular pitch. Calculate the height and diameter of the evaporatorassuming other necessary data for designing a horizontal tube evaporator.

5. Draw a neat sketch of vertical tubeevaporator. **(10)**

6. Draw a neat sketch of absorption tower (packed tower). **(10)**

7. Draw a neat sketch of double pipe heat exchanger. **(10)**

8. **Write short notes on any TWO** : **(5x2)**
   (a) Temperature correction factor
   (b) Shell and tube heat exchanger
   (c) Multi effect evaporator
   (d) Overall heat transfer coefficient