Registration No. : | | | | | | | | | | |

Total number of printed pages – 2

B. Tech

PCCH 4303

Fifth Semester Back Examination – 2014

PROCESS EQUIPMENT DESIGN

BRANCH : CHEM

QUESTION CODE : L 245

Full Marks – 70

Time : 3 Hours

*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.
Use of Steam Table, Data Table, and Process Equipment Design – MV JOSHI book which are permitted.Answer all parts of a question at a place.

1. Answer the following questions : 2×10
   (a) Define relative volatility.
   (b) Define flooding and entrainment in plate tower.
   (c) What is the relation between mass velocity and individual heat transfer co-efficient ?
   (d) How U_D is calculated from h_{io} and h_o when fouling factor is neglected ?
   (e) Define BPR or BPE.
   (f) When backward feed is employed in multi-effect evaporators ?
   (g) Is the corrosion allowance necessary, if no then when and if yes how much ?
   (h) Which standards are used for steel and plate or strips used in storage tank construction ?
   (i) Write different types of heads used in pressure vessels.
   (j) How to calculate the thickness of pressure vessels ?
2. Design a storage vessel with column supported Roof. 10

Data :		
	Tank diameter	10 m
	Tank height	14 m
	Sp. Gr. of liquid	0.8
	Material	Carbon Steel (structural)
	Permissible stress	142 N/mm^2
	Density	7.7
	Modulus of elasticity	2×10^5.

P.T.O.

3. A methanol (CH_3OH)/water (H_2O) solution containing 35 mol% methanol is to be continuously rectified at 1 std. atm. at a rate of 4000 kg/hr to provide a distillate containing 92 mol%methanol and a residue containing 5.0 mol% methanol. The feed is supplied at 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 2.5 will be used. Relative volatility of 2.6 can be taken for the system. Vapor velocity can be taken as 1 m/sec. Calculate the height and diameter of distillation column by assuming necessary data on operational point of view. Also calculate the number of actual tray required assuming 80% overall efficiency. 10

4. An evaporator is to be fed with 10000 kg/hr solution containing 10% solute by wt. The feed at 40°C is to be concentrated to a solution of 50% solute by wt. Steam is available at 115°C. Overall heat transfer coefficient U is 1750 kcal/hr.m^2.°C. Evaporator is operated at a pressure of 360 mmHg vacuum. BPR can be neglected. Enthalpy of the feed and product stream can be taken as 95 and 85 kcal/kg respectively. For this purpose, 1.2 m length and 25 mm OD tubes are used. Calculate the steam economy, number of tubes, height, and diameter of the horizontal tube evaporator. 10

5. The two liquids are flowing in a double pipe heat exchanger both at a rate of 1500 kg/hr. The inner pipe of heat exchanger has inner diameter 25 mm and the thickness of wall is 1.25 mm. The inner pipe made up of copper having thermal conductivity (K) 328 kcal/hr.m.°C. The outer pipe of heat exchanger has an internal diameter of 50 mm. For simplicityassume that both liquids have physical properties comparable with that of water. The liquid in the inner tube is being cooled from 80°C to 65°C at the expense of the liquid flowing in the outer tube which is entering at 25°C. Individual heat transfer coefficients for inner and outer sides of inner tube are 5000 and 1500 kcal/hr.m^2.°C respectively. Calculate the length of the heat exchanger required if the liquids are flowing in a counter current manner. 10

6. Draw a neat diagram of double pipe heat exchanger showing all parts with specifications. 10

7. Draw a neat diagram of distillation column (plate tower), showing all the necessary accessories. 10

8. Draw a neat diagram of single effect horizontal tube evaporator with specifications. 10